Oral hygiene interventions for people with intellectual disabilities

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Oral hygiene interventions for people with intellectual disabilities (Review)

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Oral hygiene interventions for people with intellectual disabilities

Catherine Waldron[1], June Nunn[1], Caoimhin Mac Giolla Phadraig[1], Catherine Comiskey[2], Suzanne Guerin[3], Maria Theresa van Harten[1], Erica Donnelly-Swift[1], Mike J Clarke[4]

[1]School of Dental Science, Trinity College Dublin, University of Dublin, Dublin, Ireland. [2]School of Nursing and Midwifery, Trinity College Dublin, University of Dublin, Dublin, Ireland. [3]School of Psychology, University College Dublin, Dublin, Ireland. [4]Centre for Public Health, Queen's University Belfast, Belfast, UK

Contact address: Catherine Waldron, School of Dental Science, Trinity College Dublin, University of Dublin, Lincoln Place, Dublin, D02 F859, Ireland. waldrocg@tcd.ie, waldrocg@tcd.ie.

A B S T R A C T

Background

Periodontal (gum) disease and dental caries (tooth decay) are the most common causes of tooth loss; dental plaque plays a major role in the development of these diseases. Effective oral hygiene involves removing dental plaque, for example, by regular toothbrushing. People with intellectual disabilities (ID) can have poor oral hygiene and oral health outcomes.

Objectives

To assess the effects (benefits and harms) of oral hygiene interventions, specifically the mechanical removal of plaque, for people with intellectual disabilities (ID).

Search methods

Cochrane Oral Health's Information Specialist searched the following databases to 4 February 2019: Cochrane Oral Health's Trials Register, the Cochrane Central Register of Controlled Trials (CENTRAL; Cochrane Register of Studies), MEDLINE Ovid, Embase Ovid and PsycINFO Ovid. ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform were searched for ongoing trials. The Embase search was restricted by date due to the Cochrane Centralised Search Project, which makes available clinical trials indexed in Embase through CENTRAL. We handsearched specialist conference abstracts from the International Association of Disability and Oral Health (2006 to 2016).

Selection criteria

We included randomised controlled trials (RCTs) and some types of non-randomised studies (NRS) (non-RCTs, controlled before-after studies, interrupted time series studies and repeated measures studies) that evaluated oral hygiene interventions targeted at people with ID or their carers, or both. We used the definition of ID in the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10). We defined oral hygiene as the mechanical removal of plaque. We excluded studies that evaluated chemical removal of plaque, or mechanical and chemical removal of plaque combined.

Data collection and analysis

At least two review authors independently screened search records, identified relevant studies, extracted data, assessed risk of bias and judged the certainty of the evidence according to GRADE criteria. We contacted study authors for additional information if required. We reported RCTs and NRSs separately.

Main results

We included 19 RCTs and 15 NRSs involving 1795 adults and children with ID and 354 carers. Interventions evaluated were: special manual toothbrushes, electric toothbrushes, oral hygiene training, scheduled dental visits plus supervised toothbrushing, discussion of clinical photographs showing plaque, varied frequency of toothbrushing, plaque-disclosing agents and individualised care plans. We categorised results as short (six weeks or less), medium (between six weeks and 12 months) and long term (more than 12 months).

Most studies were small; all were at overall high or unclear risk of bias. None of the studies reported quality of life or dental caries. We present below the evidence available from RCTs (or NRS if the comparison had no RCTs) for gingival health (inflammation and plaque) and adverse effects, as well as knowledge and behaviour outcomes for the training studies.

Very low-certainty evidence suggested a special manual toothbrush (the Superbrush) reduced gingival inflammation (GI), and possibly plaque, more than a conventional toothbrush in the medium term (GI: mean difference (MD) -12.40, 95% CI -24.31 to -0.49; plaque: MD -0.44, 95% CI -0.93 to 0.05; 1 RCT, 18 participants); brushing was carried out by the carers. In the short term, neither toothbrush showed superiority (GI: MD -0.10, 95% CI -0.77 to 0.57; plaque: MD 0.20, 95% CI -0.45 to 0.85; 1 RCT, 25 participants; low- to very low-certainty evidence).

Moderate- and low-certainty evidence found no difference between electric and manual toothbrushes for reducing GI or plaque, respectively, in the medium term (GI: MD 0.02, 95% CI -0.06 to 0.09; plaque: standardised mean difference 0.29, 95% CI -0.07 to 0.65; 2 RCTs, 120 participants). Short-term findings were inconsistent (4 RCTs; low- to very low-certainty evidence).

Low-certainty evidence suggested training carers in oral hygiene care had no detectable effect on levels of GI or plaque in the medium term (GI: MD -0.09, 95% CI -0.63 to 0.45; plaque: MD -0.07, 95% CI -0.26 to 0.13; 2 RCTs, 99 participants). Low-certainty evidence suggested oral hygiene knowledge of carers was better in the medium term after training (MD 0.69, 95% CI 0.31 to 1.06; 2 RCTs, 189 participants); this was not found in the short term, and results for changes in behaviour, attitude and self-efficacy were mixed.

One RCT (10 participants) found that training people with ID in oral hygiene care reduced plaque but not GI in the short term (GI: MD -0.28, 95% CI -0.90 to 0.34; plaque: MD -0.47, 95% CI -0.92 to -0.02; very low-certainty evidence).

One RCT (304 participants) found that scheduled dental recall visits (at 1-, 3- or 6-month intervals) plus supervised daily toothbrushing were more likely than usual care to reduce GI (pocketing but not bleeding) and plaque in the long term (low-certainty evidence).

One RCT (29 participants) found that motivating people with ID about oral hygiene by discussing photographs of their teeth with plaque highlighted by a plaque-disclosing agent, did not reduce plaque in the medium term (very low-certainty evidence).

One RCT (80 participants) found daily toothbrushing by dental students was more effective for reducing plaque in people with ID than once- or twice-weekly toothbrushing in the short term (low-certainty evidence).

A benefit to gingival health was found by one NRS that evaluated toothpaste with a plaque-disclosing agent and one that evaluated individualised oral care plans (very low-certainty evidence).

Most studies did not report adverse effects; of those that did, only one study considered them as a formal outcome. Some studies reported participant difficulties using the electric or special manual toothbrushes.

Authors' conclusions

Although some oral hygiene interventions for people with ID show benefits, the clinical importance of these benefits is unclear. The evidence is mainly low or very low certainty. Moderate-certainty evidence was available for only one finding: electric and manual toothbrushes were similarly effective for reducing gingival inflammation in people with ID in the medium term. Larger, higher-quality RCTs are recommended to endorse or refute the findings of this review. In the meantime, oral hygiene care and advice should be based on professional expertise and the needs and preferences of the individual with ID and their carers.

P L A I N   L A N G U A G E   S U M M A R Y

Oral hygiene programmes for people with intellectual disabilities

Review question

How effective are oral hygiene programmes for people with intellectual disabilities?

Background

The removal of dental plaque by daily toothbrushing plays a major role in preventing tooth decay and gum disease, the two main causes of tooth loss. Toothbrushing is a skill that can be difficult for people with ID; they may require help and people who care for them may need training in how to help them.

Study characteristics

We searched for studies up to 15 February 2018. This review included 34 studies that involved 1795 people with ID and 354 carers. Nineteen studies randomly allocated participants to two or more groups (i.e. randomised controlled trials (RCTs), and 15 were non-randomised studies (NRS).

The studies assessed different ways to improve the oral hygiene of people with ID: special manual toothbrushes; electric toothbrushes; oral hygiene training for carers; oral hygiene training for people with ID; varying the scheduled intervals between dental visits and supervising toothbrushing; using discussion of clinical photographs as a motivator; varying how frequently the teeth of people with ID were brushed; using a plaque-disclosing agent and using individualised oral care plans.

The studies evaluated gingival inflammation (red and swollen gums) and plaque. Some studies evaluated carer knowledge, behaviour, attitude and self-efficacy (belief in their competence) in terms of oral hygiene, as well as the oral hygiene behaviour and skills of people with ID. Tooth decay and quality of life were not measured. We grouped the studies according to when the outcomes were measured: short term (six weeks or less), medium term (between six weeks and 12 months) and long term (more than 12 months).

Key results

A special manual toothbrush (the Superbrush), used by carers, may be better at reducing levels of gingival inflammation and possibly plaque in people with ID than an ordinary manual toothbrush in the medium term, though this was not seen in the short term.

We found no difference between electric and manual toothbrushes used by people with ID or their carers in terms of gingival inflammation or plaque in the medium term, and the short-term results were unclear.

Training carers to brush the teeth of people with ID may have improved carers' oral hygiene knowledge in the medium term.

Training people with ID to brush their own teeth may have reduced the amount of plaque on their teeth in the short term.

Regularly scheduled dental recall visits and carers supervising toothbrushing between visits may have been more likely than usual care to reduce gingival inflammation and plaque in the long term.

Discussing clinical photographs of plaque on participants' teeth shown up by a disclosing agent, to motivate them to better toothbrushing did not seem to reduce plaque.

Daily toothbrushing by a dental student may be more effective for reducing plaque levels in the short term than once or twice weekly professional toothbrushing.

Toothpaste with a plaque-disclosing agent and individualised oral care plans were each evaluated in one nonrandomised study that suggested they may be beneficial.

Only one study set out to formally measure negative side effects; however, most studies commented that there were none. Some studies found that some people had difficulties with the electric or special manual toothbrushes.

Certainty of the evidence

Although some oral hygiene interventions for people with ID show scientific evidence of benefits, what these benefits actually mean for an individual's oral hygiene or oral health is unclear. The certainty of the evidence is mainly low or very low so future research may change our findings. Moderate-certainty evidence is available for only one finding: electric and manual toothbrushes are probably similarly effective for reducing gingival inflammation in people with ID in the medium term. More and better research is needed to fully evaluate interventions that show promise for improving the oral hygiene of people with ID, and to confirm which interventions

are ineffective. In the meantime, changes to current habits based on this review should be made cautiously, and decisions about oral hygiene care should be based on professional expertise and the needs and preferences of people with ID and their carers.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON [*Explanation*]

Special manual toothbrush compared to conventional manual toothbrush for people with ID

Population: children and adults with mixed levels of ID
Setting: home, residential, day care, school, mixed or not specified
Intervention: special manual toothbrush (self, carer or carer-assisted brushing)
Comparison: conventional manual toothbrush (self, carer or carer-assisted brushing)

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with conventional manual toothbrush	**Risk with special manual toothbrush**				
Gingival inflammation short term (< 6 weeks) assessed with: Saxer & Muhlemann Bleeding Index Scale: 0-3 (lower score means less inflammation) Follow-up: mean 21 days	Mean gingival inflammation short term was 1.21 (SD 0.85)	MD 0.10 lower (0.77 lower to 0.57 higher)	-	25 (1 RCT)	⊕⊕○○ **Low**[a]	There was no evidence of a difference between the toothbrushes in the short term. Two cross-over RCTs (126 participants) showed similar results
Gingival inflammation medium term (6 weeks to 12 months) assessed with: Gingival Bleeding Index % of positive sites Scale: 1-100 (lower score means less inflammation) Follow-up: mean 4 months	Mean gingival inflammation medium term was 18.3 (SD 16.2)	MD 12.4 lower (24.31 lower to 0.49 lower)	-	18 (1 RCT)	⊕○○○ **Very low**[b]	Compared to a conventional toothbrush, a special manual toothbrush (Superbrush) may have reduced gingival inflammation medium term when used by a carer for people with ID who were reliant on other people to carry out their oral hygiene

Plaque short term assessed with: Silness & Löe Plaque Index Scale: 0-3 (lower score means less plaque) Follow-up: mean 21 days	Mean plaque short term was 1.02 (SD 0.85)	MD 0.2 higher (-0.45 lower to 0.85 higher)	-	25 (1 RCT)	⊕○○○ **Very low**[c]	There was no evidence of a difference between the toothbrushes in the short term. Three other short-term RCTs (141 participants) that could not be combined in meta-analysis, had inconsistent findings
Plaque medium term (6 weeks to 12 months) assessed with: Simplified Green & Vermillion Scale: 0-3 (lower score means less plaque) Follow-up: mean 4 months	Mean plaque medium term was 0.78 (SD 0.7)	MD 0.44 lower (0.93 lower to 0.05 higher)	-	18 (1 RCT)	⊕○○○ **Very low**[b]	There may have been no difference between the two toothbrushes in terms of plaque or the Superbrush may reduce plaque medium term.[1]
Quality of life	Not assessed					-
Dental caries	Not assessed					-
Adverse effects	1 RCT and 2 NRS did not assess or report adverse effects. 1 RCT assessed allergic reactions to a single-use suction toothbrush at study outset and found none but this study was not summarised in this table (Table 6). 1 RCT and 1 NRS assessing the Superbrush found the size of the 3-headed toothbrush caused some problems either when first used or for people with limited mouth opening					-

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **ID:** intellectual disability; **MD:** mean difference; **NRS:** non-randomised study; **RCT:** randomised controlled trial; **SD:** standard deviation.

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded two levels due to imprecision: wide confidence intervals and findings were based on one study with only 25 participants.

[b]Downgraded two levels for imprecision and one for study design: based on only one study with 18 participants, in which assessments were not calibrated and baseline scores were different, and the confidence intervals were wide.

[c]Downgraded three levels due to imprecision: wide confidence intervals and based on one study with only 18 participants. In addition, 3 other RCTS could not be combined in meta-analysis and had mixed findings.

[1]One NRS (24 participants) showed no evidence of a difference between toothbrushes for plaque in the medium term..

BACKGROUND

Description of the condition

Oral hygiene is the process of cleaning the hard and soft tissues of the oral cavity (teeth, gums and tongue), fixed dental prostheses, oral appliances and dentures. Failure to perform regular and effective oral hygiene results in increased levels and varieties of the dental bacteria that make up dental plaque. Dental plaque has been shown to have a major role in the development of periodontal disease and dental caries, the two most common oral diseases (Axelsson 2004; Löe 2000)

Poor oral hygiene can affect a person's quality of life because of pain and discomfort when eating, poor self-esteem or sleep disturbance as a result of dental caries (Bonetti 2015). Evidence also exists linking levels of oral hygiene and periodontal status to diabetes, aspiration pneumonia and rheumatoid arthritis and evidence is emerging of a link with other systemic diseases and conditions such as cardiovascular disease, liver disease and obesity (Borgnakke 2015; Horwitz 2000).

People with an intellectual disability (ID) have a higher prevalence and greater severity of periodontal disease than the general population (Anders 2010; Campanaro 2014). The prevalence of dental caries in children with ID is similar to those of the same age in the general population (Whelton 2009). However, their oral health deteriorates at a faster rate as they move into adulthood. There are more untreated dental caries, more missing teeth and fewer restorations found in adults with ID than in the general population (Anders 2010; Catteau 2011; Crowley 2005; De Jongh 2008; Hennequin 2008; Morgan 2012; Oliveira 2013).

In the general population, brushing regularly with fluoridated toothpaste plays an important role in preventing dental caries and periodontal disease (Axelsson 2004; Broadbent 2011; Chestnutt 1998; Löe 1965; Löe 2000; Van der Weijden 2011; Zimmermann 2015). Whether this also applies to people with an ID is less clear, as many research studies on oral health exclude people with disabilities (Glassman 2009).

The removal of dental plaque may reduce the prevalence of periodontal disease and dental caries (Axelsson 1978; Axelsson 2004; Löe 1965; Löe 2000). However, the plaque must be removed thoroughly and regularly to achieve this effect. This health-related behaviour requires a person to have the relevant capabilities, opportunities and motivation to perform the necessary routines (Broadbent 2011; Stewart 1996; Watt 2005). For people with an ID, understanding the importance of removing dental plaque and developing the skills to do so requires more effort and achieving the standard of oral hygiene necessary for good oral health may require the support of others (Crowley 2005).

When considering the issues possibly influencing oral hygiene practices for the population with ID, it is important first to have a clear definition of ID; second, to consider the specific barriers to regular oral hygiene practices that might exist for people with ID; and third, to consider facilitators to promoting regular oral hygiene practices that might exist for people with ID.

Definition of intellectual disability

The most widely used current definition of disability comes from the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF), which incorporates the complex interactions between health conditions, environmental factors and personal factors. Regarding a person with an ID, this definition would consider how their personal factors, health condition and environment affect their lives (WHO 2001). Three elements are common for people with ID: a significant impairment of intelligence, a resultant significant reduction in adaptive behaviour/social functioning and the development of the condition (which persists throughout life) before the age of 18 years (Schalock 2010).

The WHO has also developed an operational definition of ID, which focuses mostly on the functional elements of ID, in the International Statistical Classification of Diseases and Related Health Problems, 10th version (ICD-10) (WHO 2011). The ICF definition of disability is designed to complement the ICD-10 definition.

The ICD-10 describes the four levels of ID as follows.

1. Mild ID (ICD-10 F70): intelligence quotient (IQ) range 50 to 69: "Ability to use speech in everyday situations; usually full independence in self care; Difficulties in identification of this population arise, as those with borderline disability may not be in contact with service providers."

2. Moderate ID (ICD-10 F71): IQ between 35 and 49: "Slow in comprehension; supervision of self care, retarded motor skills."

3. Severe ID (ICD-10 F72): IQ between 20 and 34: "Marked impairment of motor skills; clinically significant damage to Central Nervous System (CNS)."

4. Profound ID (ICD-10 F73): IQ less than 20: "Severely limited understanding; Immobility or restricted mobility; Incontinence; requires constant supervision; usually organic aetiology."

We acknowledge that other terms and definitions have been used to describe people with ID, both historically and currently. Whilst we acknowledge that the ICF is currently accepted as the most holistic definition of disability, we considered it unlikely to have been used in the studies that were potentially eligible for this review. Therefore, we planned to use the ICD-10 definition as the reference to determine the inclusion or exclusion of studies, as it provides a detailed nomenclature of diseases (Kurbasic 2008). In updates to this review, the ICF definition of ID will have become more commonly used in studies and will more accurately reflect the make-up of the population with disabilities. In addition, the ICF definitions are a better representation of populations requiring targeted services. However, the definition used (ICD-10) was considered by the team to accurately represent the population of interest in this review.

The heterogeneous nature of populations with ID adds further complexity to the assessment of interventions of relevance to these populations. An person's level of ID may impact their cognitive and physical abilities and personal and environmental factors, which may affect their response to an intervention. The response to an intervention therefore may be different for different people or groups of people with ID. We highlighted when studies provided details of the level of ID and personal and environmental factors of the participants.

Barriers to oral hygiene practice for people with intellectual disability

Capability, opportunity and motivation are required to achieve adequate oral hygiene. Oral hygiene tasks are more difficult for people with ID; they may lack the manual dexterity or cognitive skills to carry out or understand the need for effective oral hygiene (Anders 2010; Löe 2000). There may be other associated conditions such as sensory impairment, anxiety, or chronic medical or behavioural conditions that militate against carrying out oral hygiene effectively (Gordon 1998; Minihan 2014; Prangnell 2008). In one 2003 Irish study, carers of people with ID identified some of the physical barriers caused by the disability such as an inability to rinse, difficulty getting a toothbrush into someone's mouth, an oversensitive mouth and a tendency to gag (Taylor-Dillon 2003). Nearly 10% of people with ID have dysphagia, which is associated with an increased tendency to choke or gag during toothbrushing (Chadwick 2009).

People with ID have chronic, poor oral hygiene and require more support with their oral hygiene. Carers for people with ID are often poorly trained (Crowley 2005). Oral hygiene is not seen as a priority for overstretched carers, particularly if it is not a personal priority (Kaye 2005; Rawlinson 2001). Lack of co-operation and challenging behaviour on the part of the person with ID may add to this burden.

Facilitators for oral hygiene practice for people with intellectual disability

Behaviour management techniques may improve the co-operation of people with ID when performing oral hygiene. Education may change carers' behaviour. Management techniques may improve the co-operation of people with ID when performing oral hygiene. Education may change carers' attitudes and improve their skills (Faulks 2000; Mac Giolla Phadraig 2013). Management support and guidance, stakeholder engagement, policy documents and increased resources may improve levels of oral hygiene provision in community and institutionalised settings (Glassman 2003; Glassman 2006; Glassman 2009). Specially designed or adapted oral hygiene aids may improve the oral hygiene skills of people with ID or their carers (Dougall 2008).

Description of the intervention

The interventions evaluated in this Cochrane Review focused on two distinct groups: people with an ID and the carers supporting, assisting or providing oral hygiene care for them. The range of carers involved was expected to be diverse; formal and non-formal personal carers with and without relevant training, with and without dental qualifications, and with and without psychology or related qualifications.

We defined oral hygiene in this review as the mechanical removal of plaque with manual or electric toothbrushes, interdental aids or other mechanical aids. Interventions designed to impact on levels of oral hygiene tend to categorise outcomes as clinical, such as reductions in plaque levels, periodontal diseases or dental caries, and behavioural/psychological, such as changes in comprehension, self-efficacy or motivation (Cooper 2013; Cooper 2014). This review included interventions that assessed clinical or behavioural/psychological outcomes or both. We considered any intervention that may have impacted on any combination of duration, frequency and effectiveness of oral hygiene practices.

How the intervention might work

Behavioural change models are relevant to oral hygiene behaviour and effective when used in interventions for people with ID (Renz 2007; Willems 2017). In one systematic review, Newton 2015 found using the constructs themselves to be a more reliable way of predicting behavioural change. Michie 2013 identified a taxonomy of 93 behavioural change techniques (BCTs) that provides a standardisation of the terminology used. In order to make the taxonomy of BCTs more accessible for clinicians, the BCTs can be grouped into 16 labelled clusters (Cane 2015; Michie 2011; Michie 2013). These labels provide a means to identifying the elements in an intervention that are likely to improve adherence and make routines easier to establish in relation to oral hygiene, even if they are not formally identified as BCTs. To further assist the analysis of interventions, Michie developed the 'Behavioural Change Wheel', which characterises the elements at three levels: a behaviour system at the hub, encircled by intervention functions and then by policy categories.

The COM-B system

We considered the interventions under the 'behaviour system' elements of Capability (which includes knowledge and skills), Opportunity (both physical and social) and Motivation (both automatic and reflexive), as outlined by Michie and colleagues as the COM-B system for understanding behaviour and behavioural change (Michie 2011).

Capability-based interventions, defined as the psychological and physical capacity to engage in the activity concerned, might be a knowledge-based intervention in relation to the comprehension and reasoning around why oral hygiene is required or a skills-based

intervention that trains a person with ID in the physical skills of toothbrushing or that trains carers how to brush the teeth of a person with ID.

Opportunity-based interventions, which include both physical and social opportunities, should consider the elements beyond the individual, that is contexts such as the variety of settings in which the intervention is delivered or undertaken, for example, home, school, dental clinic, day care or residential care setting or the influences of the families or carers' attitudes regarding oral hygiene practices.

Motivation-based interventions, which include both automatic and reflective processes, might result in conscious decision-making where a goal or reward is identified to instigate or perpetuate a daily oral hygiene routine.

An intervention may change one or more of these behavioural elements resulting in the desired behaviour of performing regular oral hygiene.

Why it is important to do this review

The difficulties of providing dental care for people with disabilities have been acknowledged (Al Kindi 2016). Access to care is known to be more difficult; resources are stretched for parents, carers and healthcare professionals (Dougall 2008; Kaye 2005; Prabhu 2010; Sagheri 2013). The consequences of oral diseases for people with ID are more profound. Interventions designed to suit people with disabilities must show benefit (WHO 2011). Whilst an increasing number of good-quality systematic reviews of oral health interventions designed for the general population have been produced (Agnihotry 2016), Cochrane has not specifically reviewed the effectiveness of oral health interventions focused on people with disabilities (Cochrane Oral Health 2019).

One scoping review of interventions aimed at the wider population of people with disabilities has identified people with ID as being the most common target subpopulation (Waldron 2016). Oral hygiene status is one of the most common targets of oral health intervention for people with disabilities. This systematic review of oral hygiene interventions for people with ID allows us to draw conclusions about the effectiveness of these types of interventions. Furthermore, the review may increase dental professionals' understanding of behavioural change principles, inform the training of the dental team, and have an impact on the design and implementation of future oral health interventions for this population.

Cochrane Oral Health undertook an extensive prioritisation exercise in 2014 to identify a core portfolio of titles that were the most clinically important ones to maintain on the Cochrane Library (Worthington 2015). This exercise identified prevention and maintenance as priorities, which included oral hygiene adherence and caries prevention. Whilst not specifically identifying people with disabilities, the exercise also prioritised oral health promotion, specifically in institutionalised settings (Worthington 2015).

OBJECTIVES

To assess the effects (benefits and harms) of oral hygiene interventions, specifically the mechanical removal of plaque, for people with intellectual disabilities (ID).

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs), including cluster-RCTs, evaluating interventions to promote oral hygiene, specifically the mechanical removal of plaque, that were targeted at people with ID and groups such as parents, carers and other healthcare professionals caring for people with ID.

As we anticipated that the number of RCTs was likely to be low, we included some types of non-randomised studies (NRS): non-randomised controlled trials (NRCTs), controlled before-after studies, interrupted time series studies (ITS) and repeated measures studies.

ITS, where multiple data points are collected before and after the intervention and the intervention effect is measured against the preintervention trend and repeated measure studies, where these measures are taken on the same people at each time point, were only included if they had a clearly defined point in time when the intervention occurred and at least three data points before and three after the intervention.

We analysed RCTs and NRS separately, and presented RCT findings as the key evidence.

We applied no language restrictions.

Types of participants

People with an ID, living at home, in day care, in hospital or in a residential care setting. We considered all ID as defined by the ICD-10 (WHO 2011).

Types of interventions

We considered all oral hygiene interventions that used or promoted the mechanical removal of plaque. Interventions may have included, but were not limited to, the following components.

1. Oral hygiene-related knowledge-based interventions for participants or their carers, for example, education in the care of the teeth and gums, diseases of the teeth and gums, and prevention of diseases of the teeth and gums.

2. Oral hygiene-related behavioural interventions for participants or their carers that result in a behavioural change

that can be observed and is replicable, for example, goal setting or positive reinforcement.

    3. Oral hygiene-related skills training for participants, for example, interventions related to toothbrushing skills or other oral hygiene routines.

    4. Oral hygiene-related skills training for carers, for example, interventions related to assessing toothbrushing skills or assisting participants with toothbrushing or other oral hygiene routines or providing oral hygiene care to participants.

To be eligible, controlled studies must have included a comparison with at least one of the following: usual care, no care or a similar alternative intervention. Examples of studies comparing similar alternative interventions might be a study comparing education provided in different formats, for example, face-to-face versus an information leaflet or a study comparing oral hygiene care provided after a training session versus oral hygiene care provided without training.

In relation to the definition of oral hygiene, we excluded interventions focusing on the chemical removal of plaque alone. The use of a chemical agent, which is used on a toothbrush and arguably removes plaque both mechanically and chemically, is complex, as the measurement of the resulting reduction of plaque cannot be assigned to either solely the mechanical or chemical action. We excluded these studies, except for those studies using a conventional non-prescription toothpaste normally used by the participants or using a non-conventional chemical agent for both the intervention and control in studies comparing the mechanical removal of plaque. For example, a study comparing a manual toothbrush with an electric toothbrush where both were used with a non-conventional toothpaste such as chlorhexidine or extra-strength fluoride toothpaste.

Types of outcome measures

Outcome measures included both behavioural and clinical measures.

We based the behavioural outcomes measured on the COM-B system and included indicators such as improved toothbrushing skills, changes in knowledge of participants and carers with regard to oral health, and increased episodes and duration of toothbrushing. We accepted any reasonable instrument used in the included studies such as questionnaires, interviews, observational outcomes, video recordings, diaries, self-reported outcomes or observational measures such as measuring toothpaste weight to check adherence with toothbrushing.

The clinical outcomes measured included indicators such as the prevalence/incidence of dental plaque, prevalence/incidence of periodontal disease (gum disease) and prevalence/incidence of dental caries. We used only published or validated assessments of the clinical outcomes or a comparable measure, for example, dental plaque measured using the Plaque Index, as outlined in Silness 1964 or Quigley-Hein Plaque Index as modified by Turesky and colleagues (Turesky 1970). Gingivitis measured using an index

such as the Gingival Index, as outlined in Löe 1963 and Löe 1967 or the Modified Gingival Index (Lobene 1986). Dental caries was to be measured using an index such as the Decayed, Missing or Filled Teeth/Surface Index (dmft/s; DMFT/S) (Petersen 2013). We considered all time frames for the delivery and follow-up of the intervention. The follow-up time frames were grouped for analysis into short, medium and long term, for all outcomes. A systematic review of the effects of oral hygiene on chronic periodontitis in the general population excluded studies lasting less than nine months, in order to differentiate between gingivitis and periodontitis (Hujoel 2005). The three RCTs included in that review were followed up for over three years. Mombelli 1998 reflected on the limitations of longitudinal studies of periodontal disease when considering the issues of measurement error in periodontal probing and the impact of concepts such as bursts of disease activity versus a continuous disease process, in relation to the progression of periodontal disease. Mombelli 1998 concluded that studies of 20 years or more in length would be required to achieve sufficient confidence in the results. One systematic review on the effects of toothbrushing frequency on the prevention of dental caries showed that the eligible interventions were all followed up for between 11 months and 15 years (Kumar 2016). The division of time frames was guided by a review of the literature on the effects of oral hygiene interventions on the oral health of people with ID and the knowledge, behaviour, attitude and self-efficacy of the people with ID or their carers.

    1. Short-term follow-up (six weeks or less) may allow for some clinically visible signs of early changes in gingival health to become apparent, permitting the impact of possible differences in the microbial load, immune responses and environmental factors in this population group to manifest in clinically observable signs (Garmyn 1998). It may also be useful to observe the clinical changes resulting from an intervention without confounding the result with other variables, for example, the effect on oral hygiene following skills training without the variable of adherence to oral hygiene practices over time (Egelberg 1994). The early, clinically visible signs would include changes in plaque prevalence/incidence and changes in gingival bleeding or inflammation (Löe 1965).

    2. Medium-term follow-up (six weeks to 12 months) may allow for some additional signs of changes in gingival health to be recorded compared to the baseline status, depending on the success of the intervention, such as gingival pocket probing depths, as well as consistent changes in knowledge and behaviour.

    3. Long-term follow-up (greater than 12 months) would allow for some assessment of those measures that require a longer time frame to show change, such as dental caries prevalence/incidence or clinical attachment loss or bone loss in relation to gingival disease, as well as continued follow-up on all other assessments. Long-term studies would also allow for follow-up on any short- or medium-term success regarding changes in oral hygiene behaviour that is crucial to maintaining oral health (Schou

1998). It must be accepted that any findings from these long-term interventions will be confounded by factors outside the study setting.

Primary outcomes

1. Gingival health of people with an ID, for example, plaque, gingival inflammation, calculus.

Secondary outcomes

1. Oral hygiene knowledge acquisition by people with an ID or the acquisition of knowledge by their carers with regard to oral hygiene.
2. Changes in behaviour, attitude and self-efficacy of people with an ID or their carers.
3. Quality of life changes or long-term, patient-centred outcomes for people with an ID (e.g. tooth retention).
4. Dental caries levels of people with an ID.
5. Any unintended (positive or negative) effects of the interventions.

Outcome measures relating to clinical outcomes must have been published or validated or comparable to measurements such as dental plaque levels (e.g. Plaque Score), gingival health (e.g. Gingival Index) or dental caries prevalence/incidence (i.e. DMFT/S). Behavioural outcome assessments with regard to changes in capability, opportunity or motivation of the participant or carer for oral hygiene practices included any instrument used in the included studies that the review authors considered reasonable.

Search methods for identification of studies

Electronic searches

Cochrane Oral Health's Information Specialist conducted systematic searches in the following databases for randomised controlled trials and controlled clinical trials:

- Cochrane Oral Health's Trials Register (searched 4 February 2019);
- Cochrane Central Register of Controlled Trials (CENTRAL; in the Cochrane Register of Studies; searched 4 February 2019);
- MEDLINE Ovid (1946 to 4 February 2019);
- Embase Ovid (12 October 2016 to 4 February 2019);
- PsycINFO Ovid (1806 to 4 February 2019).

Details of the search strategies can be found in Appendix 1. Subject strategies were modelled on the search strategy designed for MEDLINE Ovid. Due to the Cochrane Centralised Search Project to identify all clinical trials in the database and add them to CENTRAL, only the most recent months of the Embase database were searched. See the searching page on the Cochrane Oral Health

website for more information. There were no other restrictions on the date of publication when searching the electronic databases; and searches were not limited by language or publication status.

Searching other resources

The following trial registries were searched for ongoing studies to 4 February 2019 (see details of search terms used in Appendix 1):

1. US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov (clinicaltrials.gov/);
2. WHO International Clinical Trials Registry Platform (apps.who.int/trialsearch).

We handsearched the specialist conference abstracts from the International Association of Disability and Oral Health (2006 to 2016). Conference abstracts prior to 2006 were not published and were not available from other sources.

We checked the bibliographies of included studies and any relevant systematic reviews identified for further references to relevant trials (Horsley 2011).

We considered any unpublished studies discovered using the search methods described above if they met the inclusion criteria for this review.

We considered adverse effects described in included studies only.

Data collection and analysis

Selection of studies

Five review authors independently examined the studies identified by the searches and ensured that each study was examined by at least two review authors, firstly by the titles and abstracts and then by obtaining and reading the full text, if the study was considered potentially relevant. We used specific inclusion criteria in our decision-making including the participants, interventions and study designs as outlined below. A sixth review author was the arbiter. Inclusion criteria:

1. participants must have had an ID as defined by the ICD-10 or be a carer of a person with an ID;
2. the intervention must have related to oral hygiene;
3. study design must have been either an RCT or one of the NRS outlined earlier. Non-controlled studies had to have at least three before and three after measures;
4. complex interventions with an oral hygiene element were considered if the outcome from the oral hygiene component could be appraised separately.

Details such as keywords, authors, publication and institutions were available to the review authors. Any disagreements were discussed by the reviewing authors and the arbiter. We recorded justifications for all decisions. When we identified multiple reports of the same study, we linked these together as far as possible. We contacted study authors to clarify details regarding eligibility where

necessary. We attempted to identify all relevant studies irrespective of language. Relevant non-English language papers were translated. Any studies identified by the searches, involving any of the review authors, were examined by other review authors.

Data extraction and management

Two review authors independently extracted data for each study using a specially designed data collection sheet, which was piloted by four of the review authors. We extracted data under the following headings: profile of the participants, number of participants, settings, details of interventions including details of the carers or personnel delivering or supporting the intervention and any BCTs identified within the interventions, outcomes measured, duration of intervention and follow-up, and study design. We designed a template for the Characteristics of included studies tables, based on the methods outlined in the protocol (Waldron 2017), and headings used in the data collection sheet, to highlight the important elements of the studies (Appendix 2).

Assessment of risk of bias in included studies

Two review authors independently assessed the risk of bias for each study, discussing any disagreements with the arbiter. We recorded justifications for decisions. To avoid any conflict of interest, we excluded team members who were authors of included studies from the 'Risk of bias' assessment of those studies and alternative review authors undertook this assessment.

We considered bias for RCTs and NRCT for the following domains: selection bias, performance bias, detection bias, attrition bias and reporting bias as per the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011a). We considered bias for cluster-RCTs under the two different units of measurement, the cluster and the participant, if provided and under the same domains as for RCTs (Campbell 2012).

We considered bias for non-controlled trials using the Effective Practice and Organisation of Care (EPOC) criteria for assessing risk of bias under the following headings (EPOC 2016; Sterne 2016).

1. Was the intervention independent of other changes?
2. Was the shape of the intervention effect prespecified?
3. Was the intervention unlikely to affect data collection?
4. Was knowledge of the allocated interventions adequately prevented during the study?
5. Were incomplete outcome data adequately addressed?
6. Was the study free from selective outcome reporting?

We supplemented this with information on participant and study characteristics where appropriate.

We completed a 'Risk of bias' table for each included study and rated each study as high risk, low risk or unclear risk of bias for the separate domains and presented the results graphically (Figure 1; Figure 2). All domains were regarded as equally important in this review. The overall risk of bias within a study was determined across domains depending on the number of low, unclear and high ratings: if there was at least one rating of high risk of bias for the study, it was rated overall as high risk of bias; if all ratings were low risk of bias, the study was rated low overall; if there was a mix of low and unclear ratings, the study was rated overall as being at unclear risk of bias.

Figure 1. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.
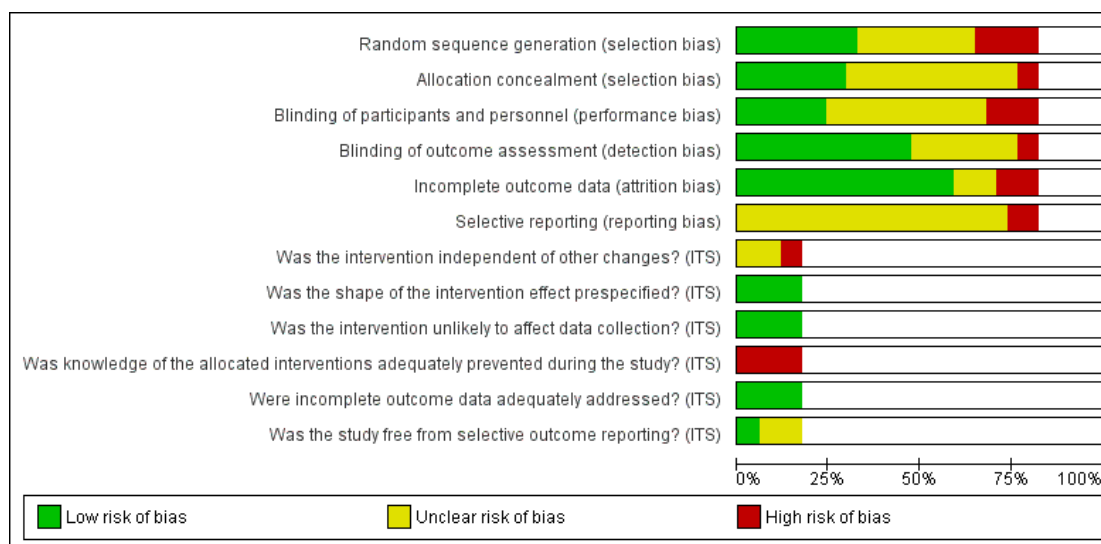
Figure 2.   Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

Measures of treatment effect

For continuous data (e.g. plaque levels, self-efficacy scale), we used the mean difference (MD) when the same scale was used or standardised mean difference (SMD) if more than one scale was used to measure the same outcome, along with the 95% confidence interval (CI). Had we found dichotomous data, we would have used risk ratios (RR) and 95% CI.

Unit of analysis issues

We considered the unit of analysis with regard to whether the intervention was targeted at individual or group level, whether there was more than one element to the intervention and whether there were different time points measured in the intervention. When possible, we planned to adjust for clustering if participants were allocated to the same intervention in groups (e.g. family members or care homes), for example, in cluster-RCTs. To account for the effect of clustering, we planned to estimate inflated standard errors (SEs) (Deeks 2011).

With regard to RCTs and other comparative studies, we considered adjustments to avoid multiple use of participants in multiarm or cross-over studies. If an intervention arm was included in more than one treatment comparison, we divided the number of participants in that arm and the number of events by the total number of treatment comparisons. This approach retained original information but reduced the precision of the pooled estimates.

We combined multiple arms when appropriate, for example, participants who brushed their own teeth and participants who required assistance or had their teeth brushed for them, or participants with different levels of disabilities. Findings for the separate arms are reported in the additional tables, but were pooled for the data analysis.

With regard to cross-over trials, data from these need to be reported in a specific way to allow their inclusion in meta-analyses (e.g. showing the data from each treatment period to allow calculation of the SE of the MD or data to approximate the correlation between results from different treatment periods). However, the necessary data were not available from the cross-over trials that we identified.

Where multiple time points were presented in the studies, we selected the time point for each study that could be compared to another study in each of the time periods (short, medium or long term) or the longest time point in each time period or both.

Dealing with missing data

We made all reasonable efforts to contact authors for details and reasons for any missing outcome data (Young 2011). If data were missing and no information was available in the paper or was not obtainable by contacting the authors, we planned to assume, for dichotomous data, that dropout was due to the intervention being unsuccessful. No dichotomous data were reported in this review. We planned to perform sensitivity analyses to assess the effects of these assumptions, for example, missing data for intervention studies could have been dealt with by using intention-to-treat numbers. For continuous data, we planned to use this information if we were able to calculate the data from other data provided, for example, calculating standard deviation (SD) from SE and P values (Higgins 2011b).

Assessment of heterogeneity

We planned to assess levels of statistical heterogeneity by observing the CI within studies and, to a lesser extent, statistically by use of the Chi² test to determine whether observed differences in results were compatible with chance alone. Interpretation of the Chi² would take into consideration the sample size and number of studies included in the meta-analysis.

We planned to quantify heterogeneity with the I² statistic, using the following guide. Some level of heterogeneity was expected (Higgins 2011a).

1. 0% to 40%: might not be important.
2. 30% to 60%: may represent moderate heterogeneity.
3. 50% to 90%: may represent substantial heterogeneity.
4. 75% to 100%: very substantial ('considerable') heterogeneity.

Assessment of reporting biases

Thorough searching of multiple databases should limit general reporting biases. We kept reporting biases due to such things as time lag bias (Hopewell 2007), selective outcome reporting (Dwan 2014), and publication bias (Hopewell 2009), to a minimum by inclusion of prospective trial registers; had we identified at least 10 studies in a comparison, we would have created funnel plots to explore publication bias and other biases related to study size. We made every effort to contact authors for results of outcomes included in their study objectives but not reported.

Data synthesis

We undertook meta-analyses only when studies were sufficiently homogeneous in their participants, interventions and outcomes; otherwise, we presented a narrative of individual study findings. We planned to combine RRs for dichotomous data and MDs or SMDs for continuous data, using random-effects models if at

least four studies were included in a meta-analysis. We used fixed-effect models when there were fewer than four studies and when heterogeneity was reasonably low.

Subgroup analysis and investigation of heterogeneity

We planned to consider subgroup analysis for topics such as the following if sufficient data were available (Bender 2008).

1. Level of ID.
2. With versus without support of dental professionals.
3. Non-formal carers (i.e. parents or siblings) versus formal carers.
4. Setting of the intervention (i.e. home-based versus residential/institutional/school-based interventions).
5. BCT used based on the COM-B system.
6. Short-term interventions versus long-term interventions.

For this version of the review, the amount of data was too small to undertake any purposeful analysis.

Sensitivity analysis

We had planned to undertake sensitivity analyses based on risk of bias; however, there were insufficient studies for a sensitivity analysis of this type. We undertook post hoc analysis excluding two studies that included some participants with an IQ above 70 (Garcia-Carrillo 2016; Gertenrich 1967a); no relevant effect was noticed.

Summarising findings and assessing the certainty of the evidence

We created 'Summary of findings' tables for the nine comparisons identified. We summarised the findings for the main outcomes measured: gingival inflammation or bleeding, and plaque (short, medium and long term); quality of life; dental caries; adverse effects. For training interventions, we also included oral health knowledge, and behaviour, attitude and self-efficacy. We used GRADEpro software to assess the certainty of the evidence under the following headings: study design (risk of bias); inconsistency; indirectness; imprecision; publication bias; large effect; plausible confounding; dose response gradient (Schünemann 2013). We categorised the certainty of the body of evidence for each of the main outcomes for each comparison as high, moderate, low or very low.

R E S U L T S

Description of studies

Results of the search

The searches from the databases resulted in 3805 records and an additional 41 records were identified from other sources. After removal of duplicates, review authors screened 3020 records by title and abstract using Covidence software (Covidence 2018), of which 2794 were judged to be irrelevant and rejected. Following this process, we attempted to source 226 full-text records for assessment for eligibility against the inclusion and exclusion criteria outlined in the protocol (Waldron 2017). We rejected 153 records. We excluded 23 records (22 studies) for reasons listed in the Characteristics of excluded studies table; three studies are awaiting classification (see Characteristics of studies awaiting classification table), and one is ongoing (see Characteristics of ongoing studies table). Therefore, 34 studies (46 records) met the inclusion criteria for this review (Figure 3).

Figure 3. Study flow diagram. ID: intellectual disability; NRS: non-randomised study; RCT: randomised controlled trial.
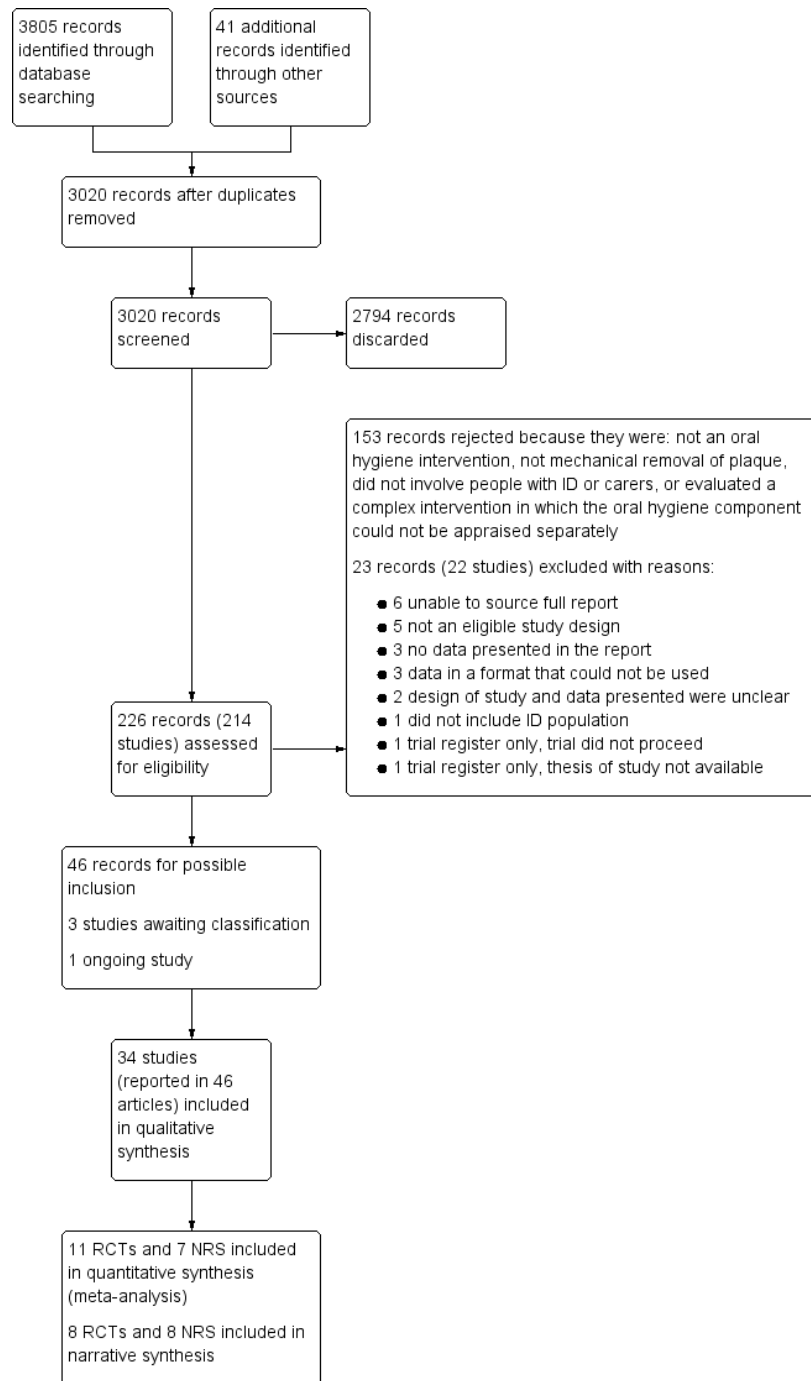
Three of the review authors piloted data extraction on a small number of records and some clarifications to the criteria were made following a team discussion (see the details in the Differences between protocol and review section). At least two review authors independently undertook screening and extraction: three review authors were involved in the screening of titles and abstracts (CW, JN, CMGP); five review authors were involved in the extraction process (CW, JN, CMGP, SG, CC).

Included studies

The study details are summarised in the Characteristics of included studies table.

Characteristics of the methodologies

Design

Thirty-four studies met the inclusion criteria for this review: 19 RCTs and 15 NRSs. RCTs and NRSs are reported separately. Fifteen studies were parallel-group RCTs (Albino 1979; Bickley 1990; Bildt 2010; Christen 2007; Dôgan 2004; Ferozali 2007; Gonzalez 2013; Kaschke 2005; Kelner 1963; Lange 1985; Olmos 2016; Phlypo 2016; Sauvetre 1995; Shaw 1983; Swallow 1969), and four were cluster RCTs (Carr 1997; Garcia-Carrillo 2016; Mac Giolla Phadraig 2015; Shaw 1991). Four RCTs were cross-over trials: one trial had two arms (Shaw 1983), and the others had three arms (Christen 2007; Dôgan 2004; Kaschke 2005). Of the NRS, nine studies were NRCTs (Altabet 2003; Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Lange 2000; Teitelbaum 2009; Williams 1988), three were ITS studies (Glassman 2006; Jarman 1983; Kissel 1983), and three were repeat measure (RM) studies (Abramson 1972; Bouter 1979; Snell 1989).

Date and duration

The 19 RCTs were reported between 1963 and 2016. One RCT included long-term follow-up (24 months) (Shaw 1991); eight included medium-term follow-up (greater than six weeks to less than 12 months) (Bickley 1990; Bildt 2010; Carr 1997; Ferozali 2007; Garcia-Carrillo 2016; Kelner 1963; Mac Giolla Phadraig 2015; Phlypo 2016); and 10 had only short-term follow-up (six weeks or less) (Albino 1979; Christen 2007; Dôgan 2004; Gonzalez 2013; Kaschke 2005; Lange 1985; Olmos 2016; Sauvetre 1995; Shaw 1983; Swallow 1969).
The 15 NRS were reported between 1967 and 2009. Two NRS had long-term follow-up (16 to 19 months) (Bratel 1991; Snell 1989), 10 had medium-term follow-up (Altabet 2003; Bouter 1979; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c;

Gertenrich 1967d; Glassman 2006; Jarman 1983; Kissel 1983; Williams 1988), and two had only short-term follow-up (Lange 2000; Teitelbaum 2009). The duration was unclear for one NRS (Abramson 1972).

Size

The number of participants in the studies was based on the number of participants recorded at baseline; some studies reported the intention-to-treat numbers.
The number of participants in the RCTs ranged from 18 to 329. Ten RCTs had fewer than 50 participants (Albino 1979; Bickley 1990; Bildt 2010; Christen 2007; Dôgan 2004; Ferozali 2007; Gonzalez 2013; Kaschke 2005; Lange 1985; Sauvetre 1995), five RCTs had between 50 and 100 participants (Carr 1997; Garcia-Carrillo 2016; Phlypo 2016; Shaw 1983; Swallow 1969), and four RCTs had more than 100 participants (Kelner 1963; Mac Giolla Phadraig 2015; Olmos 2016; Shaw 1991). Most studies evaluated interventions aimed specifically at people with ID. Four of the RCTs included carers as participants: one assessed outcomes for the carers only (Gonzalez 2013), and three assessed outcomes for both people with ID and carers (Mac Giolla Phadraig 2015; Olmos 2016; Phlypo 2016). One did not report the number of carers involved (Olmos 2016).
The number of participants in the NRS ranged from three to 79. Four NRS had fewer than 20 participants (Abramson 1972; Bouter 1979; Kissel 1983; Snell 1989), eight NRS had between 20 and 50 participants (Bratel 1991; Gertenrich 1967a; Gertenrich 1967c; Gertenrich 1967d; Glassman 2006; Jarman 1983; Teitelbaum 2009; Williams 1988), and three NRS had more than 50 participants (Altabet 2003; Gertenrich 1967b; Lange 2000). Two NRS assessed outcomes for both people with ID and carers (Glassman 2006; Kissel 1983); one NRS involved carers in the study but only assessed outcomes for the people with ID (Lange 2000).

Location, language and setting

The studies were carried out in 10 different countries: Belgium (two RCTs: Phlypo 2016; Sauvetre 1995), Brazil (one NRS: Teitelbaum 2009), Germany (three RCTs: Christen 2007; Kaschke 2005; Olmos 2016), Ireland (one RCT: Mac Giolla Phadraig 2015), Spain (one RCT: Garcia-Carrillo 2016), Sweden (one NRS: Bratel 1991), the Netherlands (one RCT: Bildt 2010; one NRS: Bouter 1979), Turkey (one RCT: Dôgan 2004), the UK (four RCTs: Bickley 1990; Shaw 1983; Shaw 1991; Swallow 1969), and the USA (six RCTs: Albino 1979; Carr 1997; Ferozali 2007; Gonzalez 2013; Lange 1985; Kelner 1963; 12 NRS: Abramson 1972; Altabet 2003; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Glassman 2006;

Jarman 1983; Kissel 1983; Lange 2000; Snell 1989; Williams 1988). Three studies were written in German (Christen 2007; Kaschke 2005; Olmos 2016), and one in Dutch (Bildt 2010). The settings were residential (eight RCTs: Carr 1997; Ferozali 2007; Gonzalez 2013; Lange 1985; Mac Giolla Phadraig 2015; Olmos 2016; Phlypo 2016; Swallow 1969; 13 NRSs: Abramson 1972; Altabet 2003; Bouter 1979; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Glassman 2006; Jarman 1983; Kissel 1983; Lange 2000; Teitelbaum 2009; Williams 1988); school (four RCTs: Albino 1979; Dôgan 2004; Garcia-Carrillo 2016; Shaw 1983; one NRS: Snell 1989), day centre (three RCTs: Bickley 1990; Sauvetre 1995; Shaw 1991), or mixed (two RCTs: Christen 2007; Kelner 1963; one NRS (Bratel 1991). Two RCTs were unclear (Bildt 2010; Kaschke 2005).

Ethical approval and consent

Twenty-one studies did not report having ethical approval; 11 RCTs (Bildt 2010; Christen 2007; Dôgan 2004; Ferozali 2007; Garcia-Carrillo 2016; Gonzalez 2013; Kaschke 2005; Lange 1985; Mac Giolla Phadraig 2015; Phlypo 2016; Sauvetre 1995), and one NRS (Teitelbaum 2009) reported having received some form of ethical approval; the one quasi-RCT was unclear on the issue (Lange 1985).

The participants or guardians gave consent in 14 RCTs (Bickley 1990; Carr 1997; Christen 2007; Dôgan 2004; Ferozali 2007; Garcia-Carrillo 2016; Gonzalez 2013; Kelner 1963; Lange 1985; Mac Giolla Phadraig 2015; Phlypo 2016; Shaw 1983; Shaw 1991; Sauvetre 1995), and three of the NRS (Glassman 2006; Lange 2000; Teitelbaum 2009); four RCTs and 11 NRS did not report consent; one RCT (Bildt 2010) and one NRS (Kissel 1983) were unclear.

Characteristics of the participants

In relation to people with ID, the studies included 1795 participants at baseline. In some studies, the difference between intention-to-treat numbers and those actually included at baseline was not explained. A total of 92 participants were reported as lost to follow-up; however, this number should be treated with caution as it is possible that those participants included at baseline were the more compliant participants and other potential participants were lost before baseline data could be collected. There were 17 studies that actively involved the carers of the people with ID in the delivery of the intervention, of these, seven focused on the carers as participants: six provided details of the number of carers (three RCTs: Gonzalez 2013; Mac Giolla Phadraig 2015; Phlypo 2016; three NRS: Glassman 2006; Kissel 1983; Lange 2000). A total of 354 carers provided baseline data; 92 were lost to follow-up.

Twenty-six studies had both males and females; one study had only males (Abramson 1972); seven studies did not report the sex of participants (Bickley 1990; Dôgan 2004; Kaschke 2005; Kelner 1963; Phlypo 2016; Sauvetre 1995; Shaw 1983).

Two RCTs (Dôgan 2004; Shaw 1983) and six NRS (Abramson 1972; Gertenrich 1967c; Gertenrich 1967d; Kissel 1983; Snell 1989; Teitelbaum 2009) involved only participants with ID who were less than 18 years old. Seven studies recruited both children and adults (Albino 1979; Gertenrich 1967a; Jarman 1983; Kelner 1963; Lange 1985; Swallow 1969; Williams 1988). Seventeen studies had participants who were aged 18 years or older, with an age range of 18 to 79 years. Bildt 2010 reported only mean age and three studies did not report the age profile (Bickley 1990; Gonzalez 2013; Phlypo 2016).

We converted study descriptions of the participants' level of ID to the ICD-10 descriptors: mild, moderate, severe and profound.

Interventions	Design	ICD-10 category	Unclear
1. Special toothbrush	RCT	Dôgan 2004: mild Bildt 2010: moderate to profound Ferozali 2007: profound	Christen 2007 Kaschke 2005 Sauvetre 1995
	NRS	Williams 1988: profound	-
2. Electric toothbrush	RCT	Dôgan 2004: mild Garcia-Carrillo 2016: mild to moderate; and some participant IQs > 70 Shaw 1983: severe	Carr 1997 Christen 2007 Kaschke 2005 Kelner 1963 Swallow 1969
	NRS	Gertenrich 1967d: mild (and some > IQ 70) Gertenrich 1967a: mild to severe (and some	-

		> IQ 70) Bratel 1991: moderate Gertenrich 1967b; Gertenrich 1967c: se-vere to profound	
3. Training of carers	RCT	Mac Giolla Phadraig 2015: mild to pro-found Phlypo 2016: severe to profound	Gonzalez 2013 Olmos 2016
	NRS	Glassman 2006: mild to severe Lange 2000: moderate to profound Kissel 1983: severe to profound	-
4. Training of people with ID	RCT	Albino 1979: moderate to severe Lange 1985: mild to moderate	-
	NRS	Bouter 1979: moderate Abramson 1972: severe Jarman 1983: severe Snell 1989: severe to profound	-
5. Scheduled dental recall in-tervals and supervised tooth-brushing	RCT	-	Shaw 1991
	NRS	-	-
6. Clinical photographs	RCT	-	Bickley 1990
	NRS	-	-
7. Varying frequency of tooth-brushing	RCT	-	Swallow 1969
	NRS	-	-
8. Plaque-disclosing agent	RCT	-	-
	NRS	Teitelbaum 2009: mild to moderate	-
9. Individualised care plan	RCT	-	-
	NRS	Altabet 2003: mild to profound	-

ICD-10: International Statistical Classification of Diseases and Related Health Problems, 10th revision; ID: intellectual disability; IQ: intelligence quotient; NRS: non-randomised study; RCT: randomised controlled trial

Two studies reported including some participants with an IQ above 70 (ranging as high as 87 (Garcia-Carrillo 2016) and 94 (Gertenrich 1967a)). We undertook a sensitivity analysis to determine the effect on the effect size of the outcomes of excluding these studies. There was no relevant effect.

Fifteen studies reported that participants with ID had comorbidities: nine RCTs (Albino 1979; Bildt 2010; Carr 1997; Christen

2007; Ferozali 2007; Garcia-Carrillo 2016; Kaschke 2005; Shaw 1983; Shaw 1991) and six NRS (Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Glassman 2006; Jarman 1983; Snell 1989). The most frequent conditions reported were cerebral palsy (five studies), epilepsy (four studies), Down's syndrome (three studies), visual impairment (three studies) and hearing impairment (two studies). Other conditions included; anxiety disorder, asthma, autism, chronic bronchitis, depression, diabetes, emesis, enteral feeding, gastro-oesophageal reflux disease, heart defect, hepatitis C, hiatal hernia, Hunter's syndrome, hydrocephaly, hypertension, hypothyroidism, muscular dystrophy, ocular tension, paranoid schizophrenia, phenylketonuria disorder, Prader-Willi syndrome, speech difficulties, swallowing problems, Tay-Sachs disorder, thyroid problems, Turner's syndrome, along with general terms to describe physical disabilities. One study reported that participants were excluded if they had any systemic disease (Teitelbaum 2009), and 18 studies did not report any comorbidities.

Characteristics of the interventions

More than one study evaluated each of the following comparisons.

1. Comparison 1: special manual toothbrushes versus conventional manual toothbrushes for people with ID.

2. Comparison 2: electric toothbrushes versus manual toothbrushes for people with ID.

3. Comparison 3: oral hygiene care training versus no oral hygiene care training or a placebo training session for carers of people with ID.

4. Comparison 4: oral hygiene training versus no oral hygiene training of people with ID.

One study evaluated each of the following comparisons.

1. Comparison 5: one-, three- and six-monthly dental recall intervals plus daily supervised brushing versus usual care for people with ID.

2. Comparison 6: discussion of individual clinical photographs as a toothbrushing motivator versus no discussion of photographs for people with ID.

3. Comparison 7: daily, twice-weekly and once-weekly frequencies of teeth brushing versus usual care for people with ID.

4. Comparison 8: use of a toothpaste with a plaque-disclosing agent versus a conventional toothpaste for people with ID.

5. Comparison 9: individualised oral care plan versus usual care (according to guidelines) for people with ID.

Interventions involving electric and manual toothbrushes

Thirteen studies compared an electric toothbrush to a manual toothbrush, eight RCTs and five NRS (Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d). Four RCTs were cross-over trials: one had two arms (Shaw 1983), and the others had three arms; the third arm being a special manual

toothbrush (Christen 2007; Dôgan 2004; Kaschke 2005). The other four RCTs were Carr 1997; Garcia-Carrillo 2016; Kelner 1963; and Swallow 1969.

Seven studies compared a special manual toothbrush with a conventional toothbrush. There were six RCTs: three, three-armed cross-over trials (Christen 2007; Dôgan 2004; Kaschke 2005), and three others (Bildt 2010; Ferozali 2007; Sauvetre 1995). One NRS compared a special manual toothbrush with a conventional toothbrush (Williams 1988).

The studies comparing electric toothbrushes to manual toothbrushes used a variety of electric toothbrushes: Oral B Braun (3D) (Bratel 1991; Dôgan 2004), Teledyne Waterpik Sonic Speed (Kaschke 2005), Panasonic Dentacare-Sonodent (Christen 2007), Interplak (Carr 1997), Phillips Sonicare EasyClean (Garcia-Carrillo 2016), Oral B Arcuate Action (Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c), and Broxodent (Kelner 1963). Shaw 1983 did not identify the electric toothbrush used. The studies comparing special manual toothbrushes also used a variety of toothbrushes: Collis Curve (Williams 1988), Superbrush (Bildt 2010; Christen 2007; Dôgan 2004; Kaschke 2005; Sauvetre 1995), and a single-use suction toothbrush (Ferozali 2007). Participants with ID brushed their own teeth in five of these studies (Dôgan 2004; Garcia-Carrillo 2016; Gertenrich 1967d; Sauvetre 1995; Shaw 1983) and carers (or others) brushed the teeth of those with ID in seven studies (Bildt 2010; Ferozali 2007; Gertenrich 1967b; Gertenrich 1967c; Kelner 1963; Swallow 1969; Williams 1988). Five studies were mixed: they distinguished between "self-brushers," "assisted brushers" and "carer brushed" (Bratel 1991; Carr 1997; Christen 2007; Gertenrich 1967a; Kaschke 2005); we combined these groups for meta-analysis.

Interventions involving training of carers and people with intellectual disabilities

Four RCTs (Gonzalez 2013; Mac Giolla Phadraig 2015; Olmos 2016; Phlypo 2016) and three NRSs (Glassman 2006; Kissel 1983; Lange 2000) focused on the training of carers to improve the oral health of the people with ID for whom they cared. The descriptions of the training provided lacked detail; those that indicated the duration of the training delivered it in one session, which varied in length: 90 minutes (Gonzalez 2013), three hours (Glassman 2006), or one day (Mac Giolla Phadraig 2015). Some interventions provided training manuals for the carers (Mac Giolla Phadraig 2015; Phlypo 2016), while others provided continual feedback based on observation (Glassman 2006; Lange 2000), video recordings (Kissel 1983), or monitoring of daily plaque scores (Lange 2000). Some interventions included practical skills training as well as theory, which was either delivered as role play (Mac Giolla Phadraig 2015), demonstrated on one of the participants (Lange 2000), or individualised for each carer and person with ID (Kissel 1983). The timing of the evaluation of the intervention varied: immediately after the delivery of the training

(Gonzalez 2013), four weeks (Olmos 2016), eight weeks (Phlypo 2016), 100 days (Kissel 1983), 156 days (Glassman 2006), and 11 months (Mac Giolla Phadraig 2015). The training was delivered by dental professionals except in Kissel 1983, where it was delivered by a psychologist.

Two RCTs (Albino 1979; Lange 1985) and four NRS (Abramson 1972; Bouter 1979; Jarman 1983; Snell 1989) focused on the training of people with ID to improve their oral health. The interventions focused on training people with ID in the practical skills of toothbrushing, with only one providing some theory in relation to the concepts of oral health (Albino 1979). The participants' levels of ID spanned the entire range: mild/moderate (Lange 1985), moderate (Bouter 1979), moderate/severe (Abramson 1972; Albino 1979), severe (Jarman 1983), and severe/profound (Snell 1989). Snell 1989 involved the participants in partial participation: the carers performed the toothbrushing and the participants were trained to assist where possible in the routine. In Jarman 1983, training in five other self-care routines was included in the intervention.

The duration of the training for people with ID tended to be considerably longer than that for carers; the shortest period was two weeks (Lange 1985) and the longest 19 months (Snell 1989). However, this varied from participant to participant depending on their particular needs and some interventions included a maintenance phase, where the trainer prompted the participant to undertake the next step in the routine.

The description of the toothbrushing routine varied from "task completion" (Albino 1979; Jarman 1983), to broad stages (Lange 1985), to detailed step-by-step descriptions (Abramson 1972; Bouter 1979; Snell 1989). One study used disclosing tablets to indicate plaque as a teaching and monitoring aid (Lange 1985). All the interventions used praise as a motivator; three studies also included physical rewards or tokens (Abramson 1972; Albino 1979; Jarman 1983). Four studies led or delivered training by a psychologist (Abramson 1972; Albino 1979; Bouter 1979; Jarman 1983), one study by a dentist (Lange 1985), and one study by a teacher (Snell 1989).

Interventions assessed in one study only

One RCT evaluated dental recall intervals (one-monthly, three-monthly, six-monthly) and daily supervised toothbrushing versus usual care (Shaw 1991), one RCT evaluated using an individual's clinical photographs to discuss oral hygiene performance versus not discussing them (Bickley 1990), and one RCT compared brushing daily by a dental professional to brushing twice weekly or once weekly (Swallow 1969). One NRS compared using a toothpaste with a plaque-disclosing agent versus a conventional toothpaste (Teitelbaum 2009), and another NRS compared the use of an individualised oral care plan versus usual care (Altabet 2003).

Characteristics of outcomes

The clinical outcomes assessed for the participants in the RCTs were: plaque, oral hygiene status (subjective), gingival inflammation, gingival bleeding, calculus, oral assessment, total bacterial count and potential pathogenic bacteria count. The behavioural outcomes assessed for the participants or the carers (or both) were knowledge, behaviour, attitude and self-efficacy.

The outcomes assessed for the participants in the NRS were: plaque, oral hygiene status, gingival inflammation, gingival bleeding, gingival pocketing, calculus, self-efficacy (steps in a toothbrushing routine), duration of the toothbrushing episode, individually tailored expected toothbrushing performance and level of "self-initiation." The outcomes assessed for the carers in the NRS were: need for verbal instruction and physical guidance, carer presence during toothbrushing by a person with ID and carer use of verbal instruction, physical guidance and rewards.

Timing of outcome measurement

Thirteen studies reported outcomes at more than one time point, which were, for the most part, within the same time frame: short term (Lange 1985; Lange 2000; Sauvetre 1995) or medium term (Carr 1997; Ferozali 2007; Garcia-Carrillo 2016; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Jarman 1983). We selected the longest time points for each study that were common among the studies for each of the time periods (short, medium or long term). Two studies reported findings across the time frames. Bratel 1991 reported findings in the short (one and four weeks), medium (12 weeks) and long term (16 months); we used the data from the four-week, 12-week and 16-month time points for analysis. Shaw 1991 reported findings in the medium and long term (three, six, 12, 18 and 24 months); we used only data from the 24-month time point for analysis as the participant numbers were not provided for any other time points.

Gingival health

Gingival inflammation

Twelve RCTs reported gingival inflammation, 11 of which used a validated gingival index. The indices used were Silness & Löe (Carr 1997; Garcia-Carrillo 2016; Lange 1985; Phlypo 2016; Swallow 1969), Lobene (Mac Giolla Phadraig 2015), WHO Technical Report 621 Gingival Index (Shaw 1983), Saxer & Muhlemann Papillary Bleeding Index (Christen 2007; Kaschke 2005; Sauvetre 1995), and Ainamo & Bay (Bildt 2010). The other RCT used the subjective rating of "worse, same or better" (Kelner 1963).

Six NRS reported gingival inflammation; two studies used a validated gingival index: Silness & Löe (Bratel 1991) and the WHO Technical Report 621 Gingival Index (Shaw 1991). The four studies using a subjective rating of gingival inflammation used the

terms "obvious gingivitis, decrease in gingivitis or absence of clinically observable gingivitis" (Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d).

Modifications to the gingival indices were made in several studies; the most common modification was in relation to the number of teeth and surfaces examined. Thirteen studies used six standard teeth on the following surfaces.

Surfaces assessed on 6 standard teeth for gingival inflammation	Studies
4 buccal and 2 lingual surfaces	Bildt 2010; Carr 1997; Mac Giolla Phadraig 2015; Phlypo 2016; Teitelbaum 2009
The Bentley 1995 modification; 2 randomly selected (by coin toss) quadrants (1 in the upper jaw, 1 in the lower jaw, contralateral)	Garcia-Carrillo 2016
4 surfaces per tooth	Bratel 1991
3 surfaces per tooth; buccal, mesial and lingual	Sauvetre 1995
2 surfaces per tooth; on the buccal and lingual surfaces	Christen 2007; Kaschke 2005
2 surfaces per tooth; on the mesial and distal surfaces of each tooth	Lange 1985; Lange 2000
The interdental papillae and the intervening gingiva on the buccal surfaces of all standing teeth	Swallow 1969
Other modifications	**Studies**
No probe used and only teeth that were visible to the examiner	Mac Giolla Phadraig 2015
If standard teeth were missing they were not substituted	Lange 2000

Only two studies (Shaw 1983; Shaw 1991) reported carrying out a periodontal pocket index assessment (WHO 1978) and only one of these, an NRS, reported the findings (Shaw 1991).

Plaque

Fourteen RCTs reported plaque as an outcome using a validated index. The indices used were Silness & Löe (Garcia-Carrillo 2016; Phlypo 2016; Sauvetre 1995; Shaw 1983; Swallow 1969), Green & Vermillion (Bildt 2010; Carr 1997; Lange 1985), Quigley-Hein (Christen 2007; Dôgan 2004; Kaschke 2005), Kobayashi & Ash (Albino 1979), the WHO Technical Report No 621 (Bickley 1990), Approximal Plaque Index (Christen 2007; Dôgan 2004; Kaschke 2005), and Shaw & Murray (Bickley 1990). One RCT used a subjective rating of oral hygiene describing the outcome

using the terms "worse," "same" or "better" (Kelner 1963).

Six NRS reported plaque as an outcome using a validated index; the indices used were Silness & Löe (Bratel 1991), Green & Vermillion (Glassman 2006; Teitelbaum 2009; Williams 1988), Ramfjord (Lange 2000) and the WHO Technical Report No 621 (Shaw 1991). A further five NRS used a subjective rating describing the outcome using the following terms: "excellent," "good," "fair," "poor" or "very poor" (Altabet 2003); "good," "fair," "poor" or "very poor" (Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d).

Four studies used more than one measure of plaque. Modifications to the indices were made in several studies, most commonly in relation to the number of teeth and surfaces examined. Sixteen

studies used six standard teeth on the following surfaces.

Surfaces assessed on 6 standard teeth for plaque levels	Studies
4 buccal and 2 lingual surfaces	Bickley 1990; Carr 1997; Glassman 2006; Mac Giolla Phadraig 2015; Phlypo 2016; Shaw 1983; Shaw 1991; Teitelbaum 2009; Williams 1988
The Bentley 1995 modification; 2 randomly selected (by coin toss) quadrants (1 in the upper jaw, 1 in the lower jaw, contralateral)	Garcia-Carrillo 2016
4 surfaces per tooth	Bratel 1991
3 surfaces per tooth; buccal, mesial and lingual	Sauvetre 1995
2 surfaces per tooth; on the buccal and lingual surfaces	Albino 1979; Bildt 2010
2 surfaces per tooth; on the mesial and distal surfaces of each tooth	Lange 1985; Lange 2000
Other modifications	Studies
No probe used and only teeth that were visible to the examiner	Mac Giolla Phadraig 2015
If standard teeth were missing they were not substituted	Lange 2000

Calculus

Four studies reported on calculus; three RCTs and one NRS. The indices used were: Green & Vermillion (Carr 1997; Garcia-Carrillo 2016) and the WHO Technical Report 621 (Bickley 1990 (assessed but not reported); Shaw 1991). All three studies that reported their findings used the six standard teeth. Two studies assessed four buccal and two lingual surfaces and one study assessed four surfaces per tooth (buccal, lingual, mesial and distal).

Oral assessment

Ferozali 2007 used a tool to assess the health of four elements; lips, oral mucosa, gingivae and plaque, which was a modification of the Beck Total Oral Assessment Tool. This study also measured a total bacteria count and a potentially pathogenic bacteria count. The following are the references for the clinical indices referred to in this section: Ainamo 1975; Beck 1993; Bentley 1995; Fleiss 1987; Greene 1960; Kobayashi 1964; Lange 1977; Lobene 1986; Löe 1967; Saxer 1975; Shaw 1977; WHO 1978.

Oral hygiene knowledge acquisition

Three RCTs assessed changes in oral healthcare knowledge of carers, all using multiple-choice questionnaires, two of which were specifically designed by the investigators for the intervention (Gonzalez 2013; Mac Giolla Phadraig 2015), and the third (Phlypo 2016) used the questionnaire designed by Mac Giolla Phadraig 2015. Two studies had 10 questions on oral health-related knowledge (Mac Giolla Phadraig 2015; Phlypo 2016), and one study had 20 basic oral hygiene questions (Gonzalez 2013). The Mac Giolla Phadraig 2015 questionnaire was reported as having been tested for reliability, validity, responsiveness and reproducibility and found to be acceptable. Gonzalez 2013 used a different questionnaire pre- and postintervention, with the same content but different wording; the authors sought expert advice to assess the content.

Changes in behaviour, attitude and self-efficacy

Two of the RCTs that assessed knowledge of carers also assessed changes in their behaviour, attitude, self-efficacy or a combination of these at the same time: the studies had four questions on behaviour and five each on attitude and self-efficacy (Mac Giolla

Phadraig 2015; Phlypo 2016). One RCT assessed changes in self-reported behaviour alone, using five questions (Olmos 2016). Four other NRS assessed behavioural changes in both carers and people with ID by monitoring of their behaviour using trained observers aided by specifically designed checklists (Bouter 1979; Glassman 2006; Jarman 1983; Kissel 1983). Reliability of the recorded observations was assessed by the study authors and was found to be acceptable in all four of these studies.

The methods used to assess changes in behaviour included: use of different methods of reinforcement by carers (Jarman 1983); assessing staff use of training methods when providing oral hygiene support (verbal instruction, physical guidance and reward) and participants' levels of self-initiation and their need for verbal instruction and physical guidance (Kissel 1983); the effect of training on carers and levels of feedback and support to them (Abramson 1972); behavioural methods used by carers to assist people with ID (Bouter 1979); the type of toothbrush used, the type of toothpaste used, the frequency of fluoride application, the timing of toothbrushing and duration of toothbrushing (Olmos 2016); carers' presence during toothbrushing (Glassman 2006); and the number of training sessions required for the toothbrushing skill to be performed without prompting (Snell 1989).

Indirect measures of behaviour change included measuring wear and tear on toothbrushes and a diary kept by the parents/staff of the participants' brushing frequency (Bratel 1991). Bildt 2010 assessed ease of toothbrush use by carers and toothbrushing frequency, as well as degree of resistance to toothbrushing by people with ID.

Quality of life changes or long-term, patient-centred outcomes

No studies measured quality of life changes or long-term, patient-centred outcomes as formal outcomes.

Dental caries levels

No studies measured dental caries levels.

Any unintended (positive or negative) effects of the interventions

Positive effects

No studies reported any positive unintended effects.

Negative (adverse) effects

Twenty-four studies did not report any unintended negative effects (or an intention to measure them from the beginning of the study). Ten studies investigated or reported negative unintended or adverse effects.

Subjective outcomes

Several subjective outcomes were reported narratively, in relation to possible benefits or harm, for example, interviews with people using an electric toothbrush to assess their experiences using it (Bratel 1991); feedback from carers on the toothbrushes used (Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d); carer questionnaire about experience of using a special three-headed toothbrush (Bildt 2010); social validation of participants' abilities with regard to oral hygiene completed by their carers and carers' perception of training (Glassman 2006); a staff acceptability questionnaire (Kissel 1983); and questions on participants' skill retention (Snell 1989).

COM-B system characteristics

Most studies did not define behavioural change theories in the interventions. Therefore, we assessed all of the studies using the COM-B system to identify the BCTs inherent in the interventions (Michie 2011). We considered how the interventions affected **C**apability (physical strength, skill or stamina or psychological strength, knowledge, skill or stamina), **O**pportunity (physical opportunity afforded by the environment or the social opportunity afforded by social factors such as cultural norms or social cues) and **M**otivation (reflective brain process; evaluation and plans or automatic brain processes; desires, impulses, inhibitions, etc.).

The element we identified most often was capability: 29 studies had the potential to change the capability of either participants (11 studies) or carers (eight studies) or both (10 studies), either on a physical level (11 studies) or on a physical and psychological level (18 studies). These interventions included a focus on training, modelling or enablement of the participant or carer in the skill of toothbrushing.

In relation to the element of opportunity, physical opportunity was the more common potential element identified (26 studies). These interventions included elements such as specific time being set aside for the toothbrushing routine, environmental restructuring such as providing different oral hygiene or other aids or changing the setting where the toothbrushing took place. The potential for social opportunity (e.g. cultural norms or social cues) to impact on behaviour was identified in seven studies, which were predominantly targeted at carers and involved monitoring of their behaviour.

Nineteen studies had the potential for reflective motivation and these tended to include some element of feedback in relation to behaviour or performance which was seen predominantly in the interventions targeting carers. No studies had the potential for the behaviour change to become automatic.

We determined that 16/34 studies had all three elements of capability, opportunity and motivation inherent in the intervention.

The behavioural change elements and intervention functions are detailed in the Characteristics of included studies table.

Stakeholder involvement

The involvement of stakeholders may impact on the success of an intervention and so it was felt important to this review to capture the nature of the stakeholder involvement in the interventions. Twenty-nine studies actively involved parents or carers of the participants in the intervention. Six studies involved both formal and non-formal carers, 22 studies involved formal carers only and one study used non-formal carers only. Three other studies were unclear if carers were involved. These studies were set in a school or day centre (Bickley 1990; Dôgan 2004; Sauvetre 1995). Two studies used a member of the research team to brush the participants' teeth (Swallow 1969; Williams 1988). Other stakeholders included administration staff, management staff, nursing or medical staff, speech and language therapists, an occupational therapist, a physical therapist and teachers. Eight studies reported no involvement of stakeholders, other than those directly involved in the research.

Twenty-six studies had dental professionals on the research team, 21 studies involved dentists or dental students, 16 studies involved dental hygienists or therapists, four studies involved dental nurses or assistants and one study involved an oral health promotor. The dental professionals were mainly involved in the initial oral hygiene instruction and the clinical measurements throughout the intervention. Seven studies indicated that the dental professional provided ongoing support during the intervention (Albino 1979; Bickley 1990; Glassman 2006; Sauvetre 1995; Shaw 1991; Swallow 1969; Williams 1988); one other study indicated that this support was offered but not if the offer was taken up (Mac Giolla Phadraig 2015).

Funding

Nine studies reported receiving funding from their institution or health service (Abramson 1972; Bratel 1991; Gonzalez 2013; Jarman 1983; Olmos 2016; Kissel 1983; Mac Giolla Phadraig 2015; Shaw 1991; Teitelbaum 2009). Sixteen studies did not report on funding. Eight studies reporting receiving some funding from dental companies; all funding was stated as relating to the supply of either the toothbrushes or toothpaste required for the study (Albino 1979; Bickley 1990; Dôgan 2004; Garcia-Carrillo 2016; Kelner 1963; Sauvetre 1995; Shaw 1991; Swallow 1969).

Excluded studies

Following full-text reading, we rejected 158 reports for the following reasons: not an eligible study design (75 studies), not an oral hygiene intervention (39 studies), not mechanical removal of plaque (16 studies), a complex intervention in which the oral hygiene component could not be appraised separately (11 studies) and not relating to a person with ID or their carer (17 studies). We excluded a further 20 reports after further consideration for the following reasons. We excluded two as only the title was available (Borglin 1969; Lopez 1994) and further five as only the abstract was available (Andrews 1990; Badra 1973; Ojeda 2010; Ribeiro 2011; Thornton 1991), and multiple efforts to contact the authors and source the full text were unsuccessful. A further three reports presented no data in the published reports or data were presented in a format that could not be used and attempts to contact the authors were unsuccessful (Brody 1975; Favell 1975; Meador 1979). The authors of three other reports with data in a format that could not be used were contacted but the data were no longer available (Gertenrich 1972; Lesmana 2014; Schmidt 1981). Two other reports were trial registers, one had been written up in a thesis but was unavailable and all attempts to contact the author were unsuccessful (ISRCTN10044161), and the authors of the second trial reported that the trial had not proceeded as yet, due to difficulties in recruiting participants (NCT03234231). One report was excluded as it was unclear if it met the inclusion criteria in relation to study design; all attempts to contact the authors were unsuccessful (Horner 1975). Three studies did not meet the required study design (Haran 2014; Kaschke 2008; Zaksek 2014). One of the authors of another study, with which might have had a subgroup of participants who may have been eligible for inclusion, confirmed that the study did not meet the study design criteria (Bui 2003) (see Characteristics of excluded studies table).

Two studies are awaiting classification (Akgun 2012; Birani 2008). We made contact with the authors as the theses for both are available, but, despite reminders, the information was not received before the deadline indicated for inclusion in this review.

Risk of bias in included studies

We assessed the RCTs and NRCTs for risk of bias using standardised risk of bias criteria (Higgins 2011a). We assessed the ITS and RM studies using the EPOC seven standard criteria (EPOC 2016) (Figure 1; Figure 2).

Of the 28 RCTs and NRCTs assessed, none were at overall low risk of bias. Eighteen were at overall high risk of bias (Albino 1979; Altabet 2003; Bickley 1990; Bratel 1991; Christen 2007; Dôgan 2004; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Kaschke 2005; Kelner 1963; Lange 1985; Lange 2000; Mac Giolla Phadraig 2015; Phlypo 2016; Shaw 1983; Williams 1988); the remaining 10 were at unclear risk of bias overall.

All of the ITS and RM studies were at high risk of bias overall (Abramson 1972; Bouter 1979; Glassman 2006; Jarman 1983; Kissel 1983; Snell 1989).

Allocation

Of the 19 RCTs included in this review, 11 were at low risk of bias in relation to random sequence generation (Albino 1979; Bickley 1990; Bildt 2010; Christen 2007; Ferozali 2007; Garcia-Carrillo 2016; Gonzalez 2013; Mac Giolla Phadraig 2015; Sauvetre 1995; Shaw 1983; Swallow 1969). These studies clearly indicated the method used for randomisation. A further 10 RCTs stated that the participants were randomised but gave no details of how this randomisation process was carried out. These studies were at unclear risk of bias. No RCTs were at high risk of bias. The allocation concealment rating for the RCTs was nine studies at low risk of bias and 10 studies were at unclear risk of bias.

The nine NRCTs were assessed using the RCT risk of bias criteria (Higgins 2011a). Six of these studies were at high risk of bias for random sequence generation as the participants were selected non-randomly or the participants were selected for particular groups; the remaining three studies were at unclear risk of bias as there was no reference to randomisation. One NRCT was at low risk of bias (Lange 2000); two NRCTs were at high risk of bias for allocation concealment as participants were either assigned to groups based on the date they attended or based on their need for assistance (Altabet 2003; Bratel 1991). The remaining six NRCTs were at unclear risk of bias for allocation concealment as there were no details in the reports in relation to this element.

Blinding

Four RCTs were at high risk of bias in relation to blinding of participants or personnel (or both): all four were cross-over trials (Christen 2007; Dôgan 2004; Kaschke 2005; Shaw 1983). We considered five RCTs to be at low risk as the control groups were asked to do something that was not usual care (Bildt 2010; Gonzalez 2013; Kelner 1963; Sauvetre 1995; Shaw 1991). The remaining 10 RCTs were at unclear risk of bias.

One NRCT was at high risk of bias in relation to blinding of participants or personnel (or both) (Williams 1988). Three NRCTs were at low risk of bias as some attempt was made to blind either the participants or personnel (Altabet 2003; Lange 2000; Teitelbaum 2009). The remaining five NRCTs were at unclear risk of bias for blinding of participants or personnel (or both) (Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d).

In relation to blinding of outcome assessors in the RCTs, 10 studies were at low risk of bias as the assessors were blinded to the group allocation (Bickley 1990; Bildt 2010; Christen 2007; Ferozali 2007; Garcia-Carrillo 2016; Kaschke 2005; Kelner 1963; Sauvetre 1995; Shaw 1983; Swallow 1969); seven studies were at unclear risk of bias as there were insufficient details provided in the reports in relation to blinding (Carr 1997; Dôgan 2004; Gonzalez 2013; Mac Giolla Phadraig 2015; Olmos 2016; Phlypo 2016; Shaw 1991); two studies were at high risk of bias as the assessors were not blinded to the group allocation (Albino 1979; Lange 1985). In the NRCTs, six studies were at low risk of bias as assessors were

blinded to the group allocation; the remaining three studies were at unclear risk of bias as no mention of blinding of assessors was reported (Bratel 1991; Teitelbaum 2009; Williams 1988).

Incomplete outcome data

Four RCTs were at high risk of bias in relation to incomplete outcome data as either there were high attrition rates with no explanation as to the reasons for the dropouts (Mac Giolla Phadraig 2015; Phlypo 2016; Shaw 1983) or dropouts were due to lack of participation by the participants (Albino 1979). Three studies were at unclear risk of bias as either there was insufficient detail in relation to the reason or number of dropouts (Dôgan 2004), or the reasons provided may have impacted on the outcomes: participants lost or broke the electric toothbrush (Carr 1997), or the participants were unable to following the training (Sauvetre 1995). The remaining 12 studies were at low risk of bias for incomplete outcome data. One NRCT was at unclear risk in relation to incomplete outcome data due to the lack of details provided (Gertenrich 1967b). The remaining eight NRCTs were at low risk of bias.

Selective reporting

Three RCTs were at high risk of bias in relation to selective reporting: one because the plaque index was modified during the intervention as it proved too difficult to complete (Albino 1979); two because all the outcomes outlined in the methodology were not reported (Bickley 1990; Kelner 1963). Fourteen studies were at unclear risk of bias as there was no protocol for the study but all listed outcomes were reported. Another study referred to mid-term data but they were not reported (Shaw 1983), and one study had a protocol but it appeared to have been completed retrospectively (Garcia-Carrillo 2016). No studies were at low risk of bias in relation to selective reporting.

All nine NRCTs were at unclear risk of bias for selective reporting as there was no protocol but all the expected outcomes reported in the methodology sections were reported as planned.

Other potential sources of bias

There were no other potential sources of bias.
Overall, there was a large element of 'unclear' risk of bias in many of the domains, reflecting the lack of detail provided in the published reports in relation to the methodology. This may be due to the large number of older studies included in this review. There were no studies at low risk of bias for the domain of selective reporting: many of the studies had no protocol and so were assessed at unclear risk of bias for this domain.

Risk of bias for interrupted time series and repeat measure studies

Three ITS studies (Glassman 2006; Jarman 1983; Kissel 1983) and three RM studies (Abramson 1972; Bouter 1979; Snell 1989) were assessed for risk of bias using the Effective Practice and Organisation of Care (EPOC) Group standards (EPOC 2016).

Was the intervention independent of other changes?

Of the six studies, two were independent of other changes (low risk) (Bouter 1979; Glassman 2006); three were unclear in relation to being independent of other changes as there was insufficient information (Abramson 1972; Kissel 1983; Snell 1989); and one was not independent (high risk), as the skill of toothbrushing was one of six other skills being taught at the same time (Jarman 1983).

Was the shape of the intervention effect prespecified?

All six ITS and RM studies had prespecified the shape of the intervention in relation to the methodology and expected outcomes (low risk).

Was the intervention unlikely to affect data collection?

The intervention in all six studies was unlikely to affect data collection (low risk).

Was knowledge of the allocated interventions adequately prevented during the study?

It was not possible to prevent knowledge of the allocated intervention in the six studies as the assessors in all cases were actively involved in the delivery of the intervention (high risk).

Were incomplete outcome data adequately addressed?

Incomplete data were explained in two studies and had no impact on the outcomes (Bouter 1979; Kissel 1983); there were no incomplete data in the other four studies (low risk).

Was the study free from selective outcome reporting?

Five studies were free from selective outcome reporting as all outcomes outlined in the methodology were reported (low risk). One study was unclear as it was difficult to extract the data from the figures provided (Glassman 2006).

Was the study free from other risks of bias?

No other risks of bias were identified.

Effects of interventions

See: **Summary of findings for the main comparison** Special manual toothbrush compared to conventional manual toothbrush for people with intellectual disabilities; **Summary of findings 2** Electric toothbrush compared to manual toothbrush for people with intellectual disabilities; **Summary of findings 3** Training of carers compared to no training of carers for people with intellectual disabilities; **Summary of findings 4** Oral hygiene training compared to no oral hygiene training for people with intellectual disabilities; **Summary of findings 5** Regularly scheduled dental visits and daily supervised toothbrushing compared to usual care for people with intellectual disabilities; **Summary of findings 6** Discussion of clinical photographs as oral hygiene motivators compared to no discussion for people with intellectual disabilities; **Summary of findings 7** Daily toothbrushing compared to twice-weekly or once-weekly toothbrushing for people with intellectual disabilities; **Summary of findings 8** Toothpaste with a plaque-disclosing agent compared to a conventional toothpaste for children with intellectual disabilities; **Summary of findings 9** Individualised care plans compared to usual care for people with intellectual disabilities

Comparison 1: special manual toothbrushes versus conventional manual toothbrushes for people with intellectual disabilities

Six RCTs compared a special manual toothbrush with a conventional toothbrush (Bildt 2010; Christen 2007; Dôgan 2004; Ferozali 2007; Kaschke 2005; Sauvetre 1995). Five studies used the three-headed Superbrush, while Ferozali 2007 used a single-use suction toothbrush. One NRS evaluated a toothbrush with curved bristles (the Collis Curve) (Williams 1988). See Summary of findings for the main comparison.

1.1 Gingival inflammation (short term)

Three RCTs, with 169 participants, compared using a special manual toothbrush with using a conventional manual toothbrush on gingival inflammation over two and three weeks (Christen 2007; Kaschke 2005; Sauvetre 1995; Table 1). Two studies were three-armed cross-over trials; the third arm compared an electric toothbrush (reported separately). The special brush used in all three studies was the Superbrush. The parallel-group study showed no evidence of a difference between the two toothbrushes for people with ID in the short term (MD -0.10, 95% CI -0.77 to 0.57; Analysis 1.1; Sauvetre 1995). The two cross-over RCTs also reported no difference between the toothbrushes. The level of participant ID was mixed or unclear. The certainty of the evidence was low.

1.2 Gingival inflammation (medium term)

One RCT, with 18 participants, compared the effect of carers using a special manual toothbrush (Superbrush) to brush the teeth of people with moderate-to-profound ID compared with a conventional manual toothbrush on gingival inflammation levels over four months (Bildt 2010; Table 2). It showed a large effect size in favour of the special manual toothbrush for adults with ID in the medium term (four months) when the toothbrushing was carried out by carers (MD -12.40, 95% CI -24.31 to -0.49; Analysis 1.2). The certainty of the evidence was very low.

1.3 Plaque (short term)

Four RCTs, with 189 participants aged between four and 79 years, compared using a special manual toothbrush with using a conventional manual toothbrush on plaque levels over periods of one, two and three weeks (Christen 2007; Dôgan 2004; Kaschke 2005; Sauvetre 1995). The special brush used in all four studies was the Superbrush. Three studies were three-armed cross-over trials; the third arm compared an electric toothbrush (reported separately) (Table 3).

One parallel-group RCT measured plaque at 21 days and found no evidence that either toothbrush was better in the short term (MD 0.20, 95% CI -0.45 to 0.85; 25 participants; Analysis 1.3; Sauvetre 1995). The level of ID of the participants was unclear in this study. One cross-over RCT, with participants who had mixed levels of ID, reached the same conclusion when measuring plaque at two weeks (Christen 2007). Some evidence favouring the special manual toothbrush was found in two RCTs: in Dôgan 2004, which measured plaque at one week in participants with mild ID, and in Kaschke 2005, a crossover study of participants with mixed levels of ID that measured plaque at two weeks. The certainty of the evidence was very low.

1.4 Plaque (medium term)

One RCT, with 18 participants with moderate to severe ID, compared the effect of formal carers using a special manual toothbrush (Superbrush) to brush the teeth of people with ID compared with a conventional manual toothbrush on plaque levels, over four months (Bildt 2010; Table 4). The baseline scores were not equal and the assessors were not calibrated introducing an element of indirectness in relation to certainty of the evidence. This study suggested there may be a greater reduction in plaque with the special manual toothbrush (Superbrush) for people with ID in the medium term, when the toothbrushing was carried out by formal carers; however, the result was also compatible with no difference between the interventions (MD -0.44, 95% CI -0.93 to 0.05; Analysis 1.4). The certainty of the evidence was very low. One NRS found no evidence of the superiority of either a special (Collis Curve toothbrush) or a conventional manual toothbrush (Williams 1988; Table 5). Participants in this study had profound ID and their teeth were brushed by a student dental assistant.

1.5 Oral health assessment and bacteria levels (medium term)

One RCT, with 22 participants, compared using a special manual toothbrush (single-use suction toothbrush with a therapeutic chemical agent) with using a conventional manual toothbrush (and the same therapeutic chemical agent) on general oral health and oral bacteria levels over 90 days (Ferozali 2007). All the participants had a profound level of ID and had their teeth brushed by a carer. None of the assessments provided evidence of one toothbrush being superior to the other (Analysis 1.5; Table 6). The certainty of the evidence was very low.

1.6 Changes in behaviour, attitude and self-efficacy

One RCT compared the effect of carers using a special manual toothbrush (Superbrush) to brush the teeth of people with moderate-to-profound ID compared with using a conventional manual toothbrush over four months (Bildt 2010; Table 7). The certainty of the evidence was very low. The analyses of the carer elements in this single trial found no significant difference between toothbrushes for the carer experience when handling the toothbrush and when brushing the teeth of people with ID in the medium term (handling the toothbrush: MD 0.50, 95% CI -0.35 to 1.35; brushing the teeth: MD 0.70, 95% CI -0.15 to 1.55). There was no evidence of a difference between the toothbrushes in terms of frequency of brushing by the carer (MD 0.20, 95% CI -2.13 to 2.53; Analysis 1.6). A meta-analysis of the resistance of people with ID to toothbrushing found no evidence of a significant difference between the toothbrushes (MD -1.70, 95% CI -4.90 to 1.50; Analysis 1.7).

1.7 Adverse effects

Bildt 2010, and Christen 2007 reported that the size of the three-headed toothbrush caused problems when first used or for people with limited mouth opening. Ferozali 2007 considered the allergy potential of the chemical agents being used on the toothbrushes at the outset of the study and reported there were no allergic reactions. The other studies did not report any adverse effects.

Comparison 2: electric toothbrushes versus manual toothbrushes for people with intellectual disabilities

Eight RCTs (Carr 1997; Christen 2007; Dôgan 2004; Garcia-Carrillo 2016; Kaschke 2005; Kelner 1963; Shaw 1983; Swallow 1969), and five NRSs (Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d) compared electric with manual toothbrushes. See Summary of findings 2.

2.1 Gingival inflammation (short term)

Four RCTs, with 270 participants, compared using an electric toothbrush with using a manual toothbrush on gingival inflammation, over two, three or four weeks (Christen 2007; Kaschke 2005; Shaw 1983; Swallow 1969). The level of participant ID was mixed. Three studies were cross-over trials, two included a third arm, which also compared a special manual toothbrush (reported earlier).

There was no strong evidence of a difference between the electric and manual toothbrushes for levels of gingival inflammation short term in any of the studies (Table 8). None of the studies presented data in a format that could be included in a meta-analysis. The certainty of the evidence was low.

2.2 Gingival inflammation (medium term)

Three RCTs, two of which were cluster RCTs, with 220 participants, compared using an electric toothbrush with using a manual toothbrush on gingival inflammation levels over periods of three, four, six and 12 months (Carr 1997; Garcia-Carrillo 2016; Kelner 1963; Table 9).

We combined the cluster RCTs in a meta-analysis, which showed no evidence of a difference in gingival inflammation levels between toothbrushes at six months (MD 0.02, 95% CI -0.06 to 0.09; 120 participants (10 clusters); low heterogeneity; Chi² = 0.35, df = 1 (P = 0.56); I² = 0%; Analysis 2.1). The certainty of the evidence was moderate. An RCT not included in the meta-analysis (Kelner 1963), which used a subjective assessment of gingival health and was at high risk of reporting bias, suggested a greater improvement for the electric toothbrush (53% versus 31% improvement in gingival health).

2.3 NRCT: gingival inflammation (short, medium and long term)

Five NRS, with 212 participants, compared using an electric toothbrush with using a manual toothbrush on gingival inflammation levels over four weeks to 16 months (Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d). There was no evidence of a difference between brushes in one study evaluating gingival inflammation at four weeks (Table 10). When measured at time points between eight and 34 weeks, the studies varied but provided no strong evidence of a difference in levels of gingival inflammation between the electric and manual toothbrushes (Table 11). In the long term, one NRS with participants with moderate levels of ID showed no evidence of a difference for gingival inflammation at 16 months (MD 0.00, 95% CI -0.15 to 0.15; Analysis 2.3; Table 12). The certainty of the evidence was very low. The influence of other issues such as the level of ID, who was doing the brushing and the levels of assistance provided confounded the findings.

2.4 Plaque (short term)

Four RCTs, with 270 participants, compared using an electric toothbrush with using a manual toothbrush, for people with ID, on plaque levels over one, two or four weeks (Christen 2007; Dôgan 2004; Kaschke 2005; Shaw 1983; Table 13). All of the studies were cross-over trials, three included a third arm that compared a special manual toothbrush (reported above). None of the studies presented data in a format that could be included in a meta-analysis. Two studies showed evidence in favour of the electric toothbrush short term; the other two studies showed no evidence of a difference between the two toothbrushes. The benefit of using an electric toothbrush versus a conventional manual toothbrush short term was unclear; the certainty of the evidence was very low.

2.5 Plaque (medium term)

Three RCTs (two of which were cluster RCTs), with 220 participants, compared using an electric toothbrush with using a manual toothbrush on plaque levels for people with ID, over three, four, six and 12 months (Carr 1997; Garcia-Carrillo 2016; Kelner 1963; Table 14).

Two cluster RCTs, with 120 participants, were included in a meta-analysis and did not show clear evidence of a difference between electric and manual toothbrushes at six months for people with mild or moderate ID in one study and unclear levels of ID in the other (SMD 0.29, 95% CI -0.07 to 0.65; Analysis 2.2). The certainty of the evidence was low. The RCT not included in the meta-analysis (Kelner 1963), which used a subjective assessment of oral hygiene and was at high risk of reporting bias, suggested a greater improvement in oral hygiene for the electric toothbrush (27% versus 18% improvement in oral hygiene).

2.6 NRCT: plaque (short, medium and long term)

Five NRS, with 193 participants, compared using an electric toothbrush with using a manual toothbrush, for people with ID, on plaque levels over four weeks to 16 months (Bratel 1991; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Table 15; Table 16; Table 17).

The data provided at the longest time points by the five studies (ranging between eight and 34 weeks) were included in a meta-analysis. There was no evidence of a difference between the electric and manual toothbrushes in the medium term (SMD 0.04, 95% CI -0.38 to 0.46; Analysis 2.4; moderate heterogeneity; Tau² = 0.10; Chi² = 6.97, df = 4 (P = 0.14); I² = 43%). The certainty of the evidence was very low.

2.7 Calculus (medium term)

Three RCTs, two of which were cluster RCTs, with 220 participants, compared using an electric toothbrush with using a manual toothbrush, for people with ID, on calculus levels over a periods of

four, six and 12 months (Carr 1997; Garcia-Carrillo 2016; Kelner 1963; Table 18).

Two cluster RCTs, with 120 participants (10 clusters), were included in a meta-analysis and showed no evidence of a difference for calculus levels between toothbrushes at six months (SMD -0.04, 95% CI -0.40 to 0.32; Analysis 2.5; low-to-moderate heterogeneity; Chi² = 1.44, df = 1 (P = 0.23); I² = 30%). The other RCT found in favour of the electric toothbrush. The certainty of the evidence was low.

2.8 Changes in behaviour, attitude and self-efficacy

One NRS assessed participant and carer experiences via a questionnaire, and found no evidence of a difference between toothbrushes for ease of use (question: "Do you find it difficult to brush your patient's teeth?") (Bratel 1991). The study reported that 10/12 people with ID using the electric toothbrush reported a preference for it, finding the electric toothbrush easier to use and to have "better cleaning properties to the manual toothbrush" (Table 19). Answers to the other questions were reported narratively and only for participants in the intervention group.

2.9 Adverse effects

The adverse effects reported included discomfort when brushing, difficulty controlling the force and position of the electric toothbrush, and the electric toothbrush being out of order (Bratel 1991), and participants being frightened when the electric toothbrush was first used (Christen 2007; Gertenrich 1967b; Kaschke 2005). Carr 1997 reported participants being dismissed from the study, but gave no clear reason. Garcia-Carrillo 2016 looked for adverse effects by regular visual inspection and there were none. The other studies did not report adverse effects.

Comparison 3: oral hygiene care training versus no oral hygiene care training or a placebo training session for carers of people with intellectual disabilities

Four RCTs and three NRSs evaluated oral hygiene care training for carers of people with ID. See Summary of findings 3.

3.1 Gingival inflammation (medium term)

Two RCTs, with 99 participants, compared the effect of oral hygiene care training of formal carers with no training of formal carers, on the levels of gingival inflammation of the people with ID for whom they cared (people with mild-to-profound levels of ID in one study and severe-to-profound levels in the other study), over periods of eight weeks (Phlypo 2016) and six to nine months (Mac Giolla Phadraig 2015) (Table 20). Meta-analysis of these two studies showed no evidence of a difference in the medium term

(MD -0.09, 95% CI -0.63 to 0.45; Analysis 3.1; high heterogeneity; Chi² = 3.16, df = 1 (P = 0.08); I² = 68%). The certainty of the evidence was low.

3.2 Plaque (medium term)

Two RCTs, with 99 participants, living in residential settings, compared the effect of oral hygiene care training of formal carers with no training of formal carers, on the plaque levels of the people with ID for whom they cared (people with mild-to-profound levels of ID in one study and severe-to-profound levels in the other study), over periods of eight weeks (Phlypo 2016) and six to nine months (Mac Giolla Phadraig 2015) (Table 21). Meta-analysis of these two studies showed little or no difference between the groups in the medium term (MD -0.07, 95% CI -0.26 to 0.13; Analysis 3.2). The certainty of the evidence was low.

3.3 NRCT: plaque (short and medium term)

One NRCT, with 34 participants, living in a residential setting, compared the effect of oral hygiene care training of formal carers with no training of formal carers, on the plaque levels of the people with moderate-to-profound ID for whom they cared, over 21 days (Lange 2000; Table 22). Training carers resulted in reduced plaque levels in people with ID when compared to carers who were not trained (MD -0.69, 95% CI -0.97 to -0.41; Analysis 3.3). The NRCT reported that carers who had training with accountability showed strong evidence of lower plaque levels than the group of carers without accountability (MD -1.89, 95% CI -2.12 to -1.66). The certainty of the evidence was low.

One ITS study with 11 participants compared the effect of oral hygiene care training of formal carers with no training of formal carers, on plaque levels of the people with ID for whom they cared, over five months (Glassman 2006). Training of carers in oral hygiene care for people with ID may have had a positive impact on the plaque levels of the people with ID for whom they cared in the medium term (five months) if the carers were supported and encouraged to apply the training in practice subsequently (Table 23). Meta-analysis was not possible for this study due to the format of the data presented. The certainty of the evidence was very low.

3.4 and 3.5 Knowledge of carers (short and medium term)

Three RCTs, with 213 participants (156 of whom were in 35 clusters), compared oral hygiene care training for carers of people with ID, at follow-up of one day, eight weeks, and six to 11 months, with no training for carers or a placebo training session, on their oral care knowledge (Gonzalez 2013; Mac Giolla Phadraig 2015; Phlypo 2016; Table 24).

One RCT found no evidence that a 90-minute training session increased carer oral health knowledge in the short term (MD 0.59, 95% CI -0.80 to 1.98; Analysis 3.4). The two RCTs measuring outcomes in the medium term, which used the same assessment

questionnaire and had no heterogeneity, showed a moderate effect on oral health knowledge in favour of training formal carers (MD 0.69, 95% CI 0.31 to 1.06; Analysis 3.5). The certainty of the evidence was low.

3.6 Behaviour, attitude and self-efficacy of carers (short and medium term)

Two RCTs, one of which was a cluster RCT, with 189 formal carer participants compared the effect of oral hygiene care training for carers with no training of carers on self-reported changes in behaviour, attitude and self-efficacy together, over eight weeks (Phlypo 2016) and six to 11 months (Mac Giolla Phadraig 2015). The two studies were combined in a meta-analysis and showed no evidence of a difference (MD 0.15, 95% CI -0.80 to 1.10; moderate heterogeneity; Chi² = 2.50, df = 1 (P = 0.11); I² = 60%; Analysis 3.6; Table 25). The certainty of the evidence was very low.

One RCT, with 193 formal carer participants, compared the effect of oral hygiene care training for carers versus no training, on behaviour only, over four weeks, on five specific self-reported oral care behaviours (Olmos 2016; Table 26). The study reported strong evidence of positive differences for all five behaviours in the intervention group from baseline (P < 0.01; no mean or SD provided; % data only); there was no strong evidence of positive differences in the control group. Meta-analysis was not possible due to the format of the data.

Two ITS studies with 15 formal carer participants examined the effect of oral hygiene care training of carers on their oral hygiene care skills and behaviour as well as the behaviour of the people with ID for whom they cared (Glassman 2006; Kissel 1983; Table 27). One of these studies reported general increases in carers' use of training, a reduction in the level of assistance required and an "upward trend" in the level of self-initiated steps in the tooth-brushing routine for the people with ID (Kissel 1983). The other study reported an increase in the caregivers' presence during the toothbrushing session, an increase in the seconds spent brushing by the people with ID and a very slight increase in the aptitude of the person with ID in relation to toothbrushing (Glassman 2006). Meta-analysis was not possible for these studies due to the format of the data presented. The certainty of the evidence was very low.

3.7 Adverse effects

Gonzalez 2013 assessed stress and fatigue following carer completion of a questionnaire, and found there was none. The other studies did not report adverse effects.

Comparison 4: oral hygiene training versus no oral hygiene training for people with intellectual disabilities

Two RCTs and four NRSs assessed oral hygiene training for people with ID. See Summary of findings 4.

4.1 Gingival inflammation (short term)

One RCT, with 10 participants, compared oral hygiene training for people with ID with no training, on gingival inflammation, over a six to seven weeks (Lange 1985). It found no evidence of a reduction in gingival inflammation due to training (MD -0.28, 95% CI -0.90 to 0.34; Analysis 4.1; Table 28). The certainty of the evidence was low.

4.2 Plaque (short term)

Two RCTs, with 36 participants, compared oral hygiene training for people with ID with no training on plaque levels over five to seven weeks (Albino 1979; Lange 1985; Table 29). One study showed a moderate effect size on plaque levels in favour of oral hygiene training of people with ID in the short term (MD -0.47, 95% CI -0.92 to -0.02; Analysis 4.2). The certainty of the evidence was low.

4.3 NRCT: behaviour (medium and long term)

Four ITS studies, with 59 participants, examined oral hygiene training for people with ID on their toothbrushing behaviour over periods of 100 days, 30 weeks and 19 months (Bouter 1979; Jarman 1983; Snell 1989). One study was unclear in relation to the duration of the intervention (Abramson 1972; Table 30). Oral hygiene training of people with ID may have impacted on their toothbrushing behaviour but it was unclear how this would impact on their oral health. Meta-analysis was not possible due to the format of the data presented. The certainty of the evidence was very low.

4.4 Adverse effects

Bouter 1979 reported one participant had nausea (the researchers considered it to be a delaying tactic by the participant), and Snell 1989 reported participants displaying sensitivity to mouths being held open. The other studies did not report any adverse events (Abramson 1972; Albino 1979; Jarman 1983; Lange 1985).

Comparison 5: scheduled dental recall intervals (1, 3 or 6 months) plus daily supervised toothbrushing versus usual care for people with intellectual disabilities

One cluster-RCT, with 304 participants, compared the benefit of regular dental recalls plus daily supervised toothbrushing versus no supervision or planned dental professional intervention, for people with ID, on plaque, gingival inflammation, gingival bleeding and calculus over three, six, 12, 18 and 24 months (Shaw 1991). The

recall intervals were 1-, 3- and 6- monthly: the 1-and 3-monthly recalls involved reinforcement of oral hygiene and a professional prophylaxis; the 6-monthly recall involved reinforcement of oral hygiene only. The findings at 24 months are reported here; at earlier timepoints, the number of participants was not reported (Table 31; Table 32; Table 33; Table 34). The certainty of the evidence for all reported outcomes was low. See Summary of findings 5.

5.1 Gingival pocketing (long term)

Meta-analysis at 24 months showed effect sizes for the Code 1 gingival pockets were moderate in favour of regular dental recalls and supervised toothbrushing over usual care (1-monthly: MD -0.60, 95% CI -0.97 to -0.23; 3-monthly: MD -0.50, 95% CI -0.85 to -0.15; 6-monthly: MD -0.40, 95% CI -0.76 to -0.04; Analysis 5.1).

5.2 Gingival bleeding (long term)

There was no evidence of a difference between regularly scheduled visits and supervised toothbrushing versus usual care for gingival bleeding at 24 months (1-monthly: MD -0.20, 95% CI -0.86 to 0.46; 3-monthly: MD -0.10, 95% CI -0.73 to 0.53; 6-monthly: MD 0.20, 95% CI -0.38 to 0.78; Analysis 5.2).

5.3 Plaque (long term)

Meta-analysis of data showed the effect size for plaque levels at 24 months was large in favour of regular dental recall intervals and supervised toothbrushing (1-monthly: MD -0.70, 95% CI -1.30 to -0.10; 3-monthly: MD -0.80, 95% CI -1.38 to -0.22; 6-monthly: MD -0.70, 95% CI -1.22 to -0.18; Analysis 5.3).

5.4 Calculus (long term)

The effect size at 24 months for calculus levels was large in favour of regular dental recalls at one- and three-monthly intervals (1-monthly: MD -2.00, 95% CI -2.64 to -1.36; 3-monthly: MD -1.40, 95% CI -2.04 to -0.76), but the difference was not seen in the six-monthly interval group, which only received a scale and polish at baseline (MD -0.10, 95% CI -0.72 to 0.52; Analysis 5.4).

5.5 Caries

Although the study set out to measure caries, no results were reported.

5.6 Adverse effects

None reported.

Comparison 6: discussion of individual clinical photographs as a toothbrushing motivator versus no discussion of clinical photographs for people with intellectual disabilities

One RCT, with 29 participants, showed people with ID photographs of their dental plaque shown up by the disclosing agent, taken at monthly oral hygiene sessions during the intervention, and discussed these with the participants in the intervention group over six months (Bickley 1990). Both groups received general oral hygiene instruction. See Summary of findings 6.

6.1 Plaque (medium term)

Meta-analysis showed no evidence of a difference in plaque levels between intervention and control (MD -0.10, 95% CI -1.85 to 1.65), or in the extrinsic stain score (MD -2.60, 95% CI -19.45 to 14.25; Analysis 6.1; Table 35). The certainty of the evidence was very low.

6.2 Adverse effects

None reported.

Comparison 7: daily, twice-weekly and once-weekly frequencies of toothbrushing versus usual care for people with intellectual disabilities

One RCT, with 80 participants, compared the frequency of brushing over 21 days on gingival inflammation (Swallow 1969). Daily brushing, carried out by dental students, was compared to twice weekly, once weekly or usual care. This study also compared the use of an electric toothbrush and a manual toothbrush (reported earlier). See Summary of findings 7.

7.1 Gingival inflammation (short term)

For people with ID, who had their teeth brushed by a dental student, the more frequently the teeth were brushed the greater the reduction in gingival inflammation in the short term (21 days; Table 36). The certainty of the evidence was low.

7.2 Adverse effects

None reported.

Comparison 8: use of a toothpaste with a plaque-disclosing agent versus a conventional toothpaste for people with intellectual disabilities

One non-randomised, two-armed cross-over trial, with 40 participants aged 7 to 13 years with Down Syndrome, compared using a

toothpaste containing a plaque-disclosing agent with using a conventional toothpaste on plaque and gingival inflammation levels over 10 days (Teitelbaum 2009). See Summary of findings 8.

8.1 Plaque and gingival inflammation (short term)

The toothpaste containing a plaque-disclosing agent when brushing may have reduced plaque and gingival inflammation in the short term (10 days) (Table 37; Table 38). The certainty of the evidence was very low.

8.2 Adverse effects

The study tested for an allergic reaction to any tested chemical agent; no adverse effects were reported.

Comparison 9: individualised oral care plan versus usual care (according to guidelines) for people with intellectual disabilities

One NRCT, with 79 participants, compared an individualised oral care plan with usual care, on plaque levels, over 12 months (Altabet 2003; Table 39). See Summary of findings 9.

9.1 Plaque (medium term)

An individualised oral care plan may have reduced plaque levels for people with ID over 12 months. The certainty of the evidence was very low.

9.2 Adverse effects

None reported.

ADDITIONAL SUMMARY OF FINDINGS [Explanation]

Electric toothbrush compared to manual toothbrush for people with ID

Population: children and adults with mixed levels of ID
Setting: home, residential, day care, school, mixed or not specified
Intervention: electric toothbrush (self, carer or carer-assisted brushing)
Comparison: manual toothbrush (self, carer or carer-assisted brushing)

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with manual toothbrush	**Risk with electric toothbrush**				
Gingival inflammation short term (< 6 weeks) assessed with: assorted gingival indices Scale: 0-4 (lower score means less inflammation) Follow-up: 2-4 weeks	-	-	-	252 (4 RCTs)	⊕⊕◯◯ **Low**[a]	Four studies showed no significant differences between toothbrushes for gingival inflammation in the short term. Data from the 4 studies could not be combined in a meta-analysis.[1]
Gingival inflammation medium term (6 weeks to 12 months) assessed with: assorted gingival indices Scale: 0-3 (lower score means less inflammation) Follow-up: mean 6 months	Mean gingival inflammation medium term ranged from 1.24 to 1.9	MD 0.02 higher (0.06 lower to 0.09 higher)	-	120 (2 RCTs)	⊕⊕⊕◯ **Moderate**[b]	There was little to no difference between toothbrushes for gingival inflammation medium term. Another RCT (100 participants) showed findings in favour of the electric toothbrush (53% versus 31% improvement), but it used a more subjective assessment of GI.[2]

Plaque short term (< 6 weeks) assessed with: assorted plaque indices Scale: 0-5 (lower score means less plaque) Follow-up: 1-4 weeks	-	-	-	247 (4 RCTs)	⊕○○○ **Very low**[c]	We were uncertain about the effect of using either toothbrush on plaque short term. None of the studies presented data that could be included in a meta-analysis. 2 studies (69 participants) showed some benefit in favour of the electric toothbrush; 2 studies (178 participants) showed no difference between the two toothbrushes.[3]
Plaque medium term (6 weeks to 12 months) assessed with: assorted plaque indices Scale: 0-3 (lower score means less plaque) Follow-up: mean 6 months	Mean plaque medium term ranged from 1.12 to 1.55	SMD 0.29 higher (0.07 lower to 0.65 higher)	-	120 (2 RCTs)	⊕⊕○○ **Low**[d]	There was no clear difference between the toothbrushes for plaque medium term. 1 RCT (100 participants) not included in the meta-analysis, which used a subjective assessment of oral hygiene, showed an improvement in favour of the electric toothbrush.[4]
Quality of life	Not assessed					No studies assessed quality of life changes formally, although some made comments in the results or discussion sections of the re-

		ports
Dental caries	Not assessed	-
Adverse effects	Seven studies did not assess or report adverse effects and one reported no adverse effects. 1 NRS reported discomfort when brushing, difficulty controlling the force and position of the electric toothbrush, and the electric toothbrush being out of order; 2 RCTs and 1 NRS reported participants being frightened when the electric toothbrush was first used. 1 RCT reported participants being dismissed from the study, but no clear reason was provided	-

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **ID:** intellectual disability; **MD:** mean difference; **NRS:** non-randomised study; **RCT:** randomised controlled trial; **SD:** standard deviation; **SMD:** standardised mean difference.

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a] Downgraded two levels due to study design as three studies at high risk of bias (blinding of participants and personnel was not possible in three of the studies; one study also had incomplete outcome data).

[b] Downgraded one level due to study design as studies at unclear risk of bias.

[c] Downgraded two levels for study design and one level for heterogeneity: three studies at high risk of bias (blinding of participants and personnel was not possible in three of the studies), and findings inconsistent between studies.

[d] Downgraded one level for study design and one level for imprecision: studies at unclear risk of bias and result imprecise.

[1] One NRS (23 participants) similarly found no difference between toothbrushes for gingival inflammation in the short term.

[2] Four NRS (144 participants) had inconsistent findings at 5 to 9 months for gingival inflammation in the medium term; data not suitable for meta-analysis. 1 NRS (23 participants) found no effect at 16 months (MD 0.00, 95% CI -0.15 to 0.15).

[3] One NRS (23 participants) found no difference between toothbrushes for plaque in the short term.

[4] Five NRS (173 participants) found broadly similar results to the meta-analysis, showing little or no effect on plaque in the medium term.

Training of carers compared to no training of carers for people with ID

Population: people with mixed levels of ID (age range unclear)
Setting: residential
Intervention: training of carers
Comparison: no training of carers

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no carer training	**Risk with carer training**				
Gingival inflammation short term (< 6 weeks)	Not assessed					-
Gingival inflammation medium term (6 weeks to 12 months) assessed with: Modified Silness & Löe Gingival Index Scale: 0-3 (lower score means less inflammation) Follow-up: 8 weeks to 9 months	Mean gingival inflammation medium term ranged from 1.2 to 2.47	MD 0.09 lower (0.63 lower to 0.45 higher)	-	99 (2 RCTs)	⊕⊕◯◯ **Low**^{a,b}	Training of carers may not have made a difference to gingival inflammation. Findings for the 2 studies were inconsistent
Plaque short term (< 6 weeks)	Not assessed					-
Plaque medium term (6 weeks to 12 months) assessed with: Modified Silness & Löe Plaque Index Scale: 0-3 (lower score	Mean plaque medium term ranged from 1.4 to 1.89	MD 0.07 lower (0.26 lower to 0.13 higher)	-	99 (2 RCTs)	⊕⊕◯◯ **Low**^{a,c}	Training of carers may not have reduced the plaque levels for people with ID medium term.[1]

means less plaque) Follow-up: 8 weeks to 9 months					
Knowledge medium term (6 weeks to 12 months) assessed with: questionnaire Scale 0-10 (higher score means increased knowledge) Follow-up: 8 weeks to 11 months	Mean knowledge medium term ranged from 6.8 to 7.86	MD 0.69 higher (0.31 higher to 1.06 higher)	-	189 (2 RCTs)	⊕⊕◯◯ **Low**[a,d]	Training of carers may have resulted in a moderate increase in oral healthcare knowledge medium term. 1 RCT (24 participants) not included in the meta-analysis found no clear difference between groups
Behaviour, attitude and self-efficacy (BAS) medium term (6 weeks to 12 months) assessed with: questionnaire Scale: 0-14 (higher score means improved BAS) Follow-up: 8 weeks to 11 months	Mean BAS ranged from 4.7 to 5.42	MD 0.15 higher (0.80 lower to 1.10 higher)	-	189 (2 RCTs)	⊕◯◯◯ **Very low**[a,b,d]	Training of carers may not have an effect on their BAS in the medium term In the short term, 1 RCT (193 participants) assessed behaviour and reported a strong benefit for training.[2]
Quality of life	Not assessed					No studies formally reported quality of life measures, though some studies commented on quality of life issues in the discussion and conclusion section of the reports
Dental caries	Not assessed					-

Adverse effects	1 RCT reported there were no adverse effects. The other studies did not report adverse effects	-

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

BAS: behaviour, attitude and self-efficacy; **CI:** confidence interval; **ID:** intellectual disability; **ITS:** interrupted time series; **MD:** mean difference; **NRCT:** non-randomised controlled trial; **NRS:** non-randomised study; **RCT:** randomised controlled trial; **SD:** standard deviation.

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a] Downgraded one level due to study design as studies at high risk of bias (one study was a cluster RCT).
[b] Downgraded one level due to heterogeneity as findings were inconsistent between studies.
[c] Downgraded one level due to study design as index was modified to an extent that it may have impacted on the results.
[d] Downgraded one level due to study design as carer outcomes had high levels of attrition in both studies.
[1] One NRCT (34 participants) found plaque levels of people with ID were reduced after training of their carers, short term, particularly if carers were made accountable for their performance. 1 ITS (11 participants) found broadly consistent findings to the NRCT in the medium term.
[2] Two NRS (15 participants) assessing the behaviour of the carers and people with ID showed evidence in favour of training for all outcomes assessed.

Oral hygiene training compared to no oral hygiene training for people with ID

Population: children and adults with mild to profound ID
Setting: residential or school
Intervention: oral hygiene training (toothbrushing routine)
Comparison: no oral hygiene training

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no oral hygiene training	**Risk with oral hygiene training**				
Gingival inflammation short term (< 6 weeks) assessed with: Silness & Löe Gingival Index Scale: 0-3 (lower score means less gingival inflammation) Follow-up: 6-7 weeks	The mean gingival inflammation short term was 1.26 (SD 0.46)	MD 0.28 lower (0.90 lower to 0.34 higher)	-	10 (1 RCT)	⊕◯◯◯ **Very low**[a]	There was no evidence of a difference between the groups in the short term.[1]
Gingival inflammation medium term (6 weeks to 12 months)	Not assessed					-
Plaque short term (< 6 weeks) assessed with: Green & Vermillion Plaque Index Scale: 0-3 (lower score means less plaque) Follow-up: 6-7 weeks	The mean plaque short term was 0.82 (0.24)	MD 0.47 lower (0.92 lower to 0.02 lower)	-	10 (1 RCT)	⊕◯◯◯ **Very low**[a]	Training of people with ID may have resulted in a moderate reduction in plaque short term. An RCT (26 participants) not included in the meta-analysis had similar findings.[1]

Plaque medium term (6 weeks to 12 months)	Not assessed		-
Knowledge	Not assessed		-
Behaviour, attitude and self-efficacy medium and long term (6 weeks to > 12 months) Assessed with: steps achieved in a tooth-brushing routine Follow-up: 100 days to 19 months	Results were not presented in a format that could be included in a meta-analysis	59 (4 NRS) ⊕○○○ **Very low**[b]	3 NRS (56 participants) reported an increase in toothbrushing after training; 1 NRS (3 participants) had mixed results
Quality of life	Not assessed		-
Dental caries	Not assessed		-
Adverse effects	2 RCTs and 2 NRS reported no adverse effects. In 1 NRS, 1 participant had nausea (considered a delaying tactic by study investigators), and in another NRS, 2 participants showed sensitivity to having their mouths held open		-

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **ID:** intellectual disability; **MD:** mean difference; **NRS:** non-randomised study; **RCT:** randomised controlled trial; **SD:** standard deviation.

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded two levels for imprecision and one for study design: based on the findings of one study at unclear risk of bias with only 10 participants and wide confidence intervals.

[b]Downgraded three levels due to study design: based on NRS, with no control groups and all studies were at high risk of bias.

[1]Four NRS (59 participants) assessed toothbrushing behaviour following skills training of people with ID, 3 of which showed improved toothbrushing behaviour; no measures of gingival inflammation levels were recorded in these studies.

Scheduled dental recall intervals and supervised toothbrushing compared to usual care for people with ID

Population: adults (mean age 30.9 years) (level of ID unclear)
Setting: day centre
Intervention: scheduled dental visits (oral hygiene instruction, with or without scale and polish), with supervised daily toothbrushing by carers ("staff provided reminders, encouragement and motivation")
Comparison: usual care ("no specific treatment")

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with usual care	Risk with 1-monthly dental recall intervals				
Gingival inflammation short term (< 6 weeks)	Not assessed					-
Gingival pocketing long term (> 12 months) assessed with: WHO technical report Scale: 0-2 (lower score means less pocketing) Follow-up: mean 24 months	The mean gingival pocketing long term was 0.9 (SD 1.4)	MD 0.60 lower (0.97 lower to 0.23 lower)	-	304 (1 RCT)	⊕⊕○○ **Low**[a]	One-monthly dental recall intervals and supervised toothbrushing may have reduced gingival pocketing long term. This was also found for the 3- and 6-monthly recall intervals. Findings were broadly similar at 12 and 18 months
Gingival bleeding long term (> 12 months) assessed with: WHO technical report Scale: 0-1 (lower score means less bleeding) Follow-up: mean 24 months	The mean gingival bleeding long term was 2.4 (SD 2.0)	MD 0.20 lower (0.86 lower to 0.46 higher)	-	304 (1 RCT)	⊕⊕○○ **Low**[a]	One-monthly dental recall intervals showed no evidence of benefit. This was also found for 3- and 6-monthly recall intervals. Findings were broadly similar at 12 and 18 months

Plaque short term (< 6 weeks)	Not assessed					-
Plaque long term (> 12 months) assessed with: WHO Plaque Index Scale: 0-3 (lower score means less plaque) Follow-up: mean 24 months	The mean plaque long term was 2.0 (SD 1.9)	MD 0.70 lower (1.28 lower to 0.12 lower)	-	304 (1 RCT)	⊕⊕◯◯ **Low**[a]	1-monthly dental re-call intervals may have reduced plaque levels long term (24 months). This was also found for 3-monthly recall in-tervals, but not for 6-monthly. Findings were broadly similar at 12 and 18 months
Quality of life	Not assessed					-
Dental caries	Not reported					The study assessed and reported dental caries using the DMFT Index at baseline but did not report assess-ing DMFT at any other time points
Adverse effects	None reported					-

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **DMFT:** Decayed, Missing or Filled Teeth; **ID:** intellectual disability; **MD:** mean difference; **RCT:** randomised controlled trial; **SD:** standard deviation; **WHO:** World Health Organization.

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded one level for imprecision and one for study design: based on one study at unclear risk of bias, with wide confidence intervals.

Discussion of clinical photographs as OH motivators compared to no discussion of photographs for people with ID

Population: people with ID (level of ID and age unclear)
Setting: day centre
Intervention: discussion of clinical photographs as OH motivators and OH instruction at monthly intervals
Comparison: no discussion of clinical photographs, but did receive OH instruction at monthly intervals

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with oral hygiene instruction (OHI) only	**Risk with discussion of clinical photographs plus OHI**				
Gingival inflammation short term (< 6 weeks)	Not assessed					-
Gingival inflammation medium term (6 weeks to 12 months)	Not assessed					-
Plaque short term (< 6 weeks)	Not assessed					-
Plaque medium term (6 weeks to 12 months) assessed with: WHO Plaque Index Scale: 0-3 (lower score means less plaque) Follow-up: mean 6 months	Mean plaque medium term was 7.4 (SD 2.0)	MD 0.1 lower (0.85 lower to 0.65 higher)	-	29 (1 RCT)	⊕○○○ **Very low**[a]	There was no evidence of a difference in plaque levels medium term. Broadly similar findings were observed for extrinsic plaque levels
Quality of life	Not assessed					-
Dental caries	Not assessed					-

Adverse effects	None reported	-

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **ID:** intellectual disability; **MD:** mean difference; **OH:** oral hygiene; **RCT:** randomised controlled trial; **SD:** standard deviation.

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded two levels for imprecision and one for study design: single study at high risk of bias, with wide confidence
intervals.

Daily compared to twice-weekly or once-weekly toothbrushing by dental students for people with ID

Population: people aged 15 to 30 years with mixed levels of ID
Setting: residential
Intervention: daily toothbrushing by dental student
Comparison: twice-weekly or once-weekly toothbrushing by dental student

Outcomes	Impact	Number of participants (studies)	Certainty of the evidence (GRADE)	Comment
Gingival inflammation short term (< 6 weeks)	Not assessed	-	-	-
Gingival inflammation medium term (6 weeks to 12 months)	Not assessed	-	-	-
Plaque short term (< 6 weeks) assessed with: Silness & Löe Gingival Index (lower score means less plaque) Follow-up: mean 21 days	For people with ID whose teeth were brushed for them by dental professionals, brushing daily most likely reduced gingival inflammation more effectively than twice-weekly and even more effectively than once-weekly, in the short term	80 (1 RCT)	⊕⊕◯◯ **Low**[a]	This study also compared electric and manual toothbrushes (findings reported above)
Plaque medium term (6 weeks to 12 months)	Not assessed	-	-	
Quality of life	Not assessed	-	-	-
Dental caries	Not assessed	-	-	-
Adverse effects	None reported	-	-	-

ID: intellectual disability; **RCT:** randomised controlled trial.

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded two levels for imprecision: single small study with no standard deviation data reported.

Toothpaste with a plaque-disclosing agent compared to conventional toothpaste for children with ID

Population: children aged 7 to 13 years with Down Syndrome (mild to moderate levels of ID)
Setting: residential
Intervention: toothpaste with a plaque-disclosing agent
Comparison: conventional toothpaste

Outcomes	Impact	Number of participants (studies)	Certainty of the evidence (GRADE)	Comment
Gingival inflammation short term (< 6 weeks) assessed with: Ainamo & Bay Gingival Bleeding Index (lower score means less inflammation) Follow-up: mean 10 days	Using a toothpaste with a plaque-disclosing agent may have reduced gingival inflammation slightly in the short term	80 (1 observational study)	$\oplus\bigcirc\bigcirc\bigcirc$ **Very low**[a,b]	Study was a non randomised cross over trial; only 2 of the 4 arms were relevant to this review
Gingival inflammation medium term (6 weeks to 12 months)	Not assessed	-	-	-
Plaque short term (< 6 weeks) assessed with: Simplified Green & Vermillion Plaque Index (lower score means less plaque) Follow-up: mean 10 days	Using a toothpaste with a plaque-disclosing agent may have reduced plaque levels in the short term	80 (1 observational study)	$\oplus\bigcirc\bigcirc\bigcirc$ **Very low**[a,b]	Study was a non randomised cross over trial; only 2 of the 4 arms were relevant to this review
Plaque medium term (6 weeks to 12 months)	Not assessed	-	-	-
Quality of life	Not assessed	-	-	-
Dental caries	Not assessed	-	-	-
Adverse effects	None reported	-	-	-

ID: intellectual disability

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded three levels due to study design: single non-randomised study at unclear risk of bias, with no standard deviation reported.

[b]The results of each arm in the cross-over trial were combined.

Individualised care plans compared to usual care for people with ID

Population: adults, aged 22 to 57 years with mixed levels of ID
Setting: residential
Intervention: individualised care plans based on a multidisciplinary assessment
Comparison: usual care - continued regular oral hygiene care, which was supported by a carer following institution's standard guidelines

Outcomes	Impact	Number of participants (studies)	Certainty of the evidence (GRADE)	Comment
Gingival inflammation short term (< 6 weeks)	Not assessed	-	-	-
Gingival inflammation medium term (6 weeks to 12 months)	Not assessed	-	-	-
Plaque short term (< 6 weeks)	Not assessed	-	-	-
Plaque medium term (6 weeks to 12 months) assessed with: subjective oral hygiene rating and Improvement Differential Follow-up: mean 12 months	The use of individualised oral care plans for people with ID may reduce plaque levels over 12 months. The "improvement differential" from baseline for the intervention group was 38% compared to 5% for the control group	79 (1 observational study)	⊕◯◯◯ **Very low**[a]	NRCT
Quality of life	Not assessed	-	-	-
Dental caries	Not assessed	-	-	-
Adverse effects	None reported	-	-	-

ID: intellectual disability.

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

[a]Downgraded three levels due to study design: non-randomised study at high risk of bias, use of subjective assessment tool and no standard deviation data reported.

DISCUSSION

Summary of main results

This review reported findings for nine comparisons of different types of oral hygiene interventions targeting people with ID or their carers. Four of the comparisons included between six and 13 studies. Only one study each assessed the remaining five comparisons. The individual studies were generally small; many studies having less than 50 participants, which resulted in most of the meta-analyses having fewer than 100 participants in total. The main outcomes reported were gingival health, oral hygiene knowledge, and oral hygiene behaviour. Dental caries and quality of life were not reported in any of the studies.

Comparison 1: special manual toothbrushes versus conventional manual toothbrushes for people with intellectual disabilities (six RCTs and one NRS)

Very low-certainty evidence from one RCT medium term (six weeks to 12 months) found a small effect size in favour of a special manual toothbrush (Superbrush) compared to a conventional manual toothbrush for reducing levels of gingival inflammation and possibly plaque. In this study, toothbrushing was carried out by formal carers for people with moderate-to-profound ID. There was no difference in effect size between the two toothbrushes for the other outcomes and time points measured.

One NRS study compared the Collis Curve toothbrush to a conventional toothbrush used by student dental nurses for people with profound ID and found no difference between the two toothbrushes in the medium term.

Comparison 2: electric toothbrushes versus manual toothbrushes for people with intellectual disabilities (eight RCTs and five NRS)

There was moderate-certainty evidence from two RCTs in relation to the assessment of gingival inflammation in the medium term, indicating that there was little or no difference between the electric and manual toothbrushes when used by people with mild-to-moderate or unclear levels of ID, with and without some assistance from formal carers. Low-certainty evidence found no difference between toothbrush types for medium-term plaque.

The findings in the NRS were broadly similar to the findings of the RCT meta-analysis, but the certainty of the evidence was very low. The plaque and gingival inflammation levels of the control group in all of these NRS studies improved from baseline, which was credited to the daily brushing routine instigated as part of the studies.

The evidence in relation to gingival inflammation and plaque, short term, was inconclusive as the findings were inconsistent between the four studies; the data could not be included in a meta-

analysis. The evidence was low- to very-low certainty. The electric toothbrushes had a variety of modes of action. The difference in findings between the types of electric toothbrush used may have been relevant.

Comparison 3: oral hygiene care training of carers versus no oral hygiene care training for carers of people with intellectual disabilities (four RCTs and three NRS)

There was low-certainty evidence that oral hygiene care training for formal carers had no beneficial effect on the level of gingival inflammation or plaque for people with mixed levels of ID for whom they cared, in the medium term, compared to no oral hygiene care training. One NRS showed strong evidence of a difference in plaque levels short term, in favour of the intervention, when the formal carers were made accountable for the level of care they provided for people with moderate-to-profound levels of ID (Table 22; Analysis 3.3).

Changes in formal carers' knowledge following training showed a moderate improvement in the medium term, but attitude, self-efficacy and behaviour of carers did not seem to improve after training, though the findings across studies were inconsistent. The certainty of RCT evidence for these outcomes was low to very low. Issues such as level of attendance at training, use of the educational resources, instruction on how to apply the training in practice and levels of support provided to carers were identified by the study authors as possibly impacting on the outcomes.

Comparison 4: oral hygiene training versus no oral hygiene training of people with intellectual disabilities (two RCTs and four NRS)

There were moderate reductions in the levels of plaque (but not gingival inflammation) in favour of oral hygiene training of people with mixed levels of ID compared to no oral hygiene training in the short term (Table 28; Table 29; Analysis 4.1; Analysis 4.2). The certainty of the evidence was very low.

Three of the four NRS assessing changes in behaviour found in favour of the training as measured by an increase in the steps achieved in a toothbrushing routine for people with severe and profound levels of ID. The certainty of the evidence was very low (Table 30). It was unclear if the improvement in the toothbrushing routines in the NRS impacted on gingival health, as no clinical measurements were carried out.

Comparison 5: one-, three- and six-monthly dental recall intervals plus daily supervised toothbrushing versus usual care for people with intellectual disabilities (one RCT)

One RCT provided low-certainty evidence that regular dental recall visits and supervised toothrbushing might have improved gingival health (gingival pocketing, plaque and calculus levels) in the

long term for people with unclear levels of ID (Table 31; Table 32; Table 33; Table 34; Analysis 5.1; Analysis 5.2; Analysis 5.3; Analysis 5.4). The difference between one-, three- and six-monthly recall intervals was minimal and unlikely to be clinically significant.

Comparison 6: discussion of individual clinical photographs as a toothbrushing motivator versus no discussion of photographs for people with intellectual disabilities (one RCT)

One RCT provided very low-certainty evidence demonstrating that the discussion of clinical photographs as an oral hygiene motivator most likely had no effect on plaque levels in the medium term (Table 35; Analysis 6.1).

Comparison 7: daily, twice-weekly and once-weekly frequencies of teeth brushing versus usual care for people with intellectual disabilities (one RCT)

One RCT provided low-certainty evidence that brushing daily compared to brushing twice weekly, once weekly or usual care may reduce plaque levels in the short term. The brushing was carried out by a dental professional in this intervention (Table 36).

Comparison 8: use of a toothpaste with a plaque-disclosing agent versus a conventional toothpaste for people with intellectual disabilities (one NRS)

One NRS found that the use of a toothpaste with a plaque-disclosing agent might reduce plaque and gingival inflammation levels for children with Down Syndrome (mild and moderate levels of ID), more than conventional toothpaste, in the short term (Table 37; Table 38). The certainty of the evidence was very low.

Comparison 9: individualised oral care plan versus usual care (according to guidelines) for people with intellectual disabilities (one NRS)

One NRS found that individualised oral care plans might improve oral hygiene for people with mixed levels of ID, in the medium term (Table 39). The intervention involved the input of a multidisciplinary team. The certainty of the evidence was very low.

Adverse effects

Only one study considered adverse effects as a formal outcome. Most studies did not report adverse effects. Some studies that reported adverse effects informally, reported transient difficulties with the electric and special manual toothbrushes but did not quantify them. It should be noted that any persistent resistance to clinical assessments or interventions resulted in participants being excluded from the studies.

Overall completeness and applicability of evidence

The aim of this review was to determine the effects (benefits and harms) of oral hygiene interventions for people with ID. The clinical and behavioural outcomes focused predominately on the potential benefits. Any persistent resistance to the clinical assessments or to the intervention, by people with ID, resulted in them being excluded from the study. Any harms identified were not considered as a formal outcome, often not quantified and tended to be reported in the discussion section. Any formal qualitative assessments of the interventions were completed by the carers involved and were normally in the form of poststudy interviews.

None of the studies formally addressed quality of life changes and long-term, patient-centred outcomes. There were occasional comments in the discussion section of the studies regarding increases in self-efficacy or confidence of the carers. The lack of qualitative outcomes may be linked to the age of many of the studies and lack of reporting standards. No studies provided data on dental caries. In relation to unintended effects, no studies reported any positive unintended effects. Negative unintended effects or adverse effects were reported only within the text; no formal assessments were reported.

All of the other primary and secondary outcomes outlined in our protocol were reported. The clinical outcomes reported were gingival inflammation, plaque and calculus. The tools used to assess these outcomes were modified or adapted for the ID population. Any differences observed in the clinical assessments must be considered in relation to their practical impact on gingival health long term. The non-clinical outcomes reported for the carers were knowledge, behaviour, attitude and self-efficacy. Changes in behaviour were reported for people with ID.

The topics considered for subgroup analysis, as outlined in the protocol, were recorded for the individual studies, but there were insufficient data to undertake these analyses.

Validity of assessments used

Most studies assessed clinical outcomes using validated tools, other than in six studies which used subjective assessments (Albino 1979; Gertenrich 1967a; Gertenrich 1967b; Gertenrich 1967c; Gertenrich 1967d; Kelner 1963). Many of the validated tools were modified, some to a considerable extent; some of these modifications had been validated and others had not. The level of modifications to the assessment tools highlighted the difficulties involved in carrying out clinical assessments for this population.

The use of subjective clinical assessments is most likely an historical issue and unlikely to occur in future interventions. Despite the subjective nature of these assessments, we considered these studies to add value to this review; their findings were graded with the quality of these assessments in mind.

The non-clinical outcomes (knowledge, behaviour, attitude and self-efficacy) were less well validated. The studies that included

observations of behaviour were assessed for reliability. One study, using a questionnaire to assess knowledge, self-efficacy, attitude and behaviour, reported that the tool had been validated; another study used the same tool. Another study, using a questionnaire, reported getting "expert advice on the content."

COM-B characteristics identified in the interventions

We attempted to map the behavioural change elements of the interventions in this review using the COM-B system for understanding behaviour and behavioural change (Michie 2011). These elements are: capability: defined as the psychological and physical capacity to engage in the activity; opportunity: both physical and social, which considers contexts beyond the individual; and motivation: both automatic and reflexive; which might result in conscious decision-making. An intervention may change one or more of these elements resulting in the desired behaviour of performing regular oral hygiene.

Capability

The potential for increasing the physical capability of the participants was identified in interventions that focused on training, modelling or enablement in the skill of toothbrushing. The potential for increasing psychological capability was predominantly identified in interventions for people with mild or moderate ID as they could have the capability to reflect and to make the connections between any information provided and the benefit to them. Interventions targeting people with more severe levels of ID may benefit more from interventions that use incentivisation, persuasion, coercion or restriction as a psychological tool.

Opportunity

The element of opportunity to change behaviour was considered, for example, if the intervention attempted to provide additional time or resources to the oral hygiene routine (physical opportunity) or to make the oral hygiene routine socially expected or the cultural norm (social opportunity). Physical opportunity most often involved specific time being set aside for the toothbrushing routine, or environmental restructuring such as providing different oral hygiene or other aids and changing the setting where the toothbrushing took place. Social opportunities identified were monitoring or recording of the oral hygiene routine; such as a toothbrushing diary or staff monitoring. Social opportunity-based interventions tended to focus on carers rather than people with ID. One example of an intervention that did focus on children with ID, involved a toothbrushing session using a plaque-disclosing solution in a classroom setting; the children were aware of how their classmates were performing, which may act as a social cue in relation to the toothbrushing habit (Shaw 1983).

Motivation

The element of motivation to change behaviour was considered if the intervention included the potential to reflect on the benefit of changing behaviour or for the behavioural change to become an automatic process. It was the least common element identified in the interventions. Reflective motivation was identified in interventions that included some element of feedback in relation to behaviour or performance and was seen predominantly in the interventions targeting carers. No studies were identified as having the potential for the behavioural change to become automatic. This may have been due to the duration of the interventions, as the development of habit can take some time; 19 of the studies were followed up for three months or less, and only three for more than 12 months.

To ensure that an intervention that seems effective is successfully replicated in a new setting, the explicit causal processes that elicited the behavioural change must be identified and replicated. It is difficult to identify the COM-B elements retrospectively; we can only claim that the intervention may have provided these elements. The decision to retrospectively identify these elements in our review provided valuable insight into the causal processes that were potentially in action. By mapping the behavioural change elements and intervention functions inherent in the interventions in this review, we hope we have assisted in the identification of the causal processes that should be replicated. These details are recorded in the Characteristics of included studies table.

Quality of the evidence

The certainty of the evidence varied from moderate to very low for comparisons with RCT evidence, and was very low for comparisons assessed only in NRS. The quality of reporting was poor; the lack of detail provided in relation to the methodology impacted on the assessment of risk of bias. Cross-over studies were not reported in a way that made them amenable to meta-analysis. More than half of the studies were pre-2000; before the introduction of guidelines such as the CONSORT statement in relation to the standards for reporting trials (Moher 2001). A wide variety of outcome measures was used. The limited number of studies for each comparison, all with small sample sizes, led to imprecision in the effect estimates. There were many NRSs despite the fact that RCTs are feasible for all comparisons included in this review.

Better quality evidence is required for all the comparisons identified in this review. This could be achieved by modifying the inclusion criteria or by applying positive weighting for CONSORT-compliant studies. For trials using cross-over design, the MD or data from each treatment period should be reported to allow calculation of the standard error of the SD or to approximate the correlation between results from treatment periods, so that data from these studies can be combined in any meta-analysis.

Potential biases in the review process

The most common element reducing the certainty of the evidence was the 'unclear' elements under all the risk of bias headings, most notably in relation to outcome reporting, which was predominantly as a consequence of the absence of study protocols. The level of 'high' risk in relation to randomisation was caused by the inclusion of NRSs.

We excluded 16 studies as we were unable to source the articles, unable to contact the authors for more details or the data were no longer available. These studies may have added to the review.

As the first review of this topic, we have worked hard to identify all relevant studies, but we acknowledge that some studies may not have been published, registered or presented anywhere, and we did not search every database. The study designs included in this review were wider than conventional Cochrane Reviews, but this allowed the consideration of interventions that might otherwise have been excluded. It was assumed at the protocol stage that before-and-after study designs would predominate, given the diverse nature of ID, related comorbidities, environments and level of supports available. However, this assumption was not borne out. RCTs were identified for all of the interventions except for the use of toothpaste with a plaque-disclosing agent and individualised oral care plans, and there is no reason these interventions could not be assessed in RCTs.

Given the number of studies reporting little or no difference between intervention groups compared to controls, it is unlikely that there is a publication bias for positive findings in the studies being reported.

Agreements and disagreements with other studies or reviews

Special manual toothbrushes

A systematic review by Kalf-Scholte 2018 evaluated triple-headed toothbrushes compared to single-headed toothbrushes, in a general population ("humans without fixed orthodontic appliances"), for prevalence of plaque. Kalf-Scholte 2018 included three studies also in our review (Dôgan 2004; Kaschke 2005; Sauvetre 1995). The Kalf-Scholte 2018 review conducted some subgroup analyses that suggested that when toothbrushing was assisted or carried out by a carer, there may have been a greater benefit to using a triple-headed toothbrush (Superbrush). In our review, Bildt 2010 evaluated the impact of carer toothbrushing using a three-headed or conventional toothbrush and found a small effect size in favour of the special manual toothbrush. The Kalf-Scholte 2018 review concluded that the brushes were equally effective for self-brushers; this matched the findings of our review.

Electric toothbrushes

The findings in our review appeared to conflict with the Yaacob 2014 Cochrane Review that evaluated powered versus manual toothbrushes in the general population (people with disabilities were excluded). Yaacob 2014 concluded that electric toothbrushes were more effective than manual toothbrushes in the short (one to three months) and long (greater than three months) term. It found a moderate effect size in favour of the electric toothbrush short term (SMD -0.50, 95% CI -0.70 to -0.31) and long term (SMD -0.47, 95% CI -0.82 to -0.11). Our review showed no evidence of a difference between toothbrushes for gingival inflammation levels at six months (MD 0.02, 95% CI -0.06 to 0.09; Analysis 2.1).

The greatest differences in the Yaacob 2014 review were seen in the studies that compared an electric toothbrush with a rotating oscillation mode of action. There were only two studies in our review that compared an electric toothbrush with a rotation oscillation mode of action (Braun Plaque Control 3D) to a manual toothbrush, one RCT and one NRS. The RCT found strong evidence of a difference in plaque levels in favour of the electric toothbrush after one week (P < 0.001; Dôgan 2004). The ITS found some strong evidence of differences in subgroups for plaque at 12 weeks (those using the electric toothbrush unaided) and gingivitis at 16 months (those using the electric toothbrush unaided) in favour of the electric toothbrush (P < 0.05; Bratel 1991). The data from these studies were not suitable for meta-analyses.

Oral hygiene care training of carers

Comparisons in relation to changes in carer knowledge, attitude, self-efficacy and behaviour in this review could be made to studies directed at carers in long-term healthcare settings. A systematic review of the effectiveness of continuing education in long-term care settings by Aylward 2003 found many of the same issues in their review in relation to the quality of the evidence, diversity of assessment tools, level of attrition, applying the training in practice and levels of support provided to carers at management level. Of the studies in their review that assessed both knowledge and behaviour, almost all showed an improvement in knowledge but no change in behaviour. Most of the evaluations took place immediately after the intervention, which ranged in length from 10 minutes to 52 hours.

The clinical outcomes assessed in this comparison can be compared to the Albrecht 2016 Cochrane Review, which evaluated oral health education interventions of nurses in nursing homes, and concluded that there was no difference in plaque levels compared to usual care. The two RCTs in our review similarly found no difference in plaque or gingivitis levels. Two NRS in our review found some reduction in plaque levels when staff were made accountable for the oral hygiene care of people with ID.

Oral hygiene care training for people with intellectual disabilities

The RCTs included in our review comparing oral hygiene care training for people with ID were all short-term studies. The findings were in agreement with the systematic review by Watt 2005 in relation to oral health promotion in general, which concluded that short-term interventions may have resulted in a reduction in plaque and gingivitis levels. However, they noted in their review that there was very limited evidence supporting long-term reduction in plaque and gingival bleeding outcomes. The NRS in our review, which were medium- and long-term interventions, showed some improvement in toothbrushing routines. However, these studies had small numbers of participants and were very labour intensive. Kay 1996 commented in her review, in relation to oral health promotion that the balance between input and output must be considered.

Recall intervals

Our review found one study that showed a benefit to gingival health of regular dental recall intervals (one-, three- or six-monthly) (combined with daily supervised toothbrushing); however, the certainty of the evidence was low. One Cochrane Review investigating dental recall intervals for the general population identified only one RCT, which was insufficient to draw any conclusions; this review was published in 2013 and is currently being updated (Riley 2013). Lamont 2018 found that gingivitis was not reduced more by regularly scheduled visits for scale and polish in the general population. Evidence for the value of oral hygiene instruction at dental visits in the general population is lacking (Soldani 2018).

AUTHORS' CONCLUSIONS

Implications for practice

Although some oral hygiene interventions for people with ID show evidence of benefits, the clinical importance of these benefits is unclear. Moreover, the evidence is mainly low to very low certainty, so any changes to current practice based on this review should be made cautiously, and the advice oral care professionals give about performing oral hygiene should continue to be based on their own expertise and the needs and preferences of the individual with ID and their carers.

This review found very-low certainty evidence that a special manual toothbrush (Superbrush) may reduce levels of gingival inflammation and possibly plaque medium term more than a conventional manual toothbrush for people with intellectual disabilities (ID), when the toothbrushing is carried out by carers.

The evidence in relation to the benefit of using an electric toothbrush compared to a manual toothbrush for people with ID was inconsistent between outcomes and between studies, and the certainty of the evidence ranges from very low to moderate. The moderate-certainty evidence found no difference between the two types of toothbrush for gingival inflammation medium term.

Training carers in oral hygiene care for people with ID may increase their oral hygiene knowledge but may not have a beneficial effect on their reported behaviour, attitude and self-efficacy in relation to providing oral hygiene care, nor reduce levels of gingival inflammation or plaque in people with ID. The certainty of the evidence is low to very low.

Oral hygiene training for people with ID may have some small beneficial effects on plaque levels in the short term. The certainty of the evidence is very low.

We also identified low-certainty evidence that regular scheduled dental recall intervals, combined with daily supervised toothbrushing, may help reduce gingival inflammation and plaque in people with ID in the long term, and daily toothbrushing by dental students may reduce the plaque more effectively than once- or twice-weekly toothbrushing, in the short term. Very low-certainty evidence suggests discussions about photographs of participants' teeth cleaned with a plaque-disclosing agent may not reduce plaque in the medium term.

Very low certainty evidence from one nonrandomised study suggested there may be a benefit to gingival health from using a toothpaste with a plaque-disclosing agent, and another nonrandomised study suggested an individualised oral care plan could be beneficial.

Implications for research

Better-quality evidence is required for all the comparisons identified in this review. Future trials might address the following issues.

Participants: the number of participants in future studies needs to be increased so that the uncertainties in the review findings can be resolved. The level of ID should be clearly defined using the most up-to-date classification. The trials should focus on one level of ID or differentiate between levels of ID when reporting the findings.

Interventions: interventions targeting training of carers and people with ID might consider some alternative outcomes and tools to more carefully assess some of the behavioural changes that might occur following training. The use of the COM-B system to identify and reflect on the contexts and mechanisms of action at play in future interventions may be useful in understanding what makes an intervention effective.

Comparisons: different types of electric or special manual toothbrushes with different modes of action should be considered for comparison.

Outcomes: agreement in relation to the ideal index to use for the various clinical outcomes should be reached to allow valid com-

parisons between studies, that is, a 'core outcome set', as recommended by the COMET (Core Outcome Measures in Effectiveness Trials) initiative (Williamson 2017). The level of modification of the indices should be kept to a minimum, ideally trials should use only those that have been validated. Outcomes should include dental caries, quality of life changes or long-term, patient-centred outcomes; the length of follow-up would thus need to be extended in many instances. Long-term follow-up is important for all outcomes to show if any short- and medium-term benefits are sustained. Poor oral hygiene impacts on oral health and consequently on quality of life; it is essential that future studies assess this outcome. For trials using cross-over design, the MD or data from each treatment period should be reported to allow calculation of the standard error of the mean difference or to approximate the correlation between results from treatment periods, so that data from these studies can be combined in any meta-analysis.

Risk of bias: trial registration and improved reporting of the trials would reduce the number of 'unclear' risk of bias assessments found in this review.

ACKNOWLEDGEMENTS

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Abramson 1972

Methods	Study design: repeat measure Date of study: not given, pre-1972 Study duration: unclear Location: USA Setting: residential Ethical approval: none reported Consent: none reported
Participants	Description of ID used: "severely retarded;" "The mean MA (Mental Age) as measured by the Peabody Picture Vocabulary Test was 2 years and 8 months. The mental ages ranged from 2 years 2 months to 4 years 1 months." Conversion to ICD description: severe Age range (mean): 9 years 3 months to 14 years 8 months (12 years 4 months) Sex: male Comorbidity reported/details: none reported Number of participants at baseline: 9 Number of participants at final evaluation: 8 Selection of the participants for the intervention: no details
Interventions	**Comparison: training of people with ID versus no training** Intervention: teach dental hygiene techniques to people with ID using discrimination, reinforcement and modelling training. Brushing behaviour based on a checklist of 19 items
Outcomes	1. Sessions required to reach discrimination 2. Steps achieved in a 19-step toothbrushing routine using modelling and reinforcement with rewards Timing of outcome assessments: 8 observations at baseline and 8 post-training
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), motivation (reflective) Potential Intervention functions: training, modelling, incentivisation
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholders: 1 counsellor (staff member) trained to use the checklist of 19 steps to brushing
Notes	Strengths and weaknesses: duration of the intervention unclear Modifications to the intervention: none reported Adverse effects: none reported Funding source: "Supported by Grant RD - 2286-PO68CI of the Social and Rehabilitation Services, Dept of Health, Education and Welfare." Comment: unlikely to be a conflict

Abramson 1972   *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Was the intervention independent of other changes? (ITS)	Unclear risk	Comment: none stated; other changes or events may have influenced the outcomes. Study duration unclear
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis was the point of intervention
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection
Was knowledge of the allocated interventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind. All participants in the intervention known to rater and researcher
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: 1 participant did not complete the training as they moved from the setting. Unlikely to affect outcomes
Was the study free from selective outcome reporting? (ITS)	Low risk	Comment: all outcome data were reported.

Albino 1979

Methods	Study design: RCT Date of study: not given, pre-winter 1978 Study duration: 5 weeks Location: USA Setting: school Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "severely retarded children;" "IQ between 20 and 40" Conversion to ICD description: moderate and severe Age range: 3-21 years Sex: both Comorbidity reported/details: yes "Down syndrome, Tay-Sachs disorder, epilepsy, muscular dystrophy, Turner syndrome, autism, hydrocephaly, Hunter syndrome, Prader-Willi syndrome and PKU disorder." Schwartz 1978, p. 18 Number of participants at baseline: 31 Number of participants at final evaluation: 36. Comment: 11 of the post-test sample were not in the pretest sample. In total, pre and post data were available for 26 participants: 17 in intervention group, 9 in control group

	Selection of the participants for the intervention: 58 children attending a summer school. Only those allowing the oral examination were reported
Interventions	**Comparison: training of people with ID versus no training** Intervention: orientation and desensitisation (11 sessions), social (verbal and physical praise) and tangible (stars traded for small toys) reinforcement. Individualisation and parental involvement; individual feedback on their children's progress along with suggestions that they might use at home to enhance and reinforce learning. Schwartz 1978, p. 20 Control: orientation and desensitisation (11 sessions) only
Outcomes	1. Plaque Index - Kobayashi & Ash (6 teeth scored) (V). This index is a modification of Ramjford and Schick & Ash Timing of outcome assessments: baseline and final
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (social/physical), motivation (reflective) Potential intervention functions: training, enablement, incentivisation, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both With or without dental professional involvement: with - dental instructors, dental student, predental student Other stakeholder involvement: parents, director of centre
Notes	Strengths and weakness: high attrition rate Modifications to the intervention: the intervention was continuously modified to meet the needs of individual participants. Quote: "it soon became obvious that all children were not able to master the [toothbrushing] technique and attention was given to individualisation" Schwartz 1978, p. 20 Adverse effects: none reported Funding source: quote: "Funding for this study was provided in part by a grant from Johnson and Johnson, Inc." Albino 1979, p. 28. Comment: unlikely to be a conflict

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Half the children were randomly assigned to a control group and the other half to an experimental group." (Schwartz 1978, p. 18)
Allocation concealment (selection bias)	Unclear risk	Comment: no details reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided but control group did receive some intervention

Blinding of outcome assessment (detection bias) All outcomes	High risk	Comment: examiner was not blinded. Quote: "The examiner was also the student dentist acting as instructor in the program." (Albino 1979, p. 27)
Incomplete outcome data (attrition bias) All outcomes	High risk	Comment: level of attrition likely to impact on outcome effect Quote: "attrition rate of subjects particularly when it was occasioned by fear and lack of appropriate behaviors, was discouraging." (Albino 1979, p. 27)
Selective reporting (reporting bias)	High risk	Comment: criteria for scoring plaque was modified due to difficulties in recording all surfaces. Reduced from 12 to 8 surfaces, no SD given

Altabet 2003

Methods	Study design: NRCT "2 x 2 repeated measures factorial design with two groups (tx [treatment], no tx) both measured over two distinct time periods," p. 144 Date of study: 20 March 1999 to 20 March 2000 Study duration: 12 months Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: mild to moderate and severe to profound "range of mental retardation" Conversion to ICD description: mixed Age range: 22-57 years Sex: male 44, female 35 Comorbidity reported/details: none Number of participants at baseline: 79 Number of participants at final evaluation: 79 Selection of the participants for the intervention: residents who attended for a dental examination on 3 occasions within the year of the study
Interventions	**Comparison: individualised oral care plan versus usual care** Group 1: individualised oral care plan (appendix A, p. 444) Group 2: continued regular oral hygiene care, which was supported by a carer following guidelines (appendix B, p. 445)
Outcomes	1. Rating of oral hygiene 1 to 5 (excellent to very poor), averaged over the designated time periods, p. 441 Timing of outcome assessments: baseline, midway and final

COM-B System Characteristics	Potential sources of behaviour change: capability (physical /psychological), opportunity (social/physical), motivation (reflective) Potential intervention functions: training, modelling, enablement, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienists Other stakeholder involvement: used to determine the individualised care plan - psychology or behaviour analysis, dental department referral, occupational therapist, speech-language pathologist, nursing or medical referral, physical therapy, case management, procurement of special equipment, patient education, unit supervisors, direct support staff. Direct care staff provided the day-to-day oral care (appendix A, p. 444)
Notes	Strengths and weaknesses: none noted Modifications to the intervention: yes, modifications to individualised patient plans were part of the intervention Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quote: "based on timeliness of their referral, with earlier referrals receiving the individualized oral care plans and the remaining individuals placed on a waiting list," p. 441
Allocation concealment (selection bias)	High risk	Comment: those attending early in the year were in the intervention group, p. 441
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: most likely low as study took place at 2 different time points
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The raters (facility dentist and dental hygienist) were not aware of who had participated in each group," p. 441
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing outcome data
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol, but all listed outcomes reported

Bickley 1990

Methods	Study design: RCT Date of study: not reported, pre-1990 Study duration: 6 months Location: UK Setting: day centre Ethical approval: not reported Consent: quote: "Clients agreement to participate was confirmed," p. 4
Participants	Description of ID used: "mentally handicapped" Conversion to ICD description: unclear Age range: not reported Sex: not reported Comorbidity reported/details: none reported Number of participants at baseline: 30 Number of participants at final evaluation: 29 Selection of the participants for the intervention: following a routine dental examination, identified as having poor oral hygiene
Interventions	**Comparison: discussion of individual clinical photographs used as motivators versus no discussion for people with ID** Group 1: monthly photographic records of individuals, with their plaque disclosed, used to compare and discuss their oral hygiene from visit to visit, with related OHI Group 2: monthly photographic records of individuals, with their plaque disclosed, but not used to compare; general OHI
Outcomes	1. Plaque, calculus, pocketing, bleeding indices of 6 teeth based on WHO diagnostic criteria (V) 2. Extrinsic Stain Index (Shaw & Murray 1977) (V) 3. Cognitive and perceptual learning (interviews) Timing of outcome assessments: 1. baseline and final, 2. monthly
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), motivation (reflective) Potential intervention functions: enablement, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: N/A With or without dental professional involvement: with - dental hygienist Other stakeholder involvement: none
Notes	Strengths and weaknesses: lack of direct contact between investigators and carers was a disadvantage Modifications to the intervention: none Adverse effects: none reported Funding source: quote: "For the provision of toothbrushes and toothpaste, we gratefully acknowledge the following companies Oral B, Colgate and Gibbs Mentadent." Comment: no likely conflict

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "after the baseline examination the subjects were allocated using a random numbers table into the test or the control group," p. 4
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessor was not involved in the study.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: unclear why 1 participant dropped out, but unlikely to affect outcome
Selective reporting (reporting bias)	High risk	Comment: only the plaque index was reported from the full assessments. Results of cognitive and perceptual interviews not reported. Poor reporting of measures used. Unable to contact author for more details

Bildt 2010

Methods	Study design: RCT Date of study: not given, pre-August 2010 Study duration: 4 months Location: the Netherlands Setting: unclear Ethical approval: yes, "approved by the Medical Ethics Review Committee of the University Medical Center Groningen (Registration number: NL 28061.042.09)" Consent: unclear. Carers were asked for "permission." No report of consent from participants
Participants	Description of ID used: IQ < 50, "entirely dependent on another for their oral care" Conversion to ICD description: moderate to profound Age range: not provided. Mean age: male 28 years, female 31 years Sex: males 12, females 6 Comorbidity reported/details: physical disabilities Number of participants at baseline: 18 Number of participants at final evaluation: 18 Selection of the participants for the intervention: from 2 centres for Special Care Dentistry

Interventions	**Comparison: special 3-headed manual toothbrush used by carer versus conventional manual toothbrush used by carer**
	Group 1: Superbrush used by carer on person with ID following OHI
	Group 2: Oral B Indicator used by carer on person with ID following OHI
Outcomes	1. Green & Vermillion Plaque Index (scale 0-18 - mean of 6 standard teeth)
	2. Ainamo & Bay Gingival Bleeding Index (scale 0-1, 6 teeth, % of positive sites)
	3. Questionnaire for carers, 5 questions (frequency of brushing, experience using the brush, handling of toothbrush by carer, most difficult sextant to brush for carer and level of resistance of people with ID)
	Timing of outcome assessments: baseline and 4 months
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical)
	Potential intervention functions: training, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both
	With or without dental professional involvement: with - dentist
	Other stakeholder involvement: no
Notes	Strengths and weaknesses: small sample, dentists not calibrated, some differences in baseline scores
	Modifications to the intervention: no
	Adverse effects: assessed in carers' questionnaire - small number of participants reacted to the size of the Superbrush when first used
	Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "closed envelopes"
Allocation concealment (selection bias)	Low risk	Comment: use of closed envelopes probably ensured allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: some attempt to blind carers as new toothbrushes and OHI were given to control group. Blinding or not of the participants may not have impacted on the outcome as teeth were brushed by the carers
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessors were blinded to the group allocations.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comments: no missing data

Selective reporting (reporting bias)	Unclear risk	Comment: no protocol, but all outcomes in Methods section reported

Bouter 1979

Methods	Study design: repeat measure Date of study: not reported, pre-1979 Study duration: unclear - varied from participant to participant - maximum 100 days Location: the Netherlands Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "IQ varied from <35 to 46" Conversion to ICD description: moderate Age range (mean): 20-28 years (25 years) Sex: male 4, female 4 Comorbidity reported/details: none reported Number of participants at baseline: 8 Number of participants at final evaluation: 7 Selection of the participants for the intervention: "ability to imitate non verbal behaviours and to understand verbal instruction," p. 63
Interventions	**Comparison: training of people with ID versus no training** Group 1: acquisition of skills and duration training in 15 steps of a toothbrushing routine, with 5 levels of assistance and 4 levels of feedback/praise during the acquisition stage Group 2: no training Duration training = all steps completed without assistance or feedback
Outcomes	1. Acquisition of 15 steps in toothbrushing routine and the number of sessions required to achieve these steps. Trainer recorded type of assistance technique required and type of feedback used 2. Measure of level of maintenance of the skill over $\geq$ 1 week Timing of outcome assessments: varied between participants - baseline to final - $\geq$ 5 measures per week reported for all. Follow-up/duration stage was measured at increasing intervals, progressed from 2-, 3-, 4-, 6-, 8-day intervals
COM-B System Characteristics	Potential sources of behaviour change: capability (physical /psychological), opportunity (physical), motivation (reflective) Potential Intervention functions: training, modelling, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholder involvement: none

Bouter 1979 *(Continued)*

Notes	Strengths and weaknesses: time involved in training; "It is not expected that most care workers will have even that much time available (10 - 20 minutes) for each individual subject," p. 69 Modifications to the intervention: yes, for 3 participants, steps required to progress to next step were reduced to 14 and feedback was not reduced until each step was completed on 3 consecutive occasions Adverse effects: unclear - 1 participant felt ill. Researchers considered it a possible delaying tactic. Participant given incentive of an orange, p. 66 Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Was the intervention independent of other changes? (ITS)	Unclear risk	Comment: none stated; other changes or events may have influenced the outcomes
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis was the point of intervention
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection
Was knowledge of the allocated interventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: participant who did not complete the intervention was fully documented
Was the study free from selective outcome reporting? (ITS)	Unclear risk	Comment: the trainer scored the participants, but appeared to be completely impartial

Bratel 1991

Methods	Study design: NRCT; no evidence of randomisation Date of study: none stated, pre-1988 Study duration: 16 months Location: Sweden Setting: mixed Ethical approval: no Consent: no

Participants	Description of ID used: "moderately mentally handicapped adults," (Bratel 1988, pp. 23-4) Conversion to ICD description: moderate Age (mean): 31.3 years (SD 6.3) Sex: male 13, female 10 Comorbidity reported/details: none reported Number of participants at baseline: 23 Number of participants at final evaluation: 23 (and 22 for 1 outcome) (1 lost to follow-up in Group 3 - see Table 3 in Bratel 1991, p. 6) Selection of the participants for the intervention: from the dental hospital recall system (Bratel 1988, p. 26)
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Standard oral health information provided to all: OHI according to Bass technique provide to participants and demonstrated in his/her own mouth (adapted to type of brush). Instructed to brush at least morning and night Group 1: E1 - electric toothbrush (Braun Dental d3) unaided, i.e. no help when brushing Group 2: E2 - electric toothbrush (Braun Dental d3) aided, i.e. with help from parents or staff. OHI given to parents and staff and demonstrated in participants' own mouths and practiced by them under supervision Group 3: C1 - manual toothbrush unaided Group 4: C2 - manual toothbrush aided, as in E2 We combined aided and unaided data
Outcomes	1. Silness & Löe Plaque Index (V) 2. Silness & Löe Gingival Index (V) 3. Supervision of wear and tear on toothbrushes 4. Diary of participant brushing kept by parents/staff 5. Questionnaire at baseline to assess current oral hygiene routines 6. Interview with those using electric toothbrush to assess their experiences using it Timing of outcome assessment: baseline, 1 week, 4 weeks, 12 weeks, 16 months
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (social/physical) Potential intervention functions: education, training, modelling, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both With or without dental professional involvement: with - dentist, dental hygienist Other stakeholder involvement: parents and staff carers involved in aiding groups E2 and C2
Notes	Strengths and weaknesses: issues with provision of aid by parent/staff; some found it difficult to do Modifications to the intervention: none reported Adverse effects: yes, all reported in relation to electric toothbrush; "Patients reported some discomfort during brushing," "difficult to control the force and position of the electric toothbrush," Bratel 1988, p. 26; "toothbrush out of order (2 weeks);" "Patients reported some discomfort during brushing at the 3 month follow-up," (Bratel 1991, p.

	6) Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "a selected group of patients from the recall system." "Patients were divided into two examination groups and two control groups," (Bratel 1988, p. 24). Comment: no mention of randomisation
Allocation concealment (selection bias)	High risk	Comment: not possible; those with more severe ID were aided (E2 and C2) (Bratel 1988, p. 24)
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: not reported but different settings; most likely unaware of what other groups were doing
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: all clinical measures were recorded by the lead author; no mention of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data - diary entries were summarised.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Carr 1997

Methods	Study design: cluster RCT - the group homes were the unit of randomisation, p. 134 Date of study: not stated, pre-1997 Study duration: 12 months Location: USA Setting: residential Ethical approval: no Consent: yes, "Written consent was obtained," p. 133.
Participants	Description of ID used: "Mental Retardation/Developmental Disability," p. 134 Conversion to ICD description: unclear Age range (mean): 25-64 years (36.8 years) Sex: male 32, female 24 Comorbidity reported/details: yes, cerebral palsy 5, hearing impaired 1, visually impaired 2 Number of participants at baseline: not given

	Number of participants at final evaluation: "56 residents…completed the study" Selection of the participants for the intervention: no details given
Interventions	**Comparison: electric toothbrush versus manual toothbrush** All groups - verbal OHI provided, then 1-to-1 instruction using the designated brush and practice on a typodont during initial instruction. Those requiring assistance were determined by testing their capability. p. 134 Group 1: self-brushing with Interplak electric toothbrush Group 2: self-brushing with manual toothbrush (Oral B 40) Group 3: assisted brushing with Interplak electric toothbrush Group 4: assisted brushing with manual toothbrush (Oral B 40) We combined data for self-brushers and assisted brushers for each toothbrush type
Outcomes	Outcomes measured on selected teeth "Buccal of #3, #4 and #14. Lingual of #19, Facial of #30," p. 135 1. Gingival Index (Löe) (V) 2. Simplified Oral Hygiene Index (Green and Vermillion) (V) 3. Calculus measurement, p. 135 Timing of outcome assessments: baseline, 3 months, 6 months, 9 months and 12 months
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical) Potential intervention functions: training, modelling, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental hygienist Other stakeholder involvement: carers in group homes for those requiring assistance throughout study
Notes	Strengths and weaknesses: quote: "The validity and reliability of the oral hygiene techniques used in the study must be regarded as limited. The examiners could not be present at all toothbrushing sessions and relied on staff for the implementation of tooth brushing protocols," p. 136 Modifications to the intervention: none reported Adverse effects: unclear - quote: "some subjects dismissed from study," p. 136 Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Each group home was randomly divided into two study groups, one using the Interplak and the second using a manual TB," p. 134 Comment: no further details provided
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided

Carr 1997 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: unclear if personnel were blinded; study was a cluster study so participants were most likely blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "The data were obtained by a single examiner (SB), a dental hygienist who did not know to which test group the residents had been assigned," but "Comparisons were made at the time of examination, along with specific recommendations for improvement of oral hygiene," p. 135
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Quote: "Some initial subjects had to be dismissed from the study because they either lost their Interplak for a time, it malfunctioned and /or they had to undergo hospitalization, thus interrupting the oral hygiene protocol," p. 136 Comment: no details of how many were dismissed.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Christen 2007

Methods	Study design: RCT, 3-way cross-over trial Date of study: not stated, prior to or during 2007 Study duration: 2 weeks for each arm, with 2-week washouts, 12 weeks in total Location: Germany Setting: residential and home Ethical approval: yes Consent: yes
Participants	Description of ID used: "varying degrees of intellectual and/or physical impairments" - author confirmed by email that all participants had ID Conversion to ICD description: mixed Age range: 18-45 years Sex: 22 male, 14 female Comorbidity reported/details: "varying degrees of intellectual and/or physical impairments" Number of participants at baseline: 36 Number of participants at final evaluation: 36 Selection of the participants for the intervention: all attended a university clinic for people with special needs

Interventions	**Comparison: electric toothbrush versus manual toothbrush** **Comparison: special manual toothbrush versus conventional manual toothbrush** Group 1: Dentacare-Sonodent electric toothbrush, with verbal and written instruction Group 2: Superbrush special manual toothbrush with verbal and written instruction Group 3: Oral B Cross manual toothbrush with verbal and written instruction The same toothpaste was used by all groups
Outcomes	1. Modified Quigley-Hein Plaque Index (V) 2. API (V) 3. Papilla Bleeding Index (V) Timing of outcome assessments: baseline and week 2 for each of the 3 cross-over time points, with 2-week washout periods
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical) Potential Intervention functions: training, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both With or without dental professional involvement: with - dentist Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: short duration Modifications to the intervention: none reported Adverse effects: yes, noise and vibration of electric toothbrush, size of head of both electric and Superbrush Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "In order to ensure the reliability, the classification into order groups and the allocation of the test toothbrushes was carried out by means of a lottery procedure by a third person."
Allocation concealment (selection bias)	Low risk	Quote: "The allocation of the test toothbrushes was carried out by means of a lottery procedure by a third person."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Comment: not possible to blind participants or personnel
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The examining dentist therefore at no time knew which toothbrush was being tested by a subject," p. 59

Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol, but all listed outcomes were reported.

Dôgan 2004

Methods	Study design: RCT - stratified randomisation, cross-over with 3 arms Date of study: not stated, but prior to 2004 - "received for publication 1st October 2004" Study duration: 5 weeks (including 2 weeks' washout) Location: Turkey Setting: school Ethical approval: yes, p. 351 Consent: yes
Participants	Description of ID used: "mild mental disability," according to their IQ level, p. 351 Conversion to ICD description: mild Age range (mean): 6-18 years (not reported) Sex: not reported Comorbidity reported/details: not reported Number of participants at baseline: 30 Number of participants at final evaluation: unclear Selection of the participants for the intervention: children attending the same class
Interventions	**Comparison: electric toothbrush versus manual toothbrush** **Comparison: special manual toothbrush versus conventional manual toothbrush** Group 1: Oral B Braun electric toothbrush, with instruction Group 2: Superbrush special manual toothbrush with instruction Group 3: Oral B Cross Action manual toothbrush with instruction Brushing time 3 minutes twice a day. All groups used same toothpaste throughout study
Outcomes	1. Modified Quigley-Hein Plaque Index (V) 2. API (V) Timing of outcome assessments: baseline and week 1, for each arm, with 1-week washout period
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical) Potential Intervention functions: training, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: unclear With or without dental professional involvement: with - dental profession unclear Other stakeholders: unclear, no mention of who supervised brushing
Notes	Strengths and weaknesses: data reported for the final arm only Modifications to the intervention: none reported Adverse effects: none reported

Dôgan 2004 (*Continued*)

| | | Funding source: "Thanks to Braun and Denta Co. AS for their free sample supplements." |

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "The children were randomly assigned to three groups," p. 351 Comment: no further details provided.
Allocation concealment (selection bias)	Unclear risk	Comment: no further details provided.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Comment: not possible to blind participants or personnel.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote "the same examiner, whose identity was concealed to the children," p. 35 Comment: confusing statement.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Comment: no details of dropouts reported.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Ferozali 2007

Methods	Study design: RCT - participants assigned to groups randomly Date of study: not stated, but after 2000 and pre-2007. Quote: "In 2000 prior to the current study…" Study duration: 90 days Location: USA Setting: residential Ethical approval: yes. Quote: "local and state institutional review board approval," p. 169. Comment: assumed adequate Consent: yes
Participants	Description of ID used: "developmentally disabled with profound mental retardation" Conversion to ICD description: profound Age range (mean): 31-79 years (53.6 years) Sex: male 26, female 10 Comorbidity reported/details: quote: "Enteral feeding, hiatal hernia, emesis, gastro-oesophageal reflux disease or swallowing problems" Number of participants at baseline: 36 Number of participants at final evaluation: 32 Selection of the participants for the intervention: dependent on nursing staff to carry

	out activities of daily living
Interventions	**Comparison: special manual toothbrush versus conventional manual toothbrush** Group 1: oral cleansing with a single-use suction toothbrush with sodium bicarbonate and a 1.5% hydrogen peroxide solution. Intermittent oral suctioning was given during the cleansing procedure Group 2: toothbrushing with a traditional toothbrush with sodium bicarbonate and a 1.5% hydrogen peroxide solution. Intermittent oral suctioning was provided as needed with a tonsil suction device during the cleansing procedure Group 3: oral cleansing with a traditional toothbrush and regular fluoride toothpaste was provided as before the study. Intermittent oral suctioning was provided as needed with a tonsil suction device during the cleansing procedure Group 1 and 2 only were eligible for inclusion in this review
Outcomes	1. Oral health assessment using a simplified Beck Oral Assessment Tool - tongues, lips, oral mucosa and gums 2. Bacterial load was assessed using oral cultures (V) Timing of outcome assessments: 1. baseline, midway and day 90; 2. baseline and final
COM-B System Characteristics	Potential sources of behaviour change: opportunity (physical) Potential Intervention functions: environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienist Other stakeholder involvement: nursing staff carried out the toothbrushing
Notes	Strengths and weaknesses: quote: "All groups were brushed for one minute" twice daily, p. 170 Modifications to the intervention: none reported Adverse effects: quote: "Tested for allergies at outset." No adverse effects reported, p. 170 Funding source: quote: "Sage Products donated the suction brushes, but provided no additional funding (Sage Products, Inc., Cary, IL)," p. 169

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Assignment to groups was determined by a computer-generated table of purely random numbers," p. 169
Allocation concealment (selection bias)	Low risk	Comment: no details provided but probably done as randomisation process was good
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided; teeth were brushed by carers.

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Oral health - quote: "scored according to observations made by the dental hygienist who was blinded to the group membership of the participants." Bacterial load - quote: "investigator who was blinded to group membership," p. 170
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: missing data fully explained.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Garcia-Carrillo 2016

Methods	Study design: cluster RCT - quote: "Cluster-randomised single-blinded (examiner) clinical trial" Date of study: April 2014 Study duration: 6 months Location: Spain Setting: school Ethical approval: quote: "The regional ethical committee approved (13/302-E, 7 August 2013) the informed consents and the protocol," p. 2 Consent: yes
Participants	Description of ID used: "The mean IQ was 60.6, ranging between 44 and 87," p. 4. "Only two categories of ID were included, light (n [number of participants] = 54) and limit (n = 10)," p. 4 Conversion to ICD description: mild and moderate Age range (mean): 18-65 years (34.5 years) Sex: 34 male, 30 female Comorbidity reported/details: anxiety disorder, epilepsy, ocular tension, chronic bronchitis, asthma, hepatitis C, hypertension and depression, right leg hemiparesis, type 2 diabetes, hypothyroidism, paranoid schizophrenia, thyroid problems, p. 4 Number of participants at baseline: 64 Number of participants at final evaluation: 60 Selection of the participants for the intervention: support groups (clusters) for those with limited or moderate ID were recruited
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Both groups brushed for 2 minutes, monitored by a trained supervisor with written instructions, for the first 3 months Group 1: Sonicare, Philips electric toothbrush Group 2: Vitis Access, manual toothbrush
Outcomes	Outcomes measured "were scored four sites per tooth in two randomly (by coin toss) selected quadrants (one in the upper jaw, one in the lower jaw, contralateral - Bentley & Disney 1995."

	1. Gingival Index (Löe 1963) 2. Plaque Index (Silness 1964) 3. Calculus - presence or absence 4. Presence of adverse effects was assessed by a visual inspection at each study visit Timing of outcome assessments: baseline, 3 months, 6 months
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical) Potential intervention functions: training, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholder involvement: trained monitor ("special educators, with different university degrees in pedagogy"), p. 2
Notes	Strengths and weaknesses: quote: "The obtained results, therefore, should be interpreted with caution and only should be extrapolated to populations with mild ID and fine motor skills," p. 9 Modifications to the intervention: none reported Adverse effects: none reported from either toothbrush, some bleeding related to periodontal status, p. 5 Funding source: quote: "This study was supported by an unrestricted grant from the Phillips Oral Healthcare, by means of a research contract (362/2013) with University Complutense."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "a computer-generated randomization list, by an external agent," p. 2
Allocation concealment (selection bias)	Low risk	Quote: "a computer-generated randomization list, by an external agent," p. 2 Comment: allocation concealment probably achieved.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: unclear if personnel were blinded; study was a cluster study so participants were most likely blinded
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "by a single calibrated and trained examiner, blinded to the group allocation." "The clinical evaluators were not aware of the group assignment or involved in the randomization process," p. 3

Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: all outcomes reported, detailed levels of reporting, low levels of attrition; reasons for loss not related to outcomes
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Gertenrich 1967a

Methods	Study design: NRCT - quote: "were divided into four equal groups," p. 155 Date of study: not stated, pre-1967 Study duration: 20 weeks Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "Cerebral palsied patients and mentally retarded but trainable patients" with IQ ranging from 30 to 95 for people with cerebral palsy and 30 to 50 for people with mental retardation, p. 155 Conversion to ICD description: mixed with some IQ > 70 Age range: 15-30 years Sex: 30 male, 6 female Comorbidity reported/details: cerebral palsy Number of participants at baseline: 39 Number of participants at final evaluation: 38 Selection of the participants for the intervention: no details given
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Group 1a: cerebral palsy unit - attendants brushed with Oral B Automatic Toothbrush Arcuate actions electric toothbrush Group 1b: cerebral palsy unit - attendants brushed with a manual toothbrush Group 2a: "trainable" unit - attendants brushed with Oral B Automatic Toothbrush Arcuate actions electric toothbrush Group 2b: "trainable" unit - self-brushed with Oral B Automatic Toothbrush Arcuate actions electric toothbrush Group 2c: "trainable" unit - attendants brushed with a manual toothbrush Group 2d: "trainable" unit - self-brushed with a manual toothbrush IQ: Group 1 30-95; Group 2 30-50 We combined data from self-brushers and attendant brushed participants for each brush type, for analysis
Outcomes	1. Oral hygiene categories: good, fair, poor and very poor: 1-4, higher scores are poorer (UV) 2. Gingival Inflammation categories observed: absent, obvious gingivitis, decrease in severity (UV) 3. Some subjective feedback from attendants (UV) Timing of outcome assessments: baseline, weekly for 8 weeks, final at week 8 and follow-

	up at week 20 (reported 3)
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: training, enablement, coercion (for carers only), environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienists Other stakeholder involvement: attendants who brushed the participants' teeth
Notes	Strengths and weaknesses: multiple modifications to the intervention Modifications to the intervention: in the "trainable units" using the electric toothbrush, both attendant brushed and self-brushers returned to using manual brushes for the follow-up period. The improvements in both the cerebral palsy groups occurred "due to the direct supervision by members of the institution's nursing staff," p. 159 Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Comment: no mention of randomisation.
Allocation concealment (selection bias)	Unclear risk	Comment: no details given.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details given.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessors did not know to which group the subjects were assigned, p. 147
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: 1 dropout. No reason given, but unlikely to have affected outcomes
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Gertenrich 1967b

Methods	Study design: NRCT - quote: "children were divided into two groups," p. 145 Date of study: not reported, pre-1967 Study duration: 21-28 weeks Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "Mongoloid and others possessing an average IQ of 20." Later described as an IQ from 0 to 20 Conversion to ICD description: severe or profound Age range: 5-25 years Sex: males 52, females 18 (Table 1, p. 146) Comorbidity reported/details: quote: "requiring intensive care," No other details reported Number of participants at baseline: 75 (Table 2 and 3, p. 146 - numbers did not match Table 1) Number of participants at final evaluation: 72 Selection of the participants for the intervention: no details reported
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Group 1: participants with Down's syndrome had teeth brushed twice a day with an Oral B Automatic Toothbrush - Arcuate actions by attendants who were told oral hygiene would be monitored after initial 8 weeks Group 2: participants with Down's syndrome had teeth brushed twice a day with manual toothbrush by attendants who were told oral hygiene would be monitored Group 3: participants with "low IQ" had teeth brushed twice a day with an Oral B Automatic Toothbrush - Arcuate actions by attendants who were told the intervention was finished and oral hygiene would be not be monitored after initial 8 weeks Group 4: participants with "low IQ" had teeth brushed twice a day with a manual toothbrush by attendants who were told the intervention was finished and oral hygiene would be not be monitored after initial 8 weeks We combined data for the participants with Down's syndrome and "low IQ" for the toothbrush types, for analysis
Outcomes	1. Oral hygiene categories: good, fair, poor and very poor: 1-4, higher scores were poorer (UV) 2. Gingival inflammation categories observed: absent, obvious gingivitis, decrease in severity (UV) 3. Some subjective feedback from attendants (UV) Timing of outcome assessments: 1. weekly, for 20-28 weeks, 2. baseline, 8-10 weeks, and 20-28 weeks
COM-B System Characteristics	Potential sources of behaviour change: opportunity (physical), motivation (reflective) Potential intervention functions: coercion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienists Other stakeholder involvement: attendants brushed the participants' teeth

Notes	Strengths and weaknesses: subjective measure of oral hygiene and gingival inflammation Modifications to the intervention: unclear; the interval of follow-up may have been extended due to the outbreak of mumps and measles in 2 groups Adverse effects: unclear - authors refer to "apparent disadvantages" of using an electric toothbrush, but it is unclear if these disadvantages arose in this study," p. 150 Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Comment: no report of randomisation - participants were divided equally, with equal numbers of males and females in each group
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessors did not know to which group participants were assigned, p. 147
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Comment: 3 dropouts but no reasons given. Unlikely to affect outcome
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Gertenrich 1967c

Methods	Study design: NRCT. Quote: "Each group were divided into two equal sub groups," p. 151 Date of study: not stated, pre-1967 Study duration: 34 weeks Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: IQ range 0-20 (Level V AAMD) "Only a few could talk and none was self-fed or toilet-trained," p. 150 Conversion to ICD description: severe to profound Age range: 2-12 years Sex: male 24, female 24

	Comorbidity reported/details: all non-ambulatory, p. 150 Number of participants at baseline: 48 Number of participants at final evaluation: 48 Selection of the participants for the intervention: "selected at random," p. 150
Interventions	**Comparison: electric toothbrush versus manual toothbrush** All attendants were given training in toothbrushing techniques Group 1: hydrocephaly and seizure unit participants had their teeth brushed by the attendants, using an "Oral B Automatic Toothbrush - Arcuate actions" electric toothbrush Group 2: hydrocephaly and seizure unit participants had their teeth brushed by the attendants, using a manual toothbrush Group 3: paediatric unit participants had their teeth brushed by the attendants, using an "Oral B Automatic Toothbrush - Arcuate actions" electric toothbrush Group 4: paediatric unit participants had their teeth brushed by the attendants, using manual toothbrush We combined data from the hydrocephaly and seizure units and from the paediatric units were combined for each toothbrush type, for analysis
Outcomes	1. Oral hygiene categories: good, fair, poor and very poor: 1-4, higher scores were poorer (UV) 2. Gingival inflammation categories observed: absent, obvious gingivitis, decrease in severity (UV) 3. Some subjective feedback from attendants (UV) Timing of outcome assessments: baseline, weekly for 8 weeks, follow-up 20-34 weeks. Reported 0, 8, 20 and 34 weeks
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: training, enablement, coercion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienists Other stakeholder involvement: attendants brushed the participants' teeth
Notes	Strengths and weaknesses: no effort made to certify that each participant was brushed twice daily as instructed. Researcher suspected it was not happening in some groups Modifications to the intervention: findings of the study were discussed with groups 1 and 2 at 20 weeks due to the attendants failing to brush twice daily or even daily in these groups. This resulted in changes to the organisation of the attendants, which may have impacted on the 28-week results, p. 156 Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement

Gertenrich 1967c   (*Continued*)

Random sequence generation (selection bias)	High risk	Comment: no reported randomisation - groups divided equally.
Allocation concealment (selection bias)	Unclear risk	Comment: no details given.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details given.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessors did not know to which group the participants were assigned, p. 147
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Gertenrich 1967d

Methods	Study design: NRCT Date of study: not stated, pre-1967 Study duration: 24 weeks Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "mildly retarded patients, educable group, classed as "slow learners." Conversion to ICD description: mild or IQ > 70 Age range (mean): 13-18 years Sex: 22 male, 22 female Comorbidity reported/details: none reported Number of participants at baseline: 43 Number of participants at final evaluation: 41 Selection of the participants for the intervention: no details reported
Interventions	**Comparison: electric toothbrush versus manual toothbrush** "Attendants were trained in the proper techniques and provided supervision and assistance," p. 161 Group 1: self-brushed with an Oral B Automatic Toothbrush Arcuate actions electric toothbrush Group 2: self-brushed with a manual toothbrush

Gertenrich 1967d *(Continued)*

Outcomes	1. Oral hygiene categories: good, fair, poor and very poor: 1-4, higher scores were poorer (UV) 2. Gingival Inflammation - categories observed: absent, obvious gingivitis, decrease in severity (UV) Timing of outcome assessments: baseline, 8 weeks and 24 weeks. No report of the weekly assessment from 0 to 8 weeks but it did appear to have been recorded in the graphs
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical) Potential intervention functions: training, enablement, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental hygienists Other stakeholder involvement: attendants who supervised and assisted
Notes	Strengths and weaknesses: IQ level of some participants in this study may have been > 70 Modifications to the intervention: none reported Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Comment: no evidence of randomisation.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Comment: assessors did not know to which group the participants were assigned, p. 147
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: 2 dropouts, 1 from each group. No reason given, but unlikely to have impacted on outcomes
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Glassman 2006

Methods	Study design: NRS - "multiple baseline design" Date of study: not given, pre-2006 Study duration: 3-hour training session with trainer/observer providing feedback for 142-156 days, plus telephone call follow-up 1 month after study end Location: USA Setting: residential Ethical approval: none reported Consent: quote: "Informed consent documents were obtained for all participants," p. 29
Participants	Description of ID used: "with developmental disabilities," p. 39. "Mild to moderate mental retardation," p. 45. Moderate, severe (Table 1) Conversion to ICD description: mild, moderate and severe Age range: participants 20-54 years, carers: 27-54 years Sex: participants: 8 female, 3 male; carers: 7 female, 3 male Comorbidity reported/details: yes, blind, deaf, heart defect, seizures, cerebral palsy Number of participants at baseline: 11 participants; 10 carers Number of participants at final evaluation:11 participants; 10 carers Selection of the participants for the intervention: selected to participate carers interested in improving their knowledge of preventive dentistry, p. 39
Interventions	**Comparison: training of carer versus no training of carer** Carers received 2 × 3-hour classes in preventive dentistry and basic applied behavioural principles using a training package "Overcoming obstacles to Dental Health," p. 41. Field observers provided ongoing verbal feedback and made supportive suggestions during the intervention. Toothbrushing sessions were videotaped. 3 settings
Outcomes	1. Social validation of client's abilities with regard to oral hygiene - 8 questions on 6-point scale completed by carers 2. Carers' perception of training - 6 open-ended questions via telephone 3. Plaque score 4. Carers' presence during toothbrushing 5. Observed % of tooth surfaces brushed 6. Duration of brushing Timing of outcome assessments: 1. baseline, final; 2. 1-month follow-up; outcomes 3-6 - assumed daily Details and tables unclear. Details requested from authors (no response)
COM-B System Characteristics	Potential sources of behaviour change: carer: capability (physical/psychological), opportunity (social/physical), motivation (reflective). People with ID: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: carers: education, training, enablement, incentivisation, environmental restructuring; people with ID: training, modelling, persuasion
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental assistant, dental hygienist Other stakeholder involvement: carers

Notes	Strengths and weaknesses: quote: "The issue of caregiver participation was problematic for the researchers throughout the project," p. 45. Carers received compensation for their participation; no conflict likely. Intervention developers appeared to have evaluated their own intervention Modifications to the intervention: a specific instruction to the carers to apply the training in practice was added to the intervention, p. 44 Adverse effects: none reported. Funding source: none reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Was the intervention independent of other changes? (ITS)	Unclear risk	Comment: no details provided. Length of intervention made it possible that other changes had occurred
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis was the point of intervention. The direction of the outcomes was clearly stated, pp. 40-1
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection
Was knowledge of the allocated interventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind participants or personnel.
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: no missing data.
Was the study free from selective outcome reporting? (ITS)	Unclear risk	Comment: poor image quality of data table 1.

Gonzalez 2013

Methods	Study design: RCT Date of study: no details given, pre-2003 Study duration: 30 or 90 minutes Location: USA Setting: residential, p. 293 Ethical approval: expedited approval was obtained from the Human Research Review Committee (HRRC) at the University of New Mexico prior to the initiation of this study. Study and protocol number HRRC#: 09-456," p. 294 Consent: yes - "After consent forms were obtained," p. 294.
Participants	Description of ID used: "developmental disabilities" Conversion to ICD description: unclear Age range: not reported Sex: male 8, female 14, not reported for 2 participants Comorbidity reported/details: none reported Number of participants at baseline: 30 Number of participants at final evaluation: 24 Selection of the participants for the intervention: a convenient sample
Interventions	**Comparison: training of carers versus no training of carers** Group 1: 90-minute lecture and hands-on seminar were presented covering topics in oral health for people with developmental disabilities including tooth brushing techniques, plaque removal, progression of periodontal disease and techniques on how to approach a patient with challenging behaviour when performing oral hygiene Group 2: 30-minute discussion among the participants on familiar topics
Outcomes	1. Knowledge and comprehension regarding oral health topics - 20 questions Timing of outcome assessments: immediately pre- and postintervention
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (social/physical), motivation (reflective) Potential intervention functions: education, training, modelling, enablement
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental hygienist Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: existing knowledge high. Confusion regarding answer options and venue. Validity of tool is unclear; 2 different questionnaires were used for baseline and final Modifications to the intervention: none reported Adverse effects: levels of stress and fatigue completing the questionnaire was assessed, none reported; "No harms were expressed by any of the participants at the conclusion of the study," p. 295 Funding source: caregivers received compensation for participation; no likely conflict of interest

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Enrolment was established on voluntary participation and assigning participants randomly to either group A (experimental) or group B (control) based on phone calls. Random assignment of the research subjects to one of two sites was completed by the health coordinator/recruiter of ARCA," p. 294 Comment: probably done
Allocation concealment (selection bias)	Low risk	Quote: "Enrolment was established on voluntary participation and assigning participants randomly to either group A (experimental) or group B (control) based on phone calls. Random assignment of the research subjects to one of two sites was completed by the health coordinator/recruiter of ARCA," p. 294 Comment: probably done
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: both participants and recruiter were blinded as to which group was experimental or control. The study took place at 2 different ARCA locations the same day and same time, p. 294
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: no report of blinding.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: reason for missing data is not related to the outcomes Quote: "Two participants showed up to wrong location, one participant did not complete tests accurately and two others did not show up to the study."
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Jarman 1983

Methods	Study design: ITS Date of study: not stated, pre-1983 Study duration: 29-30 weeks Location: USA Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "moderately to severely mentally retarded" Conversion to ICD description: severe Age range (mean): 14-57 years (21.5 years) Sex: mixed Comorbidity reported/details: yes, cerebral palsy, all but 2 required a wheel chair or upright walker Number of participants at baseline: 40 Number of participants at final evaluation: 40 Selection of the participants for the intervention: participants were living on the same unit in a residential facility
Interventions	**Comparison: training for people with ID versus no training of people with ID** Development of 6 skills in a morning personal care routine, of which only 1 skill, the toothbrushing skill, was relevant Group 1: use of reinforcement procedures; token reinforcement programme, single response contingency and chained response contingency, in developing a toothbrushing routine, p. 114 Group 2: no training
Outcomes	1. Performance of the skill at each stage of training 2. Improvement scores for individuals Timing of outcome assessments: daily, reported as mean at week 7 (baseline), week 25 (single contingency) and week 29 (chained contingency)
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: training, enablement, persuasion, incentivisation, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholder involvement: unit director, supervisors, attendants
Notes	Strengths and weaknesses: "…intensive instruction had been provided to each resident prior to the beginning of the study and all residents exhibited some initial competence in each skill," p. 119. "individual performance criteria was seen as an essential consideration," pp. 119-20 Modifications to the intervention: none reported Adverse effects: none reported Funding source: "The research was supported in part by Gran #00917-15-0 from the Maternal and Child Health Service."

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Was the intervention independent of other changes? (ITS)	High risk	Comment: training method was being used for 5 other personal skills at the same time
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis was the point of intervention
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection
Was knowledge of the allocated interventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind.
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: no incomplete data.
Was the study free from selective outcome reporting? (ITS)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Kaschke 2005

Methods	Study design: RCT 3-way cross-over trial Date of study: not stated, prior to 2004 (thesis by Zeller 2004) Study duration: 2 weeks for each arm, with 2-week washouts, 12 weeks in total Location: Germany Setting: unclear Ethical approval: yes Consent: not reported
Participants	Description of ID used: "varying degrees of intellectual and/or physical impairments" - author confirmed by email that all participants had an ID Conversion to ICD description: mixed Age range (mean): 18-45 years Sex: not reported Comorbidity reported/details: "varying degrees of intellectual and/or physical impairments," p. 66 Number of participants at baseline: 36 Number of participants at final evaluation: 36 Selection of the participants for the intervention: all attended a university clinic for patients with special needs

Interventions	**Comparison: electric toothbrush versus manual toothbrush**
	Comparison: special manual toothbrush versus a conventional manual toothbrush
	Group 1: Teledyne Waterpik Sonic Toothbrush, with verbal and written instruction
	Group 2: Superbrush special manual toothbrush with verbal and written instruction
	Group 3: Oral B Cross manual toothbrush with verbal and written instruction
	The same toothpaste was used by all groups.
Outcomes	1. Modified Quigley-Hein Plaque Index (V)
	2. API (V)
	3. Papilla Bleeding Index (V)
	Timing of outcome assessments: week 2 for each arm
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical)
	Potential intervention functions: training, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both
	With or without dental professional involvement: with - dentist
	Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: short duration
	Modifications to the intervention: none reported
	Adverse effects: reported - fear/uncertainty in relation to the noise/movement of the electric toothbrush, vibration of electric toothbrush cause participants to spasm resulting in breakage of electric toothbrush (thesis by Zeller 2004).
	Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Comments: no details provided.
Allocation concealment (selection bias)	Unclear risk	Quote: "blind study"
		Comment: unclear who was blinded.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Comment: cross-over trial, not possible to blind participants or personnel
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "All examinations of the oral hygiene status were conducted by one examiner who had no knowledge about the toothbrush used by each subject," p. 67
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data.

Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported; no baseline data reported

Kelner 1963

Methods	Study design: RCT Date of study: not provided, pre-1963 Study duration: 4 months Location: USA Setting: school, day centre Ethical approval: not reported Consent: yes
Participants	Description of ID used: "mental retardates" Conversion to ICD description: unclear Age range (mean): 4-32 years Sex: not reported Comorbidity reported/details: not reported Number of participants at baseline: 108 Number of participants at final evaluation: 100 Selection of the participants for the intervention: participants were enrolled in a nursery or work training centre sponsored by a local service organisation
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Group 1: automated electric toothbrush (Broxodent) with instruction Group 2: conventional toothbrush with instruction
Outcomes	1. Hygiene deposits (subjective) (UV) 2. Gingival condition (subjective) (UV) 3. General evaluation (UV) Timing of outcome assessments: baseline, month 4
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical) Potential Intervention functions: education, training, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: non-formal With or without dental professional involvement: with - dentist and dental student Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: use of subjective assessments Modifications to the intervention: none reported Adverse effects: none reported Funding source: Broxodent supplied by ER Squibb and Sons (manufacturer)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "selections were made at random," p. 103. No details of randomisation process
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: some of the participants in both groups had their teeth brushed by their parents (no details on how many); both groups given OHI
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: groups…"were made known to the examiner upon the completion of the follow-up examination," p. 103
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: dropouts were unrelated to the study
Selective reporting (reporting bias)	High risk	Comment: some aspects of the methodology were not reported (brushing frequency, who brushed, dental treatment received during the 4-month trial)

Kissel 1983

Methods	Study design: ITS Date of study: not stated, pre-1983 Study duration: 100 days Location: USA Setting: residential Ethical approval: none reported Consent: unclear - staff recommended for training and agree to participate
Participants	Description of ID used: "severely and profoundly retarded…(IQ range = 8 to 21)" Conversion to ICD description: severe and profound Age: staff: mean 25 years; residents: range 8-16 years Sex: staff: female 4; residents: male 9, female 3 (Figures 2, 4 and 6) Comorbidity reported/details: none reported Number of participants at baseline: 4 staff and 12 residents Number of participants at final evaluation: 4 staff and 12 residents Selection of the participants for the intervention: staff recommended for training by the supervisors based on their perceived need for training
Interventions	**Comparison: training of carers of people with ID versus no training of carers** Group 1: staff were trained and given written materials necessary to teach their residents in a 9-step toothbrushing routine using verbal instruction, physical guidance and con-

	tingent reinforcement, received feedback on this teaching using a video of the teaching sessions, p. 397. 2 intensive training sessions were given to the staff, 1 at the start of the treatment session and 1 at the start of the maintenance sessions Group 2: no training
Outcomes	1. Staff scored on use of the 3 levels of skills used when training residents 2. Residents scored on their response at three levels - self-initiated, verbally instructed or physically guided responses 3. Residents scored on the number of steps achieved in the toothbrushing programme 4. Staff Acceptability Questionnaire (Table 3) Timing of outcome assessments: daily - data presented as mean score during baseline and maintenance phases (100 days)
COM-B System Characteristics	Potential sources of behaviour change: staff: capability (physical/psychological), opportunity (social/physical), motivation (reflective); residents: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: staff: training, modelling, enablement, incentivisation, coercion, restrictions, environmental restructuring; residents: training, modelling, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholder involvement: observers (2 administrators, a speech and hearing therapist, a graduate student intern)
Notes	Strengths and weaknesses: "continual presence of observers could have effected outcomes, " "use of videotape feedback greatly aided staff learning," "the training program was found to be very time efficient, with each participant receiving only 3-4 hours of individual instruction from the experimenter during the 6 months of the project," p. 414 Modifications to the intervention: 1 staff member and resident started the programme later than the others, at session 36 Adverse effects: none reported Funding source: "This research was supported in part by a training grant from the National Institute of Health (1 T32 HDO7184-02)," p. 395

Risk of bias

Bias	Authors' judgement	Support for judgement
Was the intervention independent of other changes? (ITS)	High risk	Comment: training method was being used for 2 other personal skills at the same time
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis is the point of intervention.
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection

Was knowledge of the allocated inter-ventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind.
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: no incomplete data.
Was the study free from selective outcome reporting? (ITS)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Lange 1985

Methods	Study design: quasi-RCT Date of study: not stated, pre-1981 Study duration: 11 weeks Location: USA (based on author address) Setting: residential Ethical approval: unclear, "Prior to beginning the study the research proposal was reviewed by the administrative staff of L.O.M.R.disseration" thesis, p. 28 Consent: Yes, "informed consents had to be obtained from subjects and their guardians, " "a release of information was signed by the subject and his/her guardian," thesis, p. 28
Participants	Description of ID used: mild and moderate mentally retarded. Thesis, p. 30 Conversion to ICD description: mild (9 participants) and moderate (6 participants) Age range: 16-39 years Sex: male 7, female 8 Comorbidity reported/details: none reported Number of participants at baseline: 15 Number of participants at final evaluation: 15 Selection of the participants for the intervention: no details
Interventions	**Comparison: training of people with ID versus no training of people of ID** Group 1: carers disclosed and recorded plaque levels, participants trained by carers to remove all disclosed plaque by toothbrushing. Verbal and physical instruction was provided if needed. Praise given as feedback and faded as steps achieved. Maintenance - participants told they would be monitored on a regular basis Group 2: carers disclosed and recorded plaque levels after the participant had brushed; no training provided to participants Group 3: no regular recording of plaque levels or training.
Outcomes	1. Plaque Index scored 0-3 2. Gingival Index scored 0-3 Timing of outcome assessments: plaque - daily, gingival - weekly. Data presented as mean scores collected over the baseline and maintenance periods (5-7 weeks)
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), motivation (reflective) Potential intervention functions: training, modelling, enablement, persuasion, environ-

	mental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without - assessor was trained in the use of the periodontal probe Other stakeholder involvement: house parents and aides in homes
Notes	Strengths and weaknesses: self-help skills process was already in use in the facility for other life skills. Group 3 outcomes were only recorded at final time point Modifications to the intervention: participants were to record their own plaque scores, but none were able to achieve this skill, so it was recorded by the staff. The baseline period need to be extended due to unstable plaque levels. Some participants continued to require cues to complete the toothbrushing task throughout the study Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomised into matching groups by age, sex and functioning ability." Comment: no further details provided.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: not possible to blind personnel, unclear if participants were blinded
Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "Throughout the study each subject's plaque and gingival indexes were measured and recorded by the staff and/or the investigator." Thesis, p. 36
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported. Group 3 had only 1 time point measured (final)

Lange 2000

Methods	Study design: NRCT Date of study: not stated, pre-2000 Study duration: 21 days Location: USA Setting: residential Ethical approval: none reported Consent: "After explaining the study to the parents and/or legal guardians of the clients, the researchers provided the institution administration with a signed informed consent for each client included in the study," p. 206
Participants	Description of ID used: "moderately to profoundly mentally retarded" p. 207 Conversion to ICD description: moderate to profound Age (mean): intervention group: 43 years (SD 12), control group: 42 years (SD 12) Sex: male 42, female 34 Comorbidity reported/details: none reported Number of participants at baseline: 64 Number of participants at final evaluation: paired data 60/61 Selection of the participants for the intervention: selected by unit directors
Interventions	**Comparison: training of carers versus no training of carers** New policy for toothbrushing twice a day introduced, old policy indicated 4 times a day Group 1: training with accountability - care staff were trained by dental professionals to help clients brush, to brush for the non-compliant clients and disclose and chart the plaque levels and informed about new policy. Feedback was given and copies given to the unit leaders Group 2: training without accountability - care staff were trained by staff development personnel on how to brush and monitor their own oral hygiene and informed about new policy. They were instructed to put this training into use with their clients and trained to monitor client progress Group 3: no training, so not informed about change to toothbrushing policy We combined data from groups 1 and 2.
Outcomes	1. Plaque Index - Modified Ramfjord Periodontal Disease Index - plaque only, on 6 standard teeth, with disclosing solution, p. 206 Timing of outcome assessments: Group 1 and Group 2: baseline, 7, 14 and 21 days. Group 3: baseline and 21 days
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential intervention functions: education, training, modelling, enablement, incentivisation, coercion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental assistant, dental hygienist Other stakeholder involvement: administration, living unit directors, staff development department, registered general nurse, dental department staff, carers

Notes	Strengths and weaknesses: short duration, potential additional expenses - additional staff to provide monitoring/feedback Modifications to the intervention: none reported Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Comment: authors acknowledged that randomisation was not possible, p. 207
Allocation concealment (selection bias)	Low risk	Quote: "The unit director drew numbers to determine if their unit would be the control, training with accountability (experimental group 1) or training without accountability (experimental group II). They were not told the status of their unit," p. 206 Comment: assumed to be done correctly.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Quote: "Living unit staff, other than through staff development, had no opportunity to interact with staff from other living units," p. 208
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "The examiner did not know the client's group status at the time of the plaque assessment," p. 206
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: missing data clearly explained; unlikely to affect outcomes
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Mac Giolla Phadraig 2015

Methods	Study design: cluster RCT - the unit of randomisation was the residential home (Mac Giolla Phadraig 2015, p. 93). Date of study: July 2008 to September 2009 Study duration: 6-11 months Location: Ireland Setting: residential Ethical approval: "Ethical approval for the study was received from the relevant research ethics bodies," p. 93 (2015) Consent: yes - "consent and assent" figure 2, p. 94 (2015) "consent forms were sent to all care staff in the test organization two to 6 weeks before training was delivered to the intervention group," p. 185 (MacGiolla Phadraig 2013)
Participants	Description of ID used: "carer-reported severity of ID (mild to profound)" Conversion to ICD description: mixed (mild to profound) Age (mean): people with ID - intervention group: 43 years (SD 12); control group: 42 years (SD 12) Sex: carers: not reported; people with ID: 42 male 34, female, p. 95 (2015) Comorbidity reported/details: none reported Number of participants at baseline: people with ID 64, carers 187. Number of residential units: 50 Number of participants at final evaluation: people with ID - paired data 60/61, carers 154 Selection of the participants for the intervention: randomly selected from a large ID service provider
Interventions	**Comparison: training of carers versus no training of carers** Group 1: a day-long education and training session provided by oral health trainers, with practical sessions and a specifically designed training pack to train their peers with motivational discussion, a moral agreement with dental team and offer of ongoing support if needed Group 2: no training
Outcomes	1. Knowledge, behaviour, attitude and self-efficacy of carers via a questionnaire 2. Modified Gingival Index 3. Modified Silness & Löe Plaque Index - "no probe used / only surfaces visible to the researcher," p. 94 (2015) Timing of outcome assessments: baseline and 10 months
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential Intervention functions: education, training, modelling, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist, dental hygienist, oral health promoters Other stakeholder involvement: care staff, management

Notes	Strengths and weaknesses: "Almost a quarter of post-test respondents from the intervention group reported not having received training." Modifications to Plaque Index "which decreased sensitivity at the lower end of the scale," p. 94 (2015) Modifications to the intervention: none reported Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Each group was then randomly allocated as either control or intervention," p. 184 (2013) Comment: probably done.
Allocation concealment (selection bias)	Low risk	Comment: no details of randomisation method but probably done
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided in relation to blinding of personnel
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "One experienced dentist carried out all examinations following calibration exercises," p. 94. (2015) Comment: questionnaires were anonymous but no details of key holder
Incomplete outcome data (attrition bias) All outcomes	High risk	Comment: attrition rate of carers was high; no clear reason for dropouts identified
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Olmos 2016

Methods	Study design: RCT Date of study: September 2007 to February 2008 Study duration: 4 weeks Location: Germany Setting: residential Ethical approval: not reported Consent: not reported
Participants	Description of ID used: "special needs" Conversion to ICD description: unclear Age range (mean): 28-74 years (46.5)

	Sex: male 98, female 95 Comorbidity reported/details: none reported Number of participants at baseline: 193 Number of participants at final evaluation: 193 Selection of the participants for the intervention: invited to attend from a list of persons with disabilities in a city
Interventions	**Comparison: training of carers versus no training of carers** Group 1: carer and participant were provided with theoretical and practical training on oral hygiene Group 2: usual care
Outcomes	1. Type of toothbrush 2. Type of toothpaste 3. Frequency of fluoride application 4. Timing of toothbrushing 5. Duration of toothbrushing Timing of outcome assessments: baseline, week 4
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential intervention functions: education, training, motivation, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental assistant Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: short duration, followed up for 5 years, but the control group received the intervention immediately after this study so no long-term control Modifications to the intervention: none reported Adverse effects: none reported Funding source: yes. "The project has been carried out since 2005 by the non-profit Berliner Hilfswerk Zahnmedizin e.V. with the support of the Senate Department for Health and Social Affairs," (Olmos 2017)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "randomised assignment of the participants to a control and an intervention group." Comment: no details provided
Allocation concealment (selection bias)	Unclear risk	Comment: randomly assigned but no details provided.

Olmos 2016 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: no details provided.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Phlypo 2016

Methods	Study design: RCT Date of study: not stated, pre-2016 Study duration: 8 weeks Location: Belgium Setting: residential Ethical approval: yes Consent: yes - "For every selected resident, the parents or guardian granted their permission to participate," p. 5
Participants	Description of ID used: severe to profound ID Conversion to ICD description: severe, profound Age range (mean): not reported Sex: not reported Comorbidity reported/details: not reported Number of participants at baseline: 55 carers Number of participants at final evaluation: 34 carers Selection of the participants for the intervention: not reported
Interventions	**Comparison: training of carers versus no training of carers** Group 1: carers provided with an information booklet and 1 information session with practical skills Group 2: usual care
Outcomes	1. Knowledge, behaviour, attitude and self-efficacy of carers 2. Plaque Index of people with ID 3. Gingival Index of people with ID Timing of outcome assessments: 3 weeks before the intervention, 5 weeks' postintervention
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential intervention functions: education, training, enablement, environmental re-

	structuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental students Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: high attrition rate; short duration. A panel discussion with the resident dentists and director at baseline may have influenced the control group Modifications to the intervention: none reported Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Randomly selected to be clinically examined," p. 4. Comment: no details of process.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: no details provided.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: no details provided.
Incomplete outcome data (attrition bias) All outcomes	High risk	Comment: high attrition rate. Unclear why there were such high numbers who failed to complete assessment questionnaire or read the booklet
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol, but all listed outcomes reported.

Sauvetre 1995

Methods	Study design: RCT Date of study: not stated, pre-1995 Study duration: 21 days Location: Belgium Setting: day centre Ethical approval: "The study got the permission of the "Helsinki Commitions [Commissions] of the Brugmann University Hospital," "The authors respected all though the study the "Helsinki declaration" - (1989)," p. 116 Consent: none reported, but assumed as per Helsinki declaration
Participants	Description of ID used: "mental retardation," p. 116 Conversion to ICD description: unclear Age range (mean): 18-40 years Sex: not reported Comorbidity reported/details: none reported Number of participants at baseline: 25 Number of participants at final evaluation: 25 Selection of the participants for the intervention: randomly chosen from a day centre
Interventions	**Comparison: special manual toothbrush versus conventional manual toothbrush** All participants received instructions on how to brush "using the simplest method (horizontal movements with short strokes)." Asked to brush twice a day for at least 60 seconds. Reinstructed on day 7 Group 1: Superbrush, 3-headed toothbrush Group 2: Oral B P35, standard toothbrush
Outcomes	1. Plaque Index (Silness 1964) 2. Bleeding Index (Saxer 1975) for 6 standardised teeth (Ramfjord 1959). From 3 sites - buccal, mesial and lingual, p. 116 Timing of outcome assessments: baseline, day 7 and day 21
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical) Potential intervention functions: training, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: not reported With or without dental professional involvement: with - periodontist, dental hygienist Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: no mention if monitoring of toothbrushing took place; very short study Modifications to the intervention: 5 eliminated as unable to follow training to brush their teeth as was required, p. 116 Adverse effects: none reported Funding source: "This work was supported by DENTACO S.A. Norway," who produced the Superbrush

Risk of bias

Bias	Authors' judgement	Support for judgement

Random sequence generation (selection bias)	Low risk	Comment: reports randomly selected, double blind; probably done
Allocation concealment (selection bias)	Low risk	Comment: reports that the brushes were distributed by an oral hygienist immediately after the baseline assessment, who was not the assessor, p. 116. "Double blind trial" - probably done
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: control group were also asked to do something that was not usual care
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "double-blind trial" Comment: probably done.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Comment: 5 "intention to treat" participants were excluded as they were unable to follow the training
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Shaw 1983

Methods	Study design: RCT, cross-over trial Date of study: not stated, pre-1983 Study duration: 4 weeks for each arm of the trial Location: UK Setting: school Ethical approval: not reported Consent: parents gave consent for the project, p. 5.
Participants	Description of ID used: severely mentally retarded, p. 4 Conversion to ICD description: severe Age range: 9-16 years Sex: not reported Comorbidity reported/details: "a range of handicapping conditions," p. 4 Number of participants at baseline: 66 Number of participants at final evaluation: 53 Selection of the participants for the intervention: the schools agreed to participate; children selected by the staff
Interventions	**Comparison: electric toothbrush versus manual toothbrush** Individual OHI with a disclosing solution using the designated toothbrush. No specific technique was taught, but instructed to "get the stain off" and encouraged to adopt a systematic approach. All children brushed their own teeth, but with initial guidance and

	assistance. Brushing was carried out in the classroom for 5 minutes every day Group 1: Braun Electric rechargeable electric toothbrush Group 2: Oral B 30 manual toothbrush
Outcomes	1. Plaque Index - Silness & Löe (V) 2. Bleeding Index (WHO Technical Report No 621, 1971) on 6 selected teeth (V) Timing of outcome assessments: baseline, 4 weeks, (washout period during "a prolonged school holiday"), 4 weeks later
COM-B System Characteristics	Potential sources of behaviour change: capability (physical /psychological), opportunity (social/physical), motivation (reflective) Potential intervention functions: training, enablement, persuasion, incentivisation, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dentist and dental therapist Other stakeholder involvement: teachers
Notes	Strengths and weaknesses: "The teaching staff saw the project as one of socialisation and the development of self-care skills which they regarded as important. Class charts which were filled in with stars when the children had completed their brushing for the day served as a useful reminder for the staff and as motivation for the children," p. 5 Modifications to the intervention: none reported Adverse effects: none reported Funding source: "We are grateful to Braun Electric (UK) Ltd for the provision of rechargeable electric toothbrushes and to Cooper Health Products for the Oral B 30 toothbrushes," p. 5

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "The school staff randomly selected 66 children, randomly allocated to test or control," p. 4 Comment: probably done.
Allocation concealment (selection bias)	Low risk	Quote: "The school staff randomly selected 66 children, randomly allocated to test or control," p. 4 Comment: probably done.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Comment: not possible to blind participants or personnel.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "At no time was the examiner aware of the group to which the children had been assigned," p. 4

Incomplete outcome data (attrition bias) All outcomes	High risk	Comment: 20% attrition unexplained
Selective reporting (reporting bias)	Unclear risk	Comment: unclear if results are reported for the combined arms. Some midway results provided in text

Shaw 1991

Methods	Study design: cluster RCT Date of study: 1986-1988 Study duration: 2 years Location: UK Setting: day centre Ethical approval: none reported Consent: yes, p. 140 (Shaw 1991)
Participants	Description of ID used: "with mental handicaps," pp. 139-40 Conversion to ICD description: unclear Age (mean): 30.9 years (SD 10.1) Sex: males 168, females 161 (Shaw 1990, p. 137) Comorbidity reported/details: yes, "54.1% had a comorbidity reported," "Physical handicap, epilepsy, Down syndrome, speech difficulties and miscellaneous" (Shaw 1990, p. 136) Number of participants at baseline: 329 Number of participants at final evaluation: 304 Selection of the participants for the intervention: 4 largest training centres for adults in a UK city approached
Interventions	**Comparison: daily supervised toothbrushing and scheduled dental recall visits at 1-, 3- or 6-month intervals versus usual care** Group 1: no specific treatment Group 2: daily toothbrushing supervised by staff in the centre and reinforced OHI every 6 months Group 3: daily toothbrushing supervised by staff with prophylaxis and reinforced OHI every month Group 4: daily toothbrushing supervised by staff with prophylaxis and reinforced OHI every 3 months
Outcomes	1. DMFT - only reported at baseline WHO Technical Report using 6 standard teeth for 2. Plaque 3. Calculus 4. Periodontal pocketing 5. Bleeding Timing of outcome assessments: baseline, 3, 6, 12, 18 and 24 months

COM-B System Characteristics	Potential sources of behaviour change: carers and people with ID: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential intervention functions: carers: environmental restructuring. People with ID: training, enablement, persuasion, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - dental hygienist Other stakeholder involvement: staff supervising toothbrushing
Notes	Strengths and weaknesses: the difference in time involvement was very significant when cost assessments were made long-term, with applied models of professional support Modifications to the intervention: none reported Adverse effects: none reported Funding source: supported by a grant from the West Midlands Regional Health Authority, p. 140 (1990)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "Each of the centres was then randomly allocated to one of four treatment regimens," p. 140 Comment: no further details provided.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Comment: unlikely that each centre would have been aware of what the other centres were doing
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "All participants were examined at intervals of 3, 6, 12,18, and 24 months by the same examiner (MJS)." Comment: unclear if blinded or not.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: details of numbers of participants only provided at baseline and final measure (Table 1, p. 141), but clear reasons given for dropouts. Dropouts occurred in all groups and were unlikely to affect outcomes
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Snell 1989

Methods	Study design: repeat measure Date of study: not stated, pre-1989 Study duration: 3 years Location: USA Setting: school Ethical approval: none reported Consent: none reported
Participants	Description of ID used: "severe mental retardation" and "profound mental retardation" Conversion to ICD description: severe (2 participants) and profound (1 participant) Age range: 5-11 years Sex: males 2, females 1 Comorbidity reported/details: yes, severe quadriplegic, athetoid cerebral palsy, spastic cerebral palsy, visual impairment Number of participants at baseline: 3 Number of participants at final evaluation: 2 (1 lost at 19-month follow-up) Selection of the participants for the intervention: no details provided
Interventions	**Comparison: training of people with ID** Group 1: training in 3 tasks - toothbrushing (12 steps), rinsing (3 steps) and wiping mouth (2 steps) with verbal and physical prompting, which were gradually faded as the training continued, 30 minutes each school day. Praise and tokens used as motivators, which were faded over time. Maintenance started once the skills were completed without prompts for 3-5 days. In this phase, praise was only given on completion of the entire task. Training was reinstated if needed
Outcomes	1. Number of steps achieved for each task 2. Number of training sessions it took for the skill to be performed without prompting 3. Parents' awareness of changes in oral hygiene routine 4. Teachers' survey, 3 years' postintervention, "questioned on students skill retention," p. 221 Timing of outcome assessments: baseline, training (unclear, about 120 days), 4-7 months post, 19 months post, 3 years post
COM-B System Characteristics	Potential sources of behaviour change: capability (physical), opportunity (physical), motivation (reflective) Potential intervention functions: training, enablement, persuasion, incentivisation, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: without Other stakeholder involvement: teachers, speech therapist and occupational therapist, pp. 21-8
Notes	Strengths and weaknesses: small study; inconsistent measures at baseline; modifications to the training, provision of booster training during maintenance phase Modifications to the intervention: yes, as above Adverse effects: yes - reported informally, reference to 2 participants displaying sensitivity to mouths being held open, p. 220

	Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Was the intervention independent of other changes? (ITS)	Unclear risk	Comment: this type of training was used for other skills in the school
Was the shape of the intervention effect prespecified? (ITS)	Low risk	Comment: the point of analysis was the point of intervention
Was the intervention unlikely to affect data collection? (ITS)	Low risk	Comment: the intervention did not affect either the source or method of data collection
Was knowledge of the allocated interventions adequately prevented during the study? (ITS)	High risk	Comment: not possible to blind participants or personnel.
Were incomplete outcome data adequately addressed? (ITS)	Low risk	Comment: loss of 1 participant at 3-year follow-up was explained
Was the study free from selective outcome reporting? (ITS)	Low risk	Comment: all outcome data were reported.

Swallow 1969

Methods	Study design: RCT Date of study: not stated, pre-1969 Study duration: 21 days Location: UK Setting: residential Ethical approval: none reported Consent: none reported
Participants	Description of ID used: "mentally subnormal," p. 376, "mentally retarded," p. 376. "varying mental ability," p. 377 Conversion to ICD description: mixed Age range: 15-30 years Sex: 40 male, 40 female Comorbidity reported/details: none reported Number of participants at baseline: 80 Number of participants at final evaluation: 80 Selection of the participants for the intervention: total sample of patients in the setting examined in "an unbiased order" until 40 males and 40 females meeting the inclusion criteria were found, p. 377

Interventions	**Comparison 1: electric toothbrush versus manual toothbrush**
	Comparison 2: frequency of toothbrushing
	"Teeth were brushed in their own wards after breakfast or after the midday meal, brushed on alternate occasions by one of the two operators, in order to avoid bias," p. 377. Males and females were in 2 separate subgroups
	Group 1: teeth brushed once a day with an "automatic toothbrush" (supplied by Ronson Products Ltd)
	Group 2: teeth brushed once a day with a manual toothbrush (Colgate-Palmolive)
	Group 3: teeth brushed twice a week with an "automatic toothbrush" (supplied by Ronson Products Ltd)
	Group 4: teeth brushed twice a week with a manual toothbrush (Colgate-Palmolive)
	Group 5: teeth brushed once a week with an "automatic toothbrush" (supplied by Ronson Products Ltd)
	Group 6: teeth brushed once a week with a manual toothbrush (Colgate-Palmolive)
	Group 7: usual care - "rarely received any regular form of oral hygiene."
	We used data from Group 1 and 2 for Comparison 1. We combined data from electric and manual toothbrushes for each of the 3 frequency groups used for Comparison 2
Outcomes	1. Gingival Index (Silness & Löe) - "only the interdental papillae and the intervening gingiva on the buccal surfaces of all standing teeth were scored," p. 377
	2. Time spent brushing teeth
	Timing of outcome assessments: GI - baseline, day 21; brushing time - day 10
COM-B System Characteristics	Potential sources of behaviour change: opportunity (physical)
	Potential intervention functions: environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal
	With or without dental professional involvement: with - final year dental students, dentist
	Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: short intervention
	Modifications to the intervention: none reported
	Adverse effects: none reported
	Funding source: "Toothbrushes and toothpaste kindly supplied by Colgate-Palmolive. Toothbrushes kindly supplied by Ronson Products Ltd," p. 377 footnote

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "randomly allocated into 8 groups comprising 5 males and 5 females." Comment: probably done.
Allocation concealment (selection bias)	Low risk	Comment: probably done.

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Comment: not possible to blind personnel, brushing was carried out by dental students; participants may have been blinded as brushing was carried out in their own bathrooms/units
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Quote: "Subjects were again examined by the same independent observer (JNS) who had no knowledge of the grouping of the patients," p. 377
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: all participants completed the study, p. 377.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Teitelbaum 2009

Methods	Study design: NRCT - blind cross-over trial - only 2 of the 4 groups are relevant to this review Date of study: not stated, pre-2009 Study duration: 85 days of which 45 days were washout periods Location: Brazil Setting: residential Ethical approval: "This study was approved by the Joint Research and Ethics Committee of the Ponta Grossa State University Protocol: 05886 /06," p. 464. Consent: "They signed a consent form, according to the Helsinki II Declaration and the Dentistry Ethical Code (CONEP/ MS, Brazil)," p. 464
Participants	Description of ID used: "moderate mental retardation ("trainable" category, intelligence quotient 40 to 55)," p. 464. Down Syndrome Conversion to ICD description: mild to moderate Age range: 7-13 years Sex: mixed Comorbidity reported/details: exclusion criteria - excluded if any systemic disease Number of participants at baseline: 40 Number of participants at final evaluation: 40 Selection of the participants for the intervention: participants were "invited to participate"
Interventions	**Comparison: disclosing agent versus no disclosing agent** Carers invited for instruction on oral hygiene. Provided with a child's toothbrush, test toothpaste and detailed instructions. Instructed to brush 3 times a day. During the washout phase, carers returned to usual habits, using fluoridated toothpaste and toothbrush Group 1: fluoridated toothpaste

	Group 2: fluoridated toothpaste with plaque-disclosing agent Group 3: fluoridated toothpaste + chlorhexidine Group 4: fluoridated toothpaste + chlorhexidine + plaque-disclosing agent We used only data from groups 1 and 2. Groups 3 and 4 were not eligible for inclusion in this review
Outcomes	1. Plaque Index (Green & Vermillion) (V) 2. Gingival Bleeding Index (Ainamo & Bay) (V) Timing of outcome assessments: baseline and day 10 for each of 4 phases
COM-B System Characteristics	Potential sources of behaviour change: capability (physical/psychological), opportunity (physical), motivation (reflective) Potential Intervention functions: training, enablement, environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: both With or without dental professional involvement: with - dentist, dental assistant Other stakeholder involvement: parents, formal carers, participants own dentist (general dental practitioner) and dental assistant
Notes	Strengths and weaknesses: nothing noted Modifications to the intervention: none reported Adverse effects: exclusion criteria: "an allergic reaction to any tested chemical agent," - no exclusions reported Funding source: "This work was supported by Fundacao Araucaria de Apoio ao Desenvolvimento Cientıfico e Tecnologico do Parana, Brazil," p. 467

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Comment: no details provided.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Quote: "The experimental dentifrices were packed into plain white 50-g plastic tubes and coded according (to) each group." "Parents did not know which of the four experimental dentifrices they were using for their children," p. 465 Comment: probably done.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Quote: "Clinical examinations were performed by a previously trained examiner," p. 465 Comment: unclear if "blind" trial refers to the assessor or the parents, p. 464

Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: no missing data.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

Williams 1988

Methods	Study design: NRCT Date of study: not stated, pre-1988 Study duration: 3 months Location: USA Setting: residential Ethical approval: none reported Consent: none reported
Participants	Description of ID used: "profoundly mentally retarded," p. 2 Conversion to ICD description: profound Age range: 4-36 years Sex: male 9, female 15 Comorbidity reported/details: none reported Number of participants at baseline: 24 Number of participants at final evaluation: unclear Selection of the participants for the intervention: participants were "selected."
Interventions	**Comparison: special manual toothbrush versus conventional manual toothbrush** Group 1: brushed daily with Collis Curve toothbrush by student dental assistant using the Collis Curve Scrub Method Group 2: brushed daily with conventional toothbrush by student dental assistant using the Modified Stillman Method
Outcomes	1. Simplified Green & Vermillion Oral Hygiene Index - plaque only (scale 0-3) (V) Timing of outcome assessments: baseline and 3 months
COM-B System Characteristics	Potential sources of behaviour change: opportunity (physical) Potential Intervention functions: environmental restructuring
Stakeholder Involvement	Formal or non-formal carer: formal With or without dental professional involvement: with - student dental assistant, dentist Other stakeholder involvement: none reported
Notes	Strengths and weaknesses: brushing carried out by a dental professional Modifications to the intervention: none reported Adverse effects: none reported Funding source: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Quote: "equally divided into control and experimental groups," p. 2 Comment: no evidence of randomisation.
Allocation concealment (selection bias)	Unclear risk	Comment: no details provided.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Comment: not possible to blind personnel.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Comment: data collected by the dentist in the facility; unclear if blinded, p. 2
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comment: assumed no missing data, p. 292.
Selective reporting (reporting bias)	Unclear risk	Comment: no protocol but all listed outcomes reported.

API: Approximal Plaque Index; ICD: International Statistical Classification of Diseases and Related Health Problems; ID: intellectual disability; IQ: intelligence quotient; ITS: interrupted time series; N/A: not available; NRCT: non-randomised controlled trial; OHI: oral hygiene instruction; RCT: randomised controlled trial; SD: standard deviation; V: verified; WHO: World Health Organization.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Andrews 1990	Conference abstract only. Data in a format that could not be used. Efforts to contact authors were unsuccessful
Badra 1973	Title only. All attempts to source full text and contact authors were unsuccessful
Borglin 1969	Title only. Efforts to source full article and contact authors were unsuccessful
Brody 1975	Unclear data in the published report regarding study design. Efforts to contact authors were unsuccessful
Bui 2003	1 subgroup possibly eligible for inclusion. Contact with 2nd author (Antonia Scott) - study did not meet the required study design
Favell 1975	Relevant data were not presented in the published report. Attempts to contact the author were unsuccessful

(Continued)

Gertenrich 1972	Data in published report was in a format that could not be used. Contact with the author - data were no longer available
Haran 2014	Contact with author - study did not meet the required study design
Horner 1975	Interrupted time series study with unclear data; 2 participants appeared to have only 2 baseline measures; postintervention time frame was different for each participant; no clear finish time point. Unable to contact the author to clarify
ISRCTN10044161	Trial registration only. Thesis published by the author. Unable to contact the author or access the thesis
Kaschke 2008	Contact with author - study did not meet the required study design
Lesmana 2014	Abstract only. Contact made with author - data no longer available
Lopez 1994	Title only. Unable to contact the author or access the article
Meador 1979	No data provided in the published report. Unable to contact the author
NCT03234231	Trial registration only. Contact with authors - study was not progressing due to difficulties recruiting participants
NCT03791385	Authors confirmed that the study was completed, but did not include a population with intellectual disabilities
Ojeda 2010	Conference abstract only. Data were in a format that could not be used. Unable to contact the authors
Ribeiro 2011	Conference abstract. Not the mechanical control of plaque only. Subgroup may have been eligible for inclusion. Unable to contact authors
Schmidt 1981	Data in the published report were in a format that could not be used. Contact made with author (JP O'Donnell) - data no longer available
Thornton 1991	Conference abstract. Data were in a format that could not be used. Unable to contact the author
Zaksek 2014	Did not meet the required study design.
Zhou 2019	Before-and-after study - only 1 pre- and postintervention assessment reported - did not meet required study design

Characteristics of studies awaiting assessment *[ordered by study ID]*

Akgun 2012

Methods	Study design: controlled trial; details to be confirmed Date of study: not given, pre-2012 Study duration: 24 months Setting: home Ethical approval: unknown Consent: unknown
Participants	Description of ID used: mental disability Conversion to ICD description: unclear Age: unknown Sex: unknown Comorbidity reported/details: unknown Number of participants at baseline: 112 Number of participants at final evaluation: unknown Selection of participants for the intervention: participants were attending 2 special schools Country: Turkey
Interventions	**Comparison: carer oral health training versus no oral health training** Group 1: carer oral health training including oral hygiene instruction and dietary counselling (4 weeks) Group 2: no carer oral health training Dental treatment as required was carried out for the participants within the first 6 months
Outcomes	1. Plaque Index 2. Gingival Index 3. DMFT 4. DMFS Timing of outcome assessments: baseline and 24 months
Notes	Potential sources of behaviour change: capability (physical/psychological), motivation (reflective) Potential intervention functions: education, training, enablement

Birani 2008

Methods	Study design: controlled trial; exact details to be confirmed Date of study: not given, pre-2008 Study duration: 90 days Setting: unknown Ethical approval: unknown Consent: unknown
Participants	Description of ID used: severe neuropsychomotor disabilities/mental disabilities Conversion to ICD description: severe Age: unknown Sex: unknown Comorbidity reported/details: unknown Number of participants at baseline: 78 Number of participants at final evaluation: unknown

Birani 2008 *(Continued)*

	Selection of the participants for the intervention: unknown Country: Brazil
Interventions	**Comparison: oral health audiovisual material for guidance and motivation of carers versus no oral health audiovisual material** Group 1: 1 video display to the carers + oral hygiene promotion Group 2: oral hygiene promotion only
Outcomes	1. Visible Plaque Index 2. Gingival Bleeding Index Timing of outcome assessments: baseline, 15, 30, 60 and 90 days
Notes	Potential sources of behaviour change: capability (physical/psychological), motivation (reflective) Potential Intervention functions: education, training, modelling, enablement, environmental restructuring

Saptiwi 2018

Methods	Non-randomised controlled study - pretest post-test design
Participants	76 children with special needs ("mentally disabled") at "public elementary school for exceptional children" in Semarang, Indonesia
Interventions	Donuts Oral Health School Innovative Program - education, training, monitoring
Outcomes	Oral hygiene index, dental and oral healthcare maintenance
Notes	Funding: Health Polytechnic Ministry of Health, Semarang, Indonesia

DMFS: Decayed, Missing or Filled Surface; DMFT: Decayed, Missing or Filled Teeth; ICD: International Statistical Classification of Diseases and Related Health Problems; ID: intellectual disability.

Characteristics of ongoing studies *[ordered by study ID]*

NCT03522337

Trial name or title	Effectiveness of visual pedagogy-assisted tooth-brushing training among preschoolers with special needs for oral health promotion
Methods	Double-blind RCT
Participants	Children aged 2-6 years attending "Special Child Care Centres" in Hong Kong Exclusion criteria: severe visually impairment, severe hearing impairment, severe physical disability; requiring emergent dental treatment; use of antibiotic within preceding 3 months; dental prophylaxis in preceding 6 months

Interventions	Social stories about toothbrushing versus conventional information leaflet
Outcomes	Change in: carious tooth surfaces, caries prevalence, oral hygiene status, gingival status, toothbrushing performance, eating habits, dental visit experience, amount of toothpaste and toothbrush wear
Starting date	12 April 2016
Contact information	Principal investigator: Dr Gloria Hai-Ming Wong, The University of Hong Kong wonghmg@hku.hk
Notes	Quote: "The randomised sequence will be generated by an investigator who does not participate in the outreach service. The allocation sequence will be sealed in an envelope, and opened at the Special Child Care Centres by an assistant. The assistant will be responsible for delivering the materials to children and their parents."

RCT: randomised controlled trial.

DATA AND ANALYSES

Comparison 1. Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Gingival inflammation short term (< 6 weeks)	1	25	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.77, 0.57]
2 Gingival inflammation medium term (6 weeks to 12 months)	1	18	Mean Difference (IV, Fixed, 95% CI)	-12.40 [-24.31, -0.49]
3 Plaque short term (< 6 weeks)	1	25	Mean Difference (IV, Fixed, 95% CI)	0.20 [-0.45, 0.85]
4 Plaque medium term (6 weeks to 12 months)	1	18	Mean Difference (IV, Fixed, 95% CI)	-0.44 [-0.93, 0.05]
5 Oral health assessments	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
5.1 Oral assessment	1	22	Mean Difference (IV, Fixed, 95% CI)	-0.45 [-1.35, 0.45]
5.2 Total bacteria count	1	22	Mean Difference (IV, Fixed, 95% CI)	0.32 [-0.29, 0.93]
5.3 Potentially pathogenic bacteria	1	22	Mean Difference (IV, Fixed, 95% CI)	0.12 [-0.67, 0.91]
6 Behaviour, attitude and self-efficacy	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 Frequency of brushing	1	18	Mean Difference (IV, Fixed, 95% CI)	0.20 [-2.13, 2.53]
6.2 Experience of carer when brushing for a person with ID	1	18	Mean Difference (IV, Fixed, 95% CI)	0.7 [-0.15, 1.55]
6.3 Handling of TB by the carer	1	18	Mean Difference (IV, Fixed, 95% CI)	0.50 [-0.35, 1.35]
7 Degree of resistance of person with ID	1	18	Mean Difference (IV, Fixed, 95% CI)	-1.70 [-4.90, 1.50]

Comparison 2. Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Gingival inflammation medium term (6 weeks to 12 months)	2	120	Mean Difference (IV, Fixed, 95% CI)	0.02 [-0.06, 0.09]
2 Plaque medium term (6 weeks to 12 months)	2	120	Std. Mean Difference (IV, Fixed, 95% CI)	0.29 [-0.07, 0.65]
3 NRS Gingival inflammation long term (> 12 months)	1	23	Mean Difference (IV, Fixed, 95% CI)	0.0 [-0.15, 0.15]
4 NRS Plaque medium term (6 weeks to 12 months)	5	167	Std. Mean Difference (IV, Random, 95% CI)	0.04 [-0.38, 0.46]
5 Calculus medium term (6 weeks to 12 months)	2	120	Std. Mean Difference (IV, Fixed, 95% CI)	-0.04 [-0.40, 0.32]

Comparison 3. Training of carers of people with intellectual disabilities versus no training of carers

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Gingival inflammation medium term (6 weeks to 12 months)	2	99	Mean Difference (IV, Random, 95% CI)	-0.09 [-0.63, 0.45]
2 Plaque medium term (6 weeks to 12 months)	2	99	Mean Difference (IV, Fixed, 95% CI)	-0.07 [-0.26, 0.13]
3 Non-randomised study plaque short term (< 6 weeks)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Training of carers	1	34	Mean Difference (IV, Fixed, 95% CI)	-0.69 [-0.97, -0.41]
4 Knowledge short term (< 6 weeks)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
5 Knowledge medium term (6 weeks to 12 months)	2	189	Mean Difference (IV, Fixed, 95% CI)	0.69 [0.31, 1.06]
6 Behaviour, attitude and self-efficacy medium term	2	189	Mean Difference (IV, Random, 95% CI)	0.15 [-0.80, 1.10]

Comparison 4. Oral health (OH) training of people with intellectual disabilities (ID) versus no training

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Gingival inflammation short term (< 6 weeks)	1	10	Mean Difference (IV, Fixed, 95% CI)	-0.28 [-0.90, 0.34]
2 Plaque short term (< 6 weeks)	1	10	Mean Difference (IV, Fixed, 95% CI)	-0.47 [-0.92, -0.02]

Comparison 5. Dental recall intervals for people with intellectual disabilities

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Gingival pocketing long term (> 12 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 One-monthly dental recalls	1	137	Mean Difference (IV, Fixed, 95% CI)	-0.6 [-0.97, -0.23]
1.2 Three-monthly dental recalls	1	148	Mean Difference (IV, Fixed, 95% CI)	-0.5 [-0.85, -0.15]
1.3 Six-monthly dental recalls	1	171	Mean Difference (IV, Fixed, 95% CI)	-0.4 [-0.76, -0.04]
2 Gingival bleeding long term (> 12 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 One-monthly dental recall	1	137	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-0.86, 0.46]
2.2 Three-monthly dental recalls	1	148	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.73, 0.53]
2.3 Six-monthly dental recalls	1	171	Mean Difference (IV, Fixed, 95% CI)	0.20 [-0.38, 0.78]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Plaque long term (> 12 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 One-monthly dental recall	1	137	Mean Difference (IV, Fixed, 95% CI)	-0.7 [-1.30, -0.10]
3.2 Three-monthly dental recall	1	148	Mean Difference (IV, Fixed, 95% CI)	-0.8 [-1.38, -0.22]
3.3 Six-monthly dental recall	1	171	Mean Difference (IV, Fixed, 95% CI)	-0.7 [-1.22, -0.18]
4 Calculus long term (> 12 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 One-monthly dental recalls	1	137	Mean Difference (IV, Fixed, 95% CI)	-2.0 [-2.64, -1.36]
4.2 Three-monthly dental recalls	1	148	Mean Difference (IV, Fixed, 95% CI)	-1.4 [-2.04, -0.76]
4.3 Six-monthly dental recalls	1	171	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.72, 0.52]

Comparison 6. Clinical photographs as motivators for oral hygiene in people with intellectual disabilities

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Plaque medium term (6 weeks to 12 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Plaque	1	29	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-1.85, 1.65]
1.2 Extrinsic stain	1	29	Mean Difference (IV, Fixed, 95% CI)	-2.60 [-19.45, 14.25]

Analysis 1.1. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 1 Gingival inflammation short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 1 Gingival inflammation short term (< 6 weeks)

Study or subgroup	Special manual TB N	Mean(SD)	Conventional TB N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Sauvetre 1995	12	1.21 (0.85)	13	1.31 (0.87)		100.0 %	-0.10 [-0.77, 0.57]
Total (95% CI)	**12**		**13**			**100.0 %**	**-0.10 [-0.77, 0.57]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.29 (P = 0.77)

Test for subgroup differences: Not applicable

-4 -2 0 2 4

Favours special manual TB   Favours conventional TB
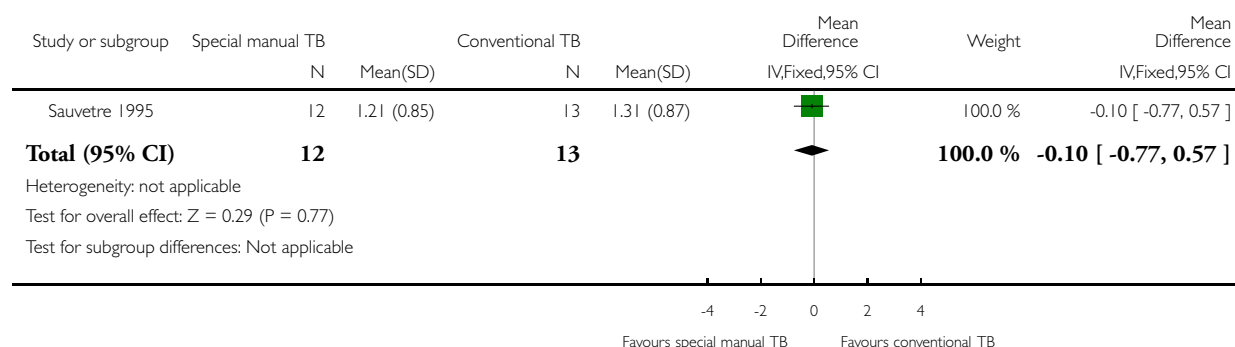
Analysis 1.2. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 2 Gingival inflammation medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 2 Gingival inflammation medium term (6 weeks to 12 months)

Study or subgroup	Special manual TB		Conventional TB		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Bildt 2010	12	18.3 (16.2)	6	30.7 (9.5)		100.0 %	-12.40 [-24.31, -0.49]
Total (95% CI)	**12**		**6**			**100.0 %**	**-12.40 [-24.31, -0.49]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.04 (P = 0.041)							
Test for subgroup differences: Not applicable							

-50   -25   0   25   50

Favours special manual TB   Favours conventional TB
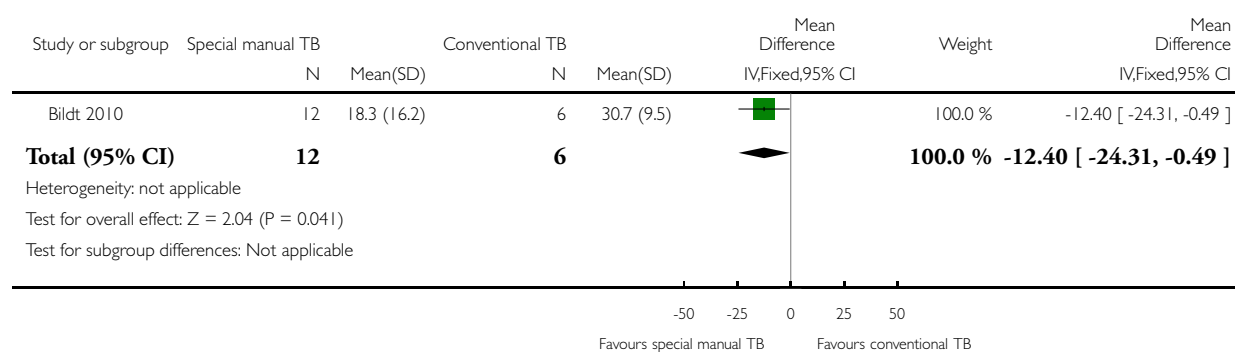
Analysis 1.3. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 3 Plaque short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 3 Plaque short term (< 6 weeks)

Study or subgroup	Special manual TB		Conventional TB		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Sauvetre 1995	12	1.02 (0.85)	13	0.82 (0.81)		100.0 %	0.20 [-0.45, 0.85]
Total (95% CI)	**12**		**13**			**100.0 %**	**0.20 [-0.45, 0.85]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.60 (P = 0.55)							
Test for subgroup differences: Not applicable							

```
        -4    -2    0    2    4
   Favours special manual TB   Favours conventional TB
```
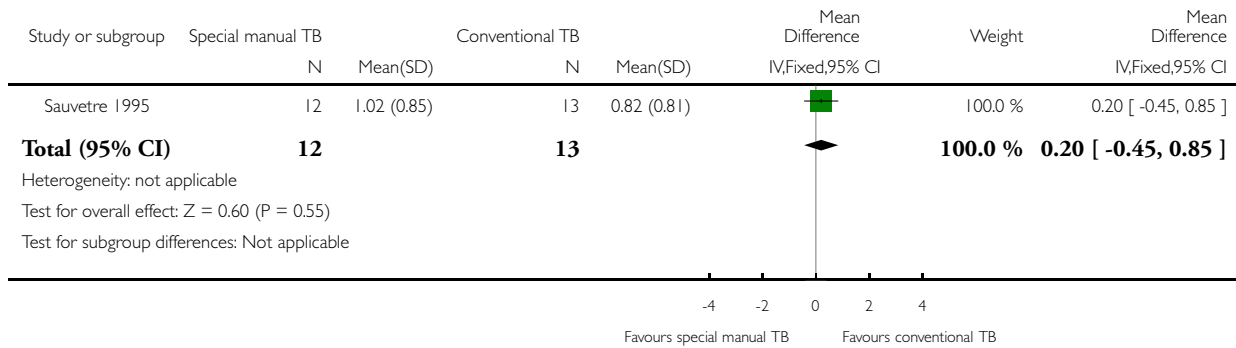
Analysis 1.4. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 4 Plaque medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 4 Plaque medium term (6 weeks to 12 months)

Study or subgroup	Special manual TB		Conventional TB		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Bildt 2010	12	0.78 (0.7)	6	1.22 (0.37)		100.0 %	-0.44 [-0.93, 0.05]
Total (95% CI)	**12**		**6**			**100.0 %**	**-0.44 [-0.93, 0.05]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.74 (P = 0.081)							
Test for subgroup differences: Not applicable							

```
        -1   -0.5   0   0.5   1
   Favours special manual TB   Favours conventional TB
```
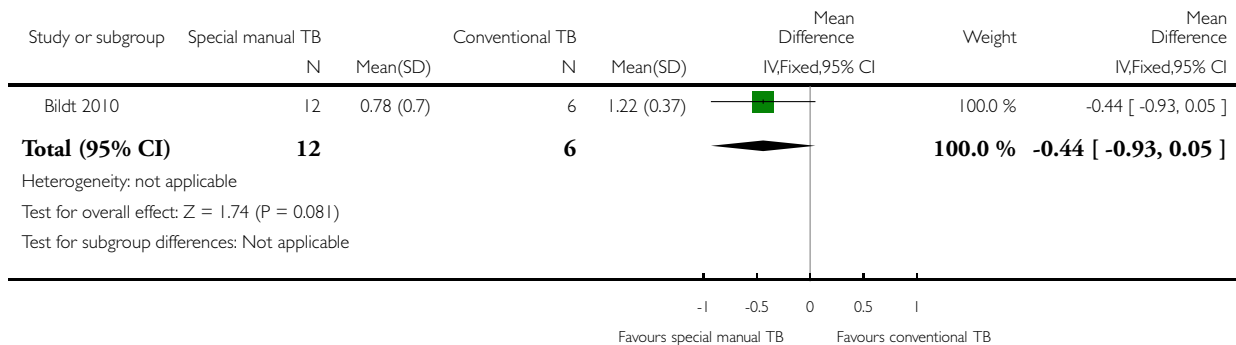
Analysis 1.5. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 5 Oral health assessments.

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 5 Oral health assessments

Study or subgroup	OH with suctioning + H2O2 N	Mean(SD)	OH with TB + H2O2 N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Oral assessment							
Ferozali 2007	12	1.54 (1)	10	1.99 (1.12)		100.0 %	-0.45 [-1.35, 0.45]
Subtotal (95% CI)	**12**		**10**			**100.0 %**	**-0.45 [-1.35, 0.45]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.98 (P = 0.32)							
2 Total bacteria count							
Ferozali 2007	12	4.39 (0.63)	10	4.07 (0.8)		100.0 %	0.32 [-0.29, 0.93]
Subtotal (95% CI)	**12**		**10**			**100.0 %**	**0.32 [-0.29, 0.93]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.03 (P = 0.30)							
3 Potentially pathogenic bacteria							
Ferozali 2007	12	0.41 (0.97)	10	0.29 (0.92)		100.0 %	0.12 [-0.67, 0.91]
Subtotal (95% CI)	**12**		**10**			**100.0 %**	**0.12 [-0.67, 0.91]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.30 (P = 0.77)							
Test for subgroup differences: Chi² = 1.95, df = 2 (P = 0.38), I² =0.0%							

-4   -2   0   2   4

Favours suctioning + HP   Favours conv TB + HP

Analysis 1.6. Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 6 Behaviour, attitude and self-efficacy.

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 6 Behaviour, attitude and self-efficacy

Study or subgroup	Special manual TB		Conventional TB		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 Frequency of brushing							
Bildt 2010	12	2.2 (4)	6	2 (0.7)		100.0 %	0.20 [-2.13, 2.53]
Subtotal (95% CI)	**12**		**6**			**100.0 %**	**0.20 [-2.13, 2.53]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.17 (P = 0.87)							
2 Experience of carer when brushing for a person with ID							
Bildt 2010	6	2 (1)	12	1.3 (0.5)		100.0 %	0.70 [-0.15, 1.55]
Subtotal (95% CI)	**6**		**12**			**100.0 %**	**0.70 [-0.15, 1.55]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.62 (P = 0.11)							
3 Handling of TB by the carer							
Bildt 2010	6	2.3 (0.8)	12	1.8 (1)		100.0 %	0.50 [-0.35, 1.35]
Subtotal (95% CI)	**6**		**12**			**100.0 %**	**0.50 [-0.35, 1.35]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.15 (P = 0.25)							

```
        -4   -2    0    2    4
  Favours conventional TB    Favours special manual TB
```

Analysis 1.7.   Comparison 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID), Outcome 7 Degree of resistance of person with ID.

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 1 Special manual toothbrush (TB) versus conventional manual TB (used by carers) for people with intellectual disabilities (ID)

Outcome: 7 Degree of resistance of person with ID

Study or subgroup	Special manual TB		Conventional TB		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Bildt 2010	6	4.3 (3.2)	12	6 (3.4)		100.0 %	-1.70 [-4.90, 1.50]
Total (95% CI)	**6**		**12**			**100.0 %**	**-1.70 [-4.90, 1.50]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.04 (P = 0.30)

Test for subgroup differences: Not applicable

```
        -10    -5     0     5     10
     Favours special manual TB   Favours conventional TB
```
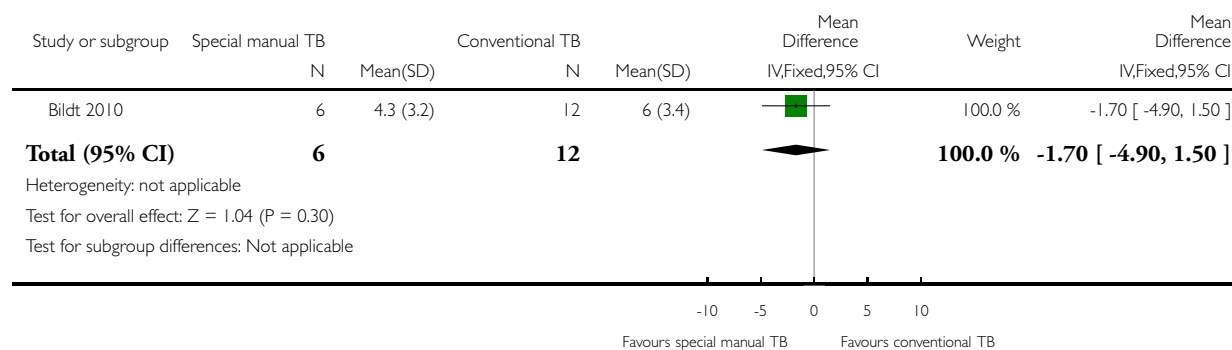
Analysis 2.1.   Comparison 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities, Outcome 1 Gingival inflammation medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome: 1 Gingival inflammation medium term (6 weeks to 12 months)

Study or subgroup	Electric TB		Manual TB		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Carr 1997 (1)	31	1.9 (0.2)	25	1.9 (0.16)		67.9 %	0.0 [-0.09, 0.09]
Garcia-Carrillo 2016	32	1.24 (0.28)	32	1.19 (0.28)		32.1 %	0.05 [-0.09, 0.19]
Total (95% CI)	**63**		**57**			**100.0 %**	**0.02 [-0.06, 0.09]**

Heterogeneity: Chi² = 0.35, df = 1 (P = 0.56); I² =0.0%

Test for overall effect: Z = 0.40 (P = 0.69)

Test for subgroup differences: Not applicable

```
       -0.5   -0.25    0    0.25   0.5
     Favours electric TB      Favours manual TB
```
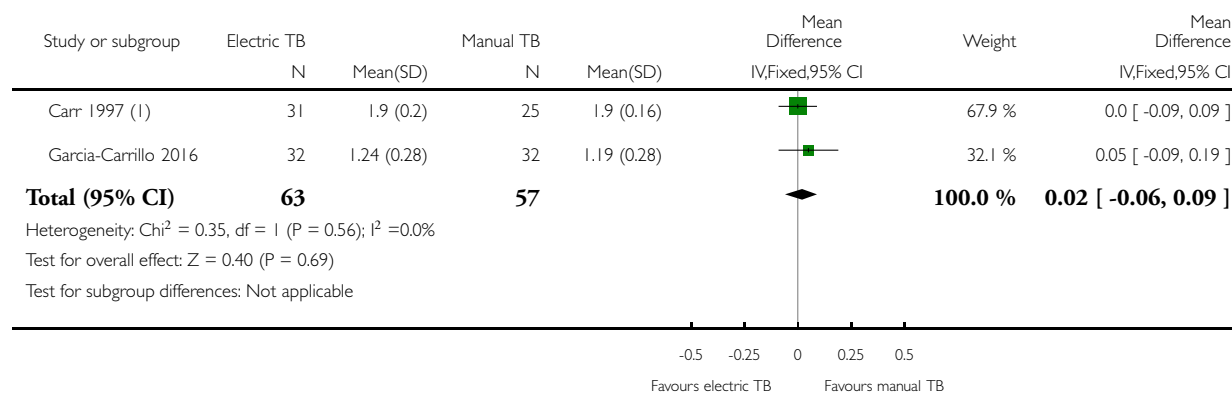
(1) Findings presented for the only comparable time point - 6 months,

Analysis 2.2.   Comparison 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities, Outcome 2 Plaque medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome: 2 Plaque medium term (6 weeks to 12 months)

Study or subgroup	Electric TB		Manual TB		Std. Mean Difference	Weight	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Garcia-Carrillo 2016	32	1.12 (0.35)	32	1.04 (0.35)		53.9 %	0.23 [-0.27, 0.72]
Carr 1997	31	1.55 (0.67)	25	1.34 (0.41)		46.1 %	0.36 [-0.17, 0.90]
Total (95% CI)	**63**		**57**			**100.0 %**	**0.29 [-0.07, 0.65]**

Heterogeneity: Chi^2 = 0.14, df = 1 (P = 0.71); I^2 =0.0%

Test for overall effect: Z = 1.57 (P = 0.12)

Test for subgroup differences: Not applicable

-4   -2   0   2   4

Favours electric TB   Favours manual TB
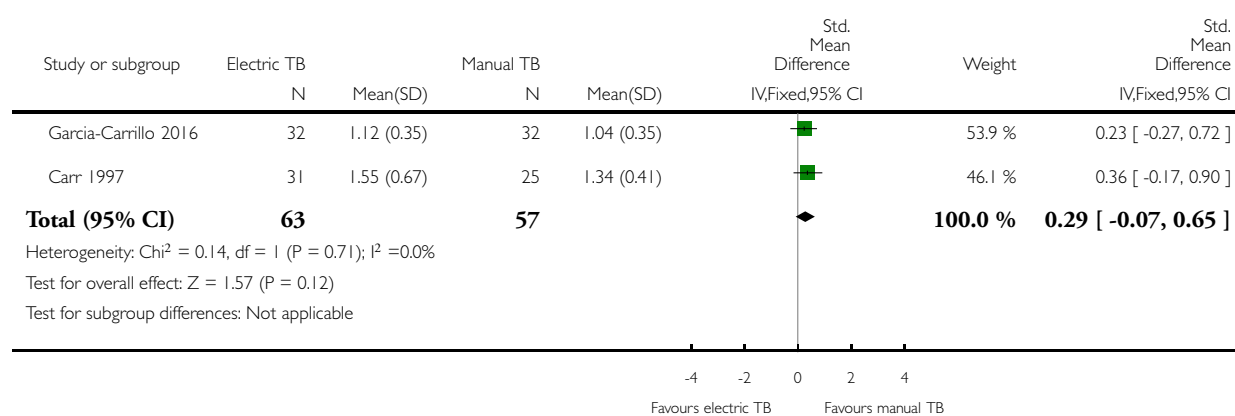
Analysis 2.3. Comparison 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities, Outcome 3 NRS Gingival inflammation long term (> 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome: 3 NRS Gingival inflammation long term (> 12 months)

Study or subgroup	Electric TB		Manual TB		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Bratel 1991	12	1.75 (0.16)	11	1.75 (0.2)	▇	100.0 %	0.0 [-0.15, 0.15]
Total (95% CI)	**12**		**11**		◆	**100.0 %**	**0.0 [-0.15, 0.15]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Not applicable

-2   -1   0   1   2

Favours electric TB   Favours manual TB
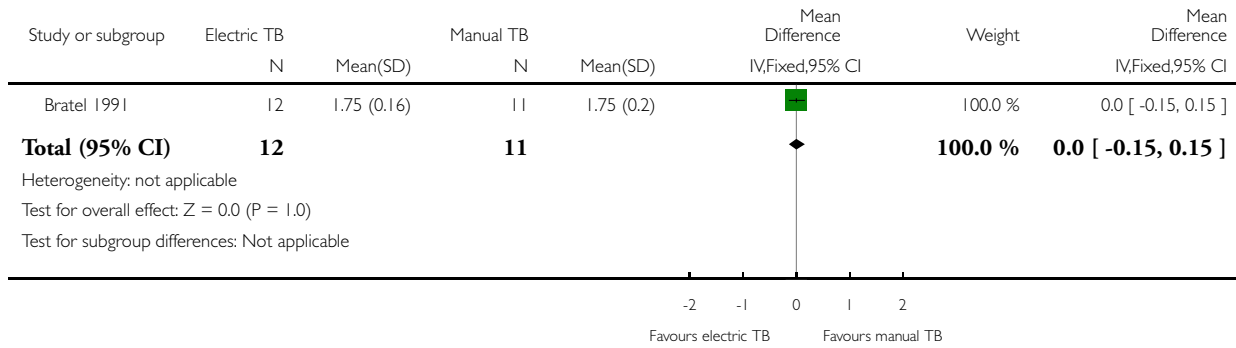
Analysis 2.4. Comparison 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities, Outcome 4 NRS Plaque medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome: 4 NRS Plaque medium term (6 weeks to 12 months)

Study or subgroup	Electric TB		Manual TB		Std. Mean Difference	Weight	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
Bratel 1991	12	1.1 (0.14)	11	1.11 (0.3)		17.1 %	-0.04 [-0.86, 0.78]
Gertenrich 1967a	7	-0.71 (0.59)	7	-0.79 (0.65)		12.1 %	0.12 [-0.93, 1.17]
Gertenrich 1967b	34	0.24 (0.55)	18	0.03 (1.37)		25.4 %	0.23 [-0.35, 0.80]
Gertenrich 1967c	18	0.36 (0.49)	18	0.69 (0.47)		21.6 %	-0.67 [-1.35, 0.00]
Gertenrich 1967d	21	-0.57 (0.54)	21	-0.88 (0.65)		23.7 %	0.51 [-0.11, 1.12]
Total (95% CI)	**92**		**75**			**100.0 %**	**0.04 [-0.38, 0.46]**

Heterogeneity: Tau² = 0.10; Chi² = 6.97, df = 4 (P = 0.14); I² =43%

Test for overall effect: Z = 0.19 (P = 0.85)

Test for subgroup differences: Not applicable

```
         -2      -1       0       1       2
     Favours electric TB     Favours manual TB
```
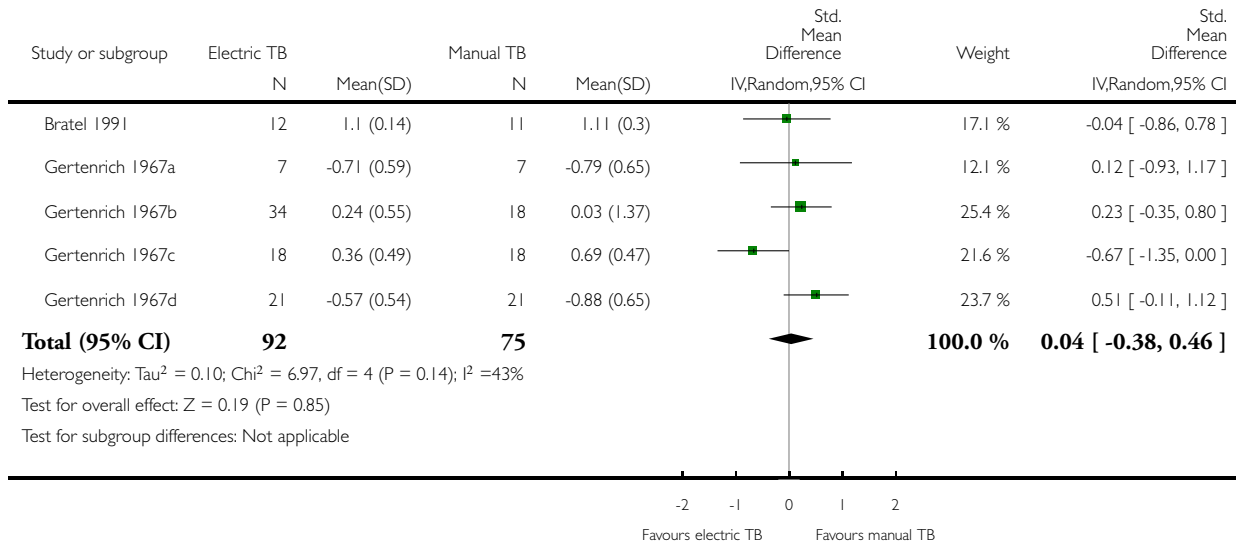
Analysis 2.5. Comparison 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities, Outcome 5 Calculus medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 2 Electric toothbrush (TB) versus manual TB for people with intellectual disabilities

Outcome: 5 Calculus medium term (6 weeks to 12 months)

Study or subgroup	Electric TB		Manual TB		Std. Mean Difference	Weight	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Carr 1997	31	0.78 (0.39)	25	0.9 (0.47)		46.2 %	-0.28 [-0.81, 0.25]
Garcia-Carrillo 2016	32	0.18 (0.12)	32	0.16 (0.12)		53.8 %	0.16 [-0.33, 0.66]
Total (95% CI)	**63**		**57**			**100.0 %**	**-0.04 [-0.40, 0.32]**

Heterogeneity: Chi² = 1.44, df = 1 (P = 0.23); I² =30%

Test for overall effect: Z = 0.21 (P = 0.83)

Test for subgroup differences: Not applicable

-4 -2 0 2 4

Favours electric TB   Favours manual TB
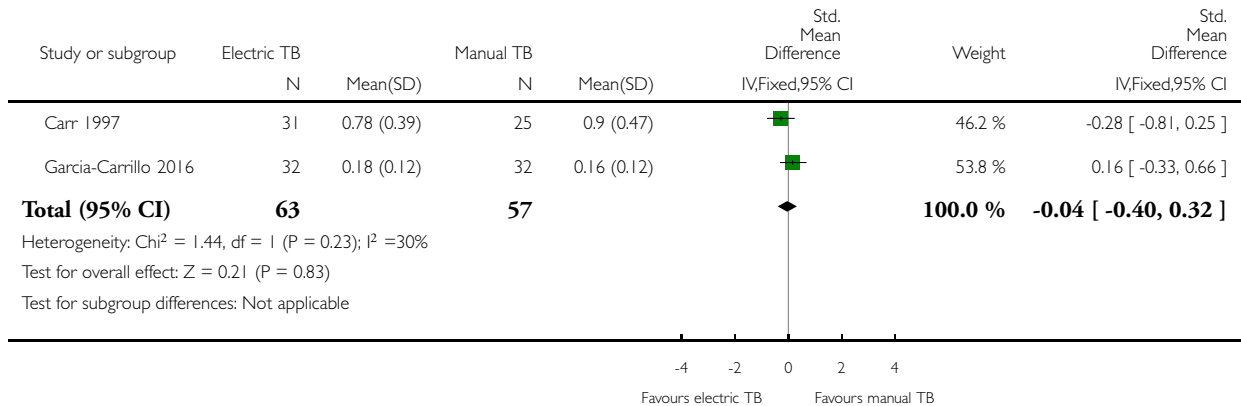
Analysis 3.1. Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 1 Gingival inflammation medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 1 Gingival inflammation medium term (6 weeks to 12 months)

Study or subgroup	Training of carers		No training of carers		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
Mac Giolla Phadraig 2015	28	2.47 (1.21)	35	2.2 (1.18)		37.5 %	0.27 [-0.32, 0.86]
Phlypo 2016	17	1.2 (0.36)	19	1.5 (0.24)		62.5 %	-0.30 [-0.50, -0.10]
Total (95% CI)	**45**		**54**			**100.0 %**	**-0.09 [-0.63, 0.45]**

Heterogeneity: Tau² = 0.11; Chi² = 3.16, df = 1 (P = 0.08); I² =68%

Test for overall effect: Z = 0.31 (P = 0.75)

Test for subgroup differences: Not applicable

-1 -0.5 0 0.5 1

Favours training   Favours no training
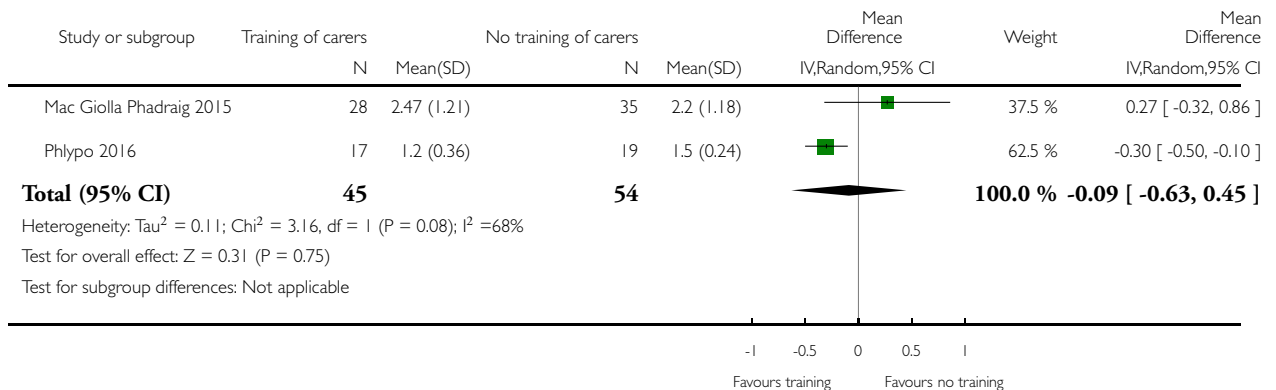
Analysis 3.2. Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 2 Plaque medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 2 Plaque medium term (6 weeks to 12 months)

Study or subgroup	Training of carers		No training of carers		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Mac Giolla Phadraig 2015	28	1.89 (1.05)	35	1.78 (0.97)		14.8 %	0.11 [-0.39, 0.61]
Phlypo 2016	17	1.4 (0.38)	19	1.5 (0.24)		85.2 %	-0.10 [-0.31, 0.11]
Total (95% CI)	**45**		**54**			**100.0 %**	**-0.07 [-0.26, 0.13]**

Heterogeneity: Chi^2 = 0.57, df = 1 (P = 0.45); I^2 =0.0%

Test for overall effect: Z = 0.70 (P = 0.49)

Test for subgroup differences: Not applicable

-4 -2 0 2 4

Favours training   Favours no training

Analysis 3.3. Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 3 Non-randomised study plaque short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 3 Non-randomised study plaque short term (< 6 weeks)

Study or subgroup	Training of carers		No training of carers		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 Training of carers							
Lange 2000	22	1.09 (0.26)	12	1.78 (0.45)		100.0 %	-0.69 [-0.97, -0.41]
Subtotal (95% CI)	**22**		**12**			**100.0 % -0.69 [-0.97, -0.41]**	

Heterogeneity: not applicable

Test for overall effect: Z = 4.89 (P < 0.00001)

Test for subgroup differences: Not applicable

-2   -1   0   1   2

Favours training   Favours no training
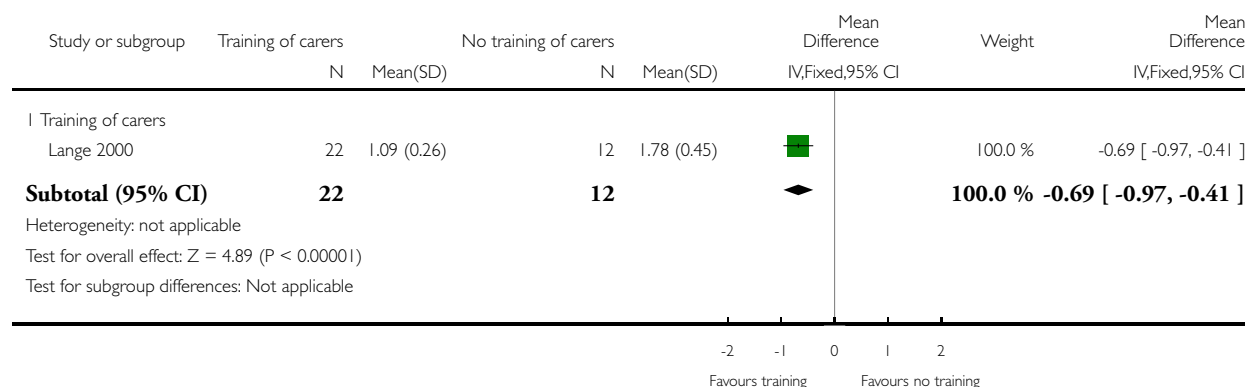
Analysis 3.4. Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 4 Knowledge short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 4 Knowledge short term (< 6 weeks)

Study or subgroup	Training of carers		No training of carers		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Gonzalez 2013	14	18.29 (1.98)	10	17.7 (1.49)			0.59 [-0.80, 1.98]

-10   -5   0   5   10

Favours no training   Favours training
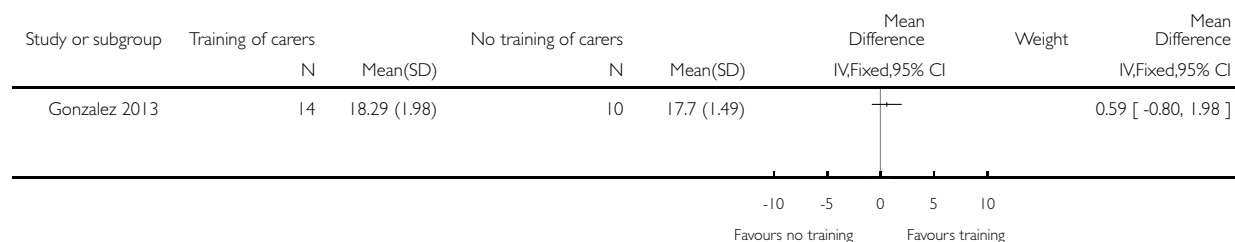
Analysis 3.5.   Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 5 Knowledge medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 5 Knowledge medium term (6 weeks to 12 months)

Study or subgroup	Training of carers		No training of carers		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Mac Giolla Phadraig 2015	79	7.86 (1.27)	76	7.21 (1.32)		85.3 %	0.65 [0.24, 1.06]
Phlypo 2016	12	6.8 (1.43)	22	5.9 (1.33)		14.7 %	0.90 [-0.08, 1.88]
Total (95% CI)	**91**		**98**			**100.0 %**	**0.69 [0.31, 1.06]**

Heterogeneity: Chi² = 0.21, df = 1 (P = 0.64); I² =0.0%

Test for overall effect: Z = 3.57 (P = 0.00035)

Test for subgroup differences: Not applicable

-4   -2   0   2   4

Favours no training   Favours training

Analysis 3.6.   Comparison 3 Training of carers of people with intellectual disabilities versus no training of carers, Outcome 6 Behaviour, attitude and self-efficacy medium term.

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 3 Training of carers of people with intellectual disabilities versus no training of carers

Outcome: 6 Behaviour, attitude and self-efficacy medium term

Study or subgroup	Training of carers		No training of carers		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
Mac Giolla Phadraig 2015	76	5.42 (1.51)	79	4.91 (1.55)		64.1 %	0.51 [0.03, 0.99]
Phlypo 2016	12	4.7 (1.72)	22	5.2 (1.49)		35.9 %	-0.50 [-1.66, 0.66]
Total (95% CI)	**88**		**101**			**100.0 %**	**0.15 [-0.80, 1.10]**

Heterogeneity: Tau² = 0.31; Chi² = 2.50, df = 1 (P = 0.11); I² =60%

Test for overall effect: Z = 0.30 (P = 0.76)

Test for subgroup differences: Not applicable

-4   -2   0   2   4

Favours no training   Favours training
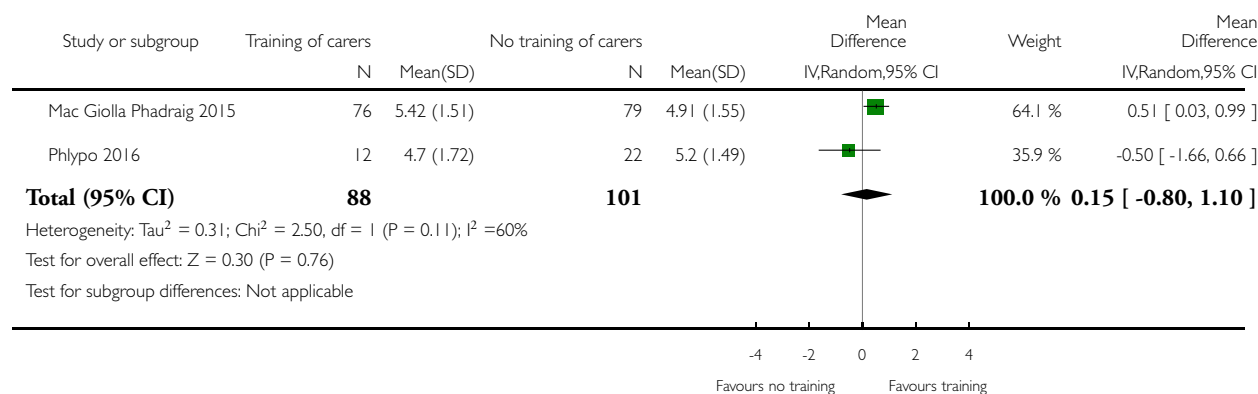
Analysis 4.1.   Comparison 4 Oral health (OH) training of people with intellectual disabilities (ID) versus no training, Outcome 1 Gingival inflammation short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 4 Oral health (OH) training of people with intellectual disabilities (ID) versus no training

Outcome: 1 Gingival inflammation short term (< 6 weeks)

Study or subgroup	OH training of people with ID		No OH training of people with ID		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Lange 1985	5	0.98 (0.54)	5	1.26 (0.46)	■	100.0 %	-0.28 [-0.90, 0.34]
Total (95% CI)	**5**		**5**		◆	**100.0 %**	**-0.28 [-0.90, 0.34]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.88 (P = 0.38)

Test for subgroup differences: Not applicable

```
        -2    -1    0    1    2
     Favours training   Favours no training
```
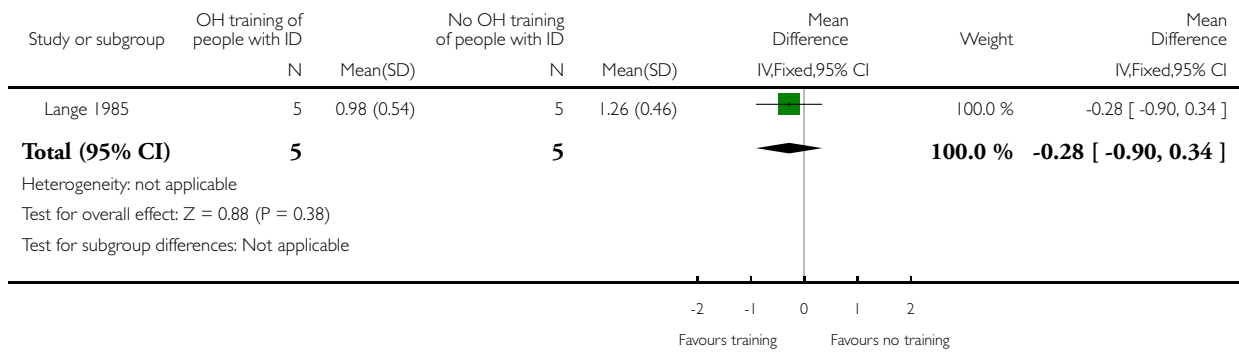
Analysis 4.2.   Comparison 4 Oral health (OH) training of people with intellectual disabilities (ID) versus no training, Outcome 2 Plaque short term (< 6 weeks).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 4 Oral health (OH) training of people with intellectual disabilities (ID) versus no training

Outcome: 2 Plaque short term (< 6 weeks)

Study or subgroup	OH training of people with ID		No OH training of people with ID		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Lange 1985	5	0.35 (0.46)	5	0.82 (0.24)		100.0 %	-0.47 [-0.92, -0.02]
Total (95% CI)	**5**		**5**			**100.0 %**	**-0.47 [-0.92, -0.02]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.03 (P = 0.043)

Test for subgroup differences: Not applicable

-2   -1   0   1   2

Favours training   Favours no training
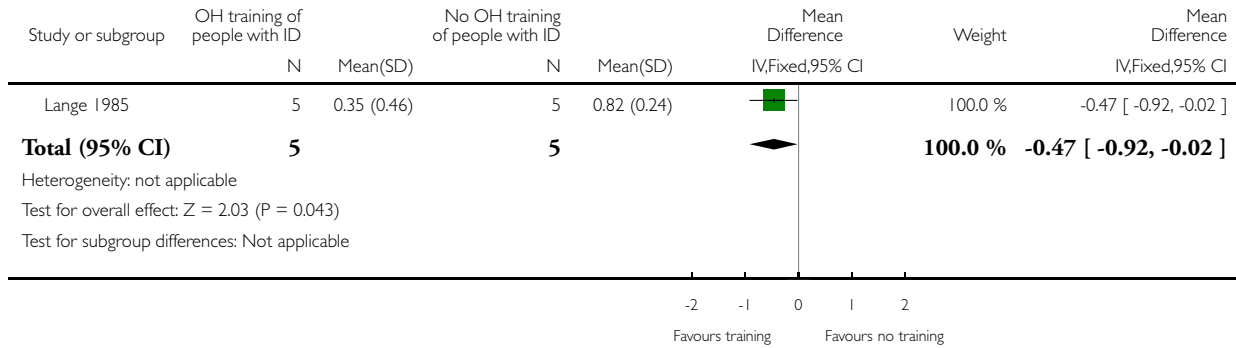
Analysis 5.1. Comparison 5 Dental recall intervals for people with intellectual disabilities, Outcome 1 Gingival pocketing long term (> 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 5 Dental recall intervals for people with intellectual disabilities

Outcome: 1 Gingival pocketing long term (> 12 months)

Study or subgroup	Regular recall interval		No regular dental recall		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 One-monthly dental recalls							
Shaw 1991	61	0.3 (0.8)	76	0.9 (1.4)		100.0 %	-0.60 [-0.97, -0.23]
Subtotal (95% CI)	**61**		**76**			**100.0 %**	**-0.60 [-0.97, -0.23]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.15 (P = 0.0016)							
2 Three-monthly dental recalls							
Shaw 1991	72	0.4 (0.7)	76	0.9 (1.4)		100.0 %	-0.50 [-0.85, -0.15]
Subtotal (95% CI)	**72**		**76**			**100.0 %**	**-0.50 [-0.85, -0.15]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.77 (P = 0.0056)							
3 Six-monthly dental recalls							
Shaw 1991	95	0.5 (0.9)	76	0.9 (1.4)		100.0 %	-0.40 [-0.76, -0.04]
Subtotal (95% CI)	**95**		**76**			**100.0 %**	**-0.40 [-0.76, -0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.16 (P = 0.031)							
Test for subgroup differences: Chi² = 0.57, df = 2 (P = 0.75), I² =0.0%							

```
        -4   -2    0    2    4
   Favours regular recall    Favours no regular recall
```

Analysis 5.2. Comparison 5 Dental recall intervals for people with intellectual disabilities, Outcome 2 Gingival bleeding long term (> 12 months).

Comparison: 5 Dental recall intervals for people with intellectual disabilities

Outcome: 2 Gingival bleeding long term (> 12 months)

Study or subgroup	Dental recall interval		No regular dental recall		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 One-monthly dental recall							
Shaw 1991	61	2.2 (1.9)	76	2.4 (2)		100.0 %	-0.20 [-0.86, 0.46]
Subtotal (95% CI)	**61**		**76**			**100.0 %**	**-0.20 [-0.86, 0.46]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.60 (P = 0.55)							
2 Three-monthly dental recalls							
Shaw 1991	72	2.3 (1.9)	76	2.4 (2)		100.0 %	-0.10 [-0.73, 0.53]
Subtotal (95% CI)	**72**		**76**			**100.0 %**	**-0.10 [-0.73, 0.53]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.31 (P = 0.76)							
3 Six-monthly dental recalls							
Shaw 1991	95	2.6 (1.8)	76	2.4 (2)		100.0 %	0.20 [-0.38, 0.78]
Subtotal (95% CI)	**95**		**76**			**100.0 %**	**0.20 [-0.38, 0.78]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.68 (P = 0.50)							

```
        -4    -2    0    2    4
   Favours regular recall    Favours no regular recall
```

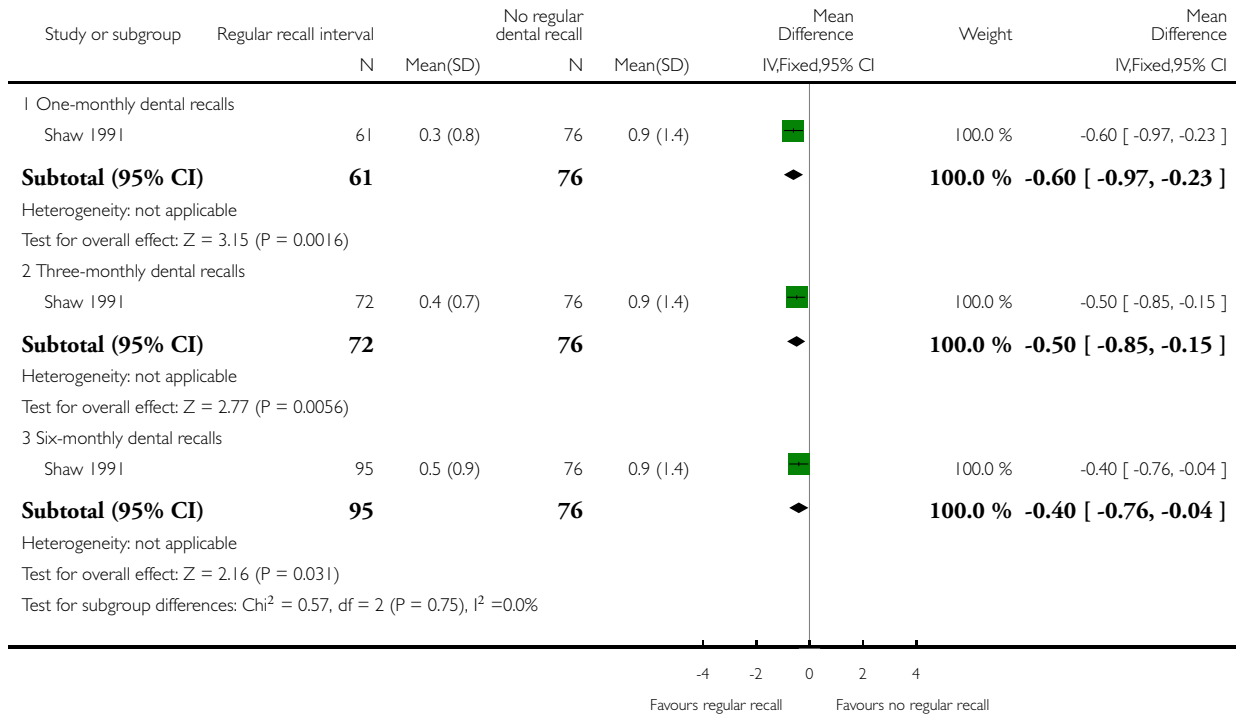**Analysis 5.3. Comparison 5 Dental recall intervals for people with intellectual disabilities, Outcome 3 Plaque long term (> 12 months).**

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 5 Dental recall intervals for people with intellectual disabilities

Outcome: 3 Plaque long term (> 12 months)

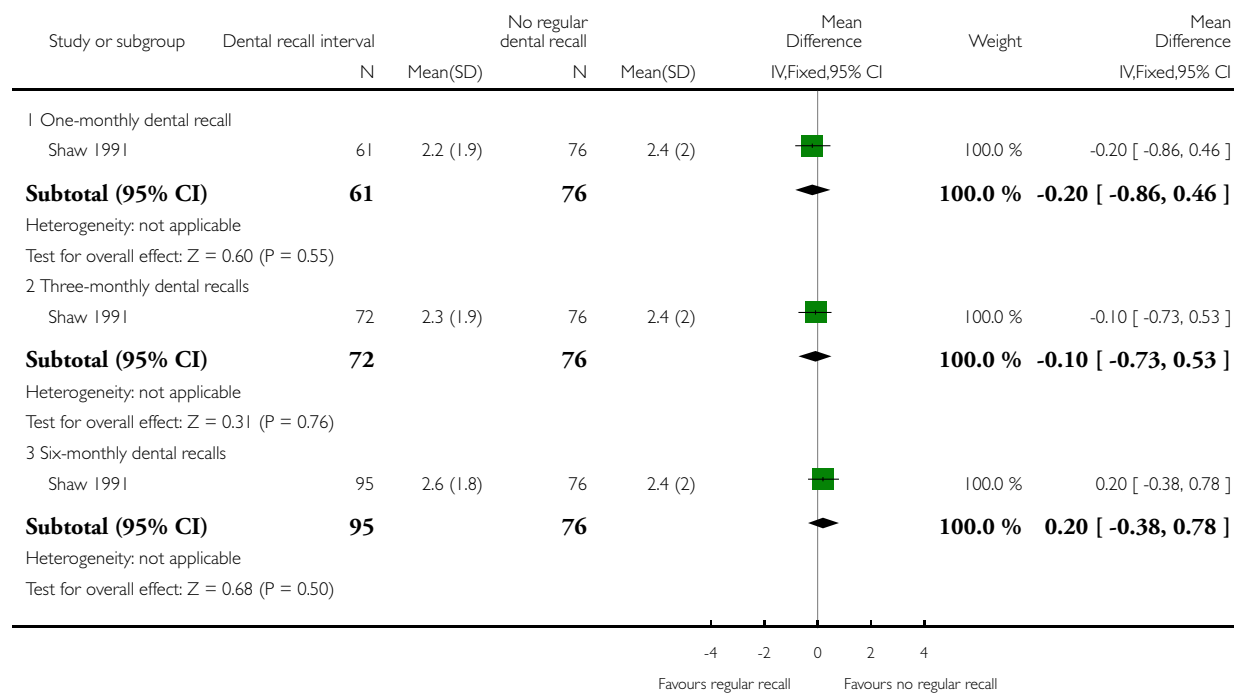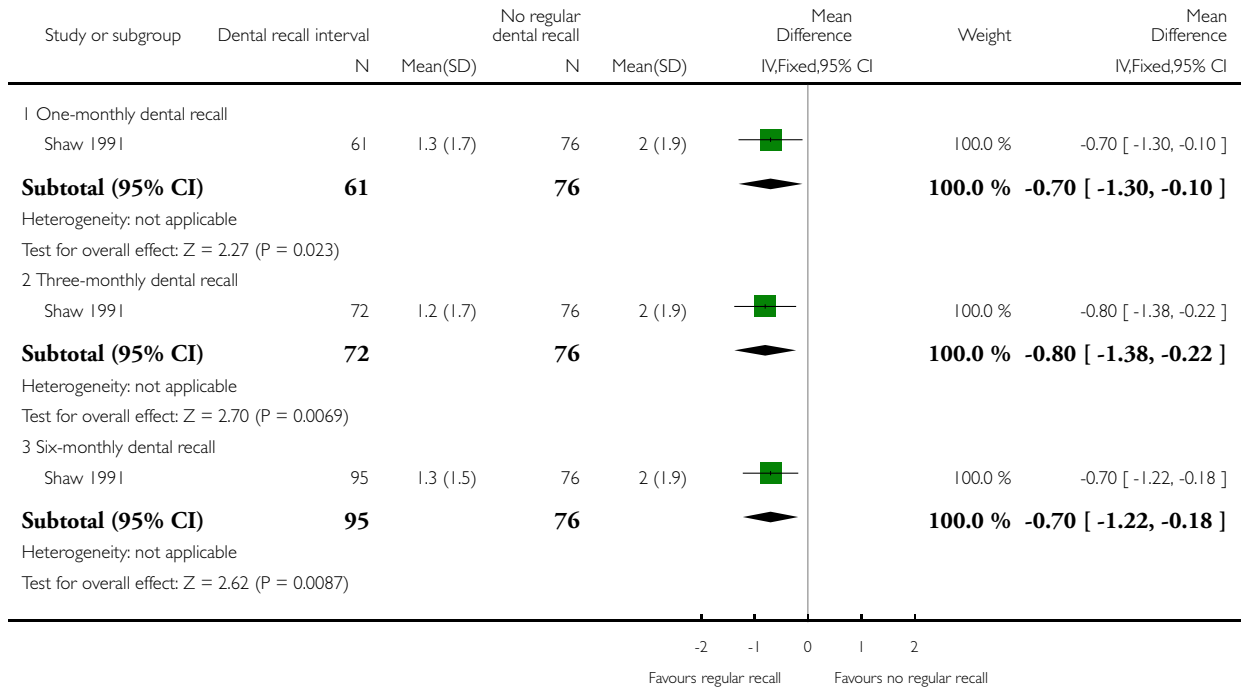| Study or subgroup	Dental recall interval		No regular dental recall		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 One-monthly dental recall							
Shaw 1991	61	1.3 (1.7)	76	2 (1.9)		100.0 %	-0.70 [-1.30, -0.10]
Subtotal (95% CI)	**61**		**76**			**100.0 %**	**-0.70 [-1.30, -0.10]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.27 (P = 0.023)							
2 Three-monthly dental recall							
Shaw 1991	72	1.2 (1.7)	76	2 (1.9)		100.0 %	-0.80 [-1.38, -0.22]
Subtotal (95% CI)	**72**		**76**			**100.0 %**	**-0.80 [-1.38, -0.22]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.70 (P = 0.0069)							
3 Six-monthly dental recall							
Shaw 1991	95	1.3 (1.5)	76	2 (1.9)		100.0 %	-0.70 [-1.22, -0.18]
Subtotal (95% CI)	**95**		**76**			**100.0 %**	**-0.70 [-1.22, -0.18]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.62 (P = 0.0087)							

```
            -2    -1    0    1    2
     Favours regular recall    Favours no regular recall
```
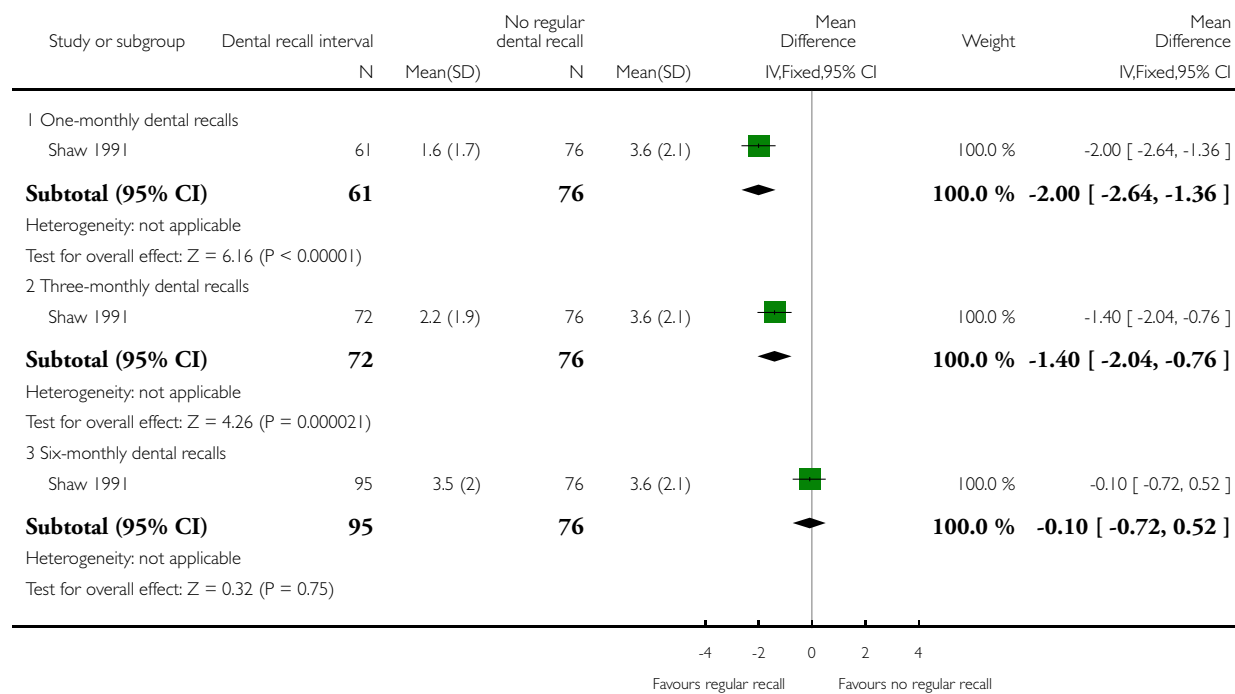
Analysis 5.4. Comparison 5 Dental recall intervals for people with intellectual disabilities, Outcome 4 Calculus long term (> 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 5 Dental recall intervals for people with intellectual disabilities

Outcome: 4 Calculus long term (> 12 months)

Study or subgroup	Dental recall interval		No regular dental recall		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 One-monthly dental recalls							
Shaw 1991	61	1.6 (1.7)	76	3.6 (2.1)		100.0 %	-2.00 [-2.64, -1.36]
Subtotal (95% CI)	**61**		**76**			**100.0 %**	**-2.00 [-2.64, -1.36]**
Heterogeneity: not applicable							
Test for overall effect: Z = 6.16 (P < 0.00001)							
2 Three-monthly dental recalls							
Shaw 1991	72	2.2 (1.9)	76	3.6 (2.1)		100.0 %	-1.40 [-2.04, -0.76]
Subtotal (95% CI)	**72**		**76**			**100.0 %**	**-1.40 [-2.04, -0.76]**
Heterogeneity: not applicable							
Test for overall effect: Z = 4.26 (P = 0.000021)							
3 Six-monthly dental recalls							
Shaw 1991	95	3.5 (2)	76	3.6 (2.1)		100.0 %	-0.10 [-0.72, 0.52]
Subtotal (95% CI)	**95**		**76**			**100.0 %**	**-0.10 [-0.72, 0.52]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.32 (P = 0.75)							

-4   -2   0   2   4

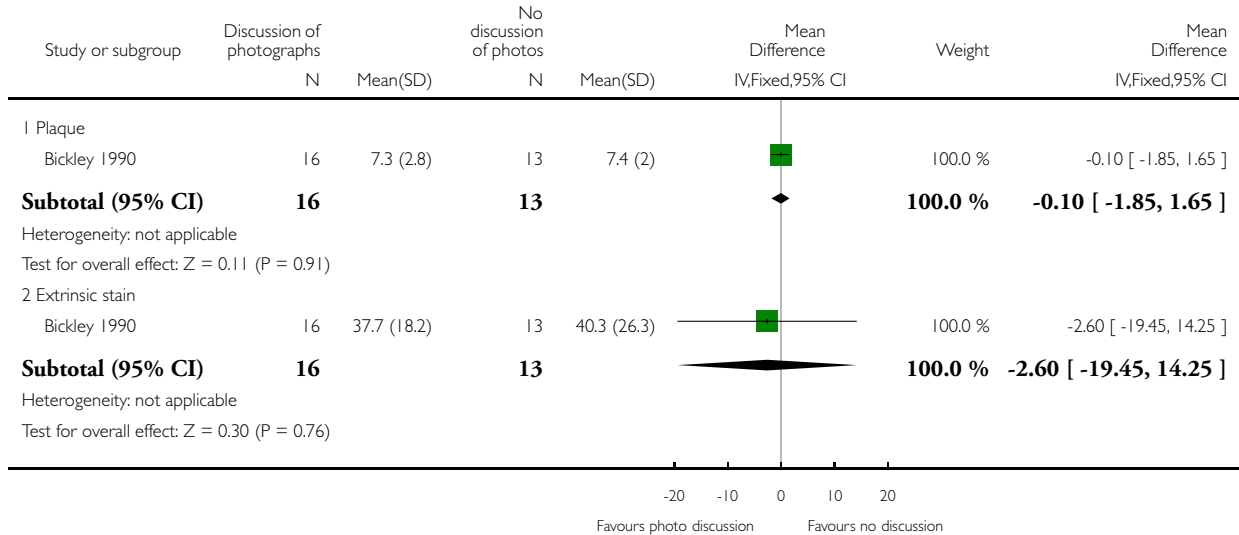Favours regular recall   Favours no regular recall

Analysis 6.1.   Comparison 6 Clinical photographs as motivators for oral hygiene in people with intellectual disabilities, Outcome 1 Plaque medium term (6 weeks to 12 months).

Review: Oral hygiene interventions for people with intellectual disabilities

Comparison: 6 Clinical photographs as motivators for oral hygiene in people with intellectual disabilities

Outcome: 1 Plaque medium term (6 weeks to 12 months)

Study or subgroup	Discussion of photographs N	Mean(SD)	No discussion of photos N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Plaque							
Bickley 1990	16	7.3 (2.8)	13	7.4 (2)		100.0 %	-0.10 [-1.85, 1.65]
Subtotal (95% CI)	**16**		**13**			**100.0 %**	**-0.10 [-1.85, 1.65]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.11 (P = 0.91)							
2 Extrinsic stain							
Bickley 1990	16	37.7 (18.2)	13	40.3 (26.3)		100.0 %	-2.60 [-19.45, 14.25]
Subtotal (95% CI)	**16**		**13**			**100.0 %**	**-2.60 [-19.45, 14.25]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.30 (P = 0.76)							

-20   -10   0   10   20

Favours photo discussion   Favours no discussion

ADDITIONAL TABLES

Table 1.   Special manual toothbrush versus conventional manual toothbrush (RCTs): gingival inflammation short term

Duration	Study	Compari-son	Index	Interven-tion mean (SD)	Con-trol mean (SD)	Total	Country	Comments	Summary
2 weeks	Kaschke 2005	Super-brush vs Oral B manual TB	PBI (scale 0-4)	**Mouth score 3.55 (0.40)** Sur-face score 7.1 (0.8)	**Mouth score 4.13 (0.35)** Sur-face score 8.25 (0.7)	54	Germany	Cross-over trial. Data pre-sented for the 2 arms com-bined. Surface score mean and SD obtained from author. Mouth score	Mean for the PBI for the Super-brush was be-low that of manual TB. However, no strong ev-idence of dif-ference

Table 1. Special manual toothbrush versus conventional manual toothbrush (RCTs): gingival inflammation short term *(Continued)*

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
								calculated from this data. Median presented in published article	between the 2 TB
	Christen 2007	Super-brush vs Oral B manual TB	PBI (scale 0-4)	**Pooled median 12.2** Self Br 10.5 Assist Br 11.5 Other Br 14.5	**Pooled median 12.6** Self Br 10.0 Assist Br 12.5 Other Br 15.5	72	Germany	Cross-over trial. Data presented for the 2 arms combined. Pooled median data calculated from reported data	"Patients who brushed their teeth did not achieve significant changes in PBI levels with any of the three toothbrushes (Wilcoxon test: p > 0.05) ," p. 63
21 days	Sauvetre 1995	Super-brush vs standard manual brush (Oral B)	S&MG (scale 0-3)	1.21 (0.85)	1.31 (0.87)	25	Belgium	Participant numbers not clearly reported, assumed to be 25.	"No significant difference was found when the results of bleeding indices were compared between the two toothbrushes, " p. 117

Assist Br: assisted brusher; Other Br: other brusher; PBI: Papillary Bleeding Index; RCT: randomised controlled trial; SD: standard deviation; Self Br: self-brusher; TB: toothbrush.

Kaschke 2005: three-armed cross-over trial; also compared the Teledyne Waterpik Sonic Speed electric TB, reported separately. Data for buccal and lingual surfaces, maxilla and mandible and Self Br, Assist Br and Other Br also reported. Christen 2007: three-armed cross-over trial; also compared the Dentacare-Sonodont electric TB, reported separately. Median and percentile data only reported. Data presented for Self Br, Assist Br and Other Br; pooled data calculated from these data. Data for buccal and lingual surfaces, maxilla and mandible also reported.

Table 2. Special manual toothbrush versus conventional manual toothbrush: gingival inflammation medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary

Table 2. Special manual toothbrush versus conventional manual toothbrush: gingival inflammation medium term *(Continued)*

4 months	Bildt 2010	Super-brush vs Oral B manual TB	GBI (scale 0-1)	18.3 (16.2)	30.7 (9.5)	18	Germany	No calibration of assessors, participant's own dentist assessed clinical outcomes. The baseline scores were considerably lower for the intervention group (24.7 vs 32.7)	Author reported no strong evidence of a difference between the 2 toothbrushes for gingival inflammation

GBI: Gingival Bleeding Index Ainamo & Bay (0-1), 6 standard teeth, % of positive sites examined; SD: standard deviation.

Table 3. Special manual toothbrush versus conventional manual toothbrush (RCTs): plaque short term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
1 week	Dôgan 2004	Super-brush vs Oral B Cross Action 35/40 manual TB	MQHPI (scale 0-5)	1.77 (0.62)	2.15 (0.58)	15	Turkey	Cross-over trial. Data presented for the final time point only	Strong evidence of a difference in PI between the Superbrush and Oral B Cross Action brush (P < 0.01) favouring the Superbrush
2 weeks	Christen 2007	Super-brush vs Oral B manual TB	MQHPI (scale 0-5)	**Pooled median 27.7** Self Br 26.5 Assist Br 26.5 Other Br 30.0	**Pooled median 28.3** Self Br 26.0 Assist Br 28.0 Other Br 31.0	72	Germany	Cross-over trial. Data presented for the 2 arms combined. Median and percentile only reported. Pooled median data calculated from	No strong evidence of a difference in QH median plaque score across all participants between the 3 different toothbrushes in the

							reported data	final examination (Friedman test: P > 0.05), p. 55
	Kaschke 2005	Super-brush vs Oral B manual TB	MQHPI (scale 0-5)	**Mouth score 2.98 (0.08)** Surface score 35.8 (0.92)	**Mouth score 3.24 (0.10)** Surface score 38.9 (1.2)	54	Germany	Cross-over trial. Data presented for the 2 arms combined. Surface score mean and SD obtained from author. Mouth score calculated from these data. Median presented in published article. Data for subgroups also presented	Plaque score for the Super-brush lay below that of the conventional manual TB. The strength of the evidence was high
21 days	Sauvetre 1995	Super-brush (3-headed) vs standard manual brush (Oral B)	S&LPI (scale 0-3)	1.02 (0.85)	0.82 (0.81)	25	Belgium	Participant numbers not clearly reported: assumed to be 25	"No significant difference was found between the two toothbrushes in the means of day 0, 7 or 21," p. 117

Assist Br: assisted brusher; MQHPI: Modified Quigley-Hein Plaque Index, scale of 0-5; Other Br: other brusher; PI: Plaque Index; QH: Quigley-Hein; RCT: randomised controlled trial; S&LPI: Silness & Löe Plaque Index, scale 0-3; SD: standard deviation; Self Br: self-brusher; TB: toothbrush.

Dôgan 2004: three-armed cross-over trial; also compared the Braun Plaque Control 3D electric TB, reported separately. Data for age groups, surfaces and approximal plaque also reported. Christen 2007: three-armed cross-over trial; also compared the Dentacare-Sonodont electric TB, reported separately. Median and percentile data only reported. Data presented for Self Br, Assist Br and Other Br, pooled data were calculated from these data. Data for buccal and lingual surfaces, maxilla and mandible also reported. Kaschke 2005: three-armed cross-over trial; also compared the Teledyne Waterpik Sonic Speed electric TB, reported separately. Data for buccal and lingual surfaces, maxilla and mandible and Self Br, Assist Br and Other Br also reported. Some strong evidence of differences were reported in favour of the Superbrush in some of these subgroups.

Table 4. Special manual toothbrush versus conventional toothbrush (RCTs): plaque medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
4 months	Bildt 2010	Superbrush vs Oral B manual TB	SG&VD (scale 0-3)	**Mouth score 0.78 (0.7)** Tooth score 4.7 (4.2)	**Mouth score 1.22 (0.36)** Tooth score 7.3 (2.2)	18	Germany	Whole mouth score calculated from tooth scores. No calibration of assessors, participant's own dentist assessed clinical outcomes. The baseline score was lower for the intervention group (8.3 vs 9.2)	Author reported no strong evidence of a difference between the 2 toothbrushes for plaque (F (2,15) = 1.20) , P = 0.33). Thesis p. 5

RCT: randomised controlled trial; **Indices:** SG&VDI: Simplified Green & Vermillion Debris Index, scale 0-18, total of 0-3 for 6 standard teeth.

Table 5. Special manual toothbrush versus conventional manual toothbrush (NRS): plaque medium term

Duration	Study	Comparison	Index	Intervention mean	Control	Total	Country	Comments	Summary
3 months	Williams 1988	Curved-bristle manual toothbrush (Collis Curve) vs conventional manual toothbrush	SG& VOHI (scale 0-3)	1.25	1.03	24	USA	SD not reported. Contact with author - data no longer available. Brushing carried out by student dental assistants	No strong evidence of a difference between the 2 toothbrushes for the oral hygiene index (t = -0.31, P < 0.76)

NRS: non-randomised study; SD: standard deviation; SG&VOHI: Simplified Green & Vermillion Oral Hygiene Index - plaque only.

Table 6. Special manual toothbrush versus conventional manual toothbrush (RCTs): oral health medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
90 days	Ferozali 2007	Oral cleansing with single-use suction brush vs a standard manual toothbrush	TOAS (scale 0-12)	1.54 (1.0)	1.99 (1.12)	22	USA	Both groups brushed with an additional chemical agent. A third group (not reported here) used a standard toothbrush and toothpaste	"There was a significant main effect over time of assessment, F(2, 26)=5.89 (p < 0.01);" all groups showed improvement. Participants receiving oral hygiene with suctioning "had the greatest improvements" in oral assessment scores and greatest sustainability over time, p. 173
		Oral cleansing with single-use suction brush vs a standard manual toothbrush	TBC	4.39 (0.63)	4.07 (0.80)	22	USA	Both groups brushed with an additional chemical agent. A third group (not reported here) used a standard toothbrush and toothpaste	No strong evidence of a difference between the 2 groups, but there was a large reduction in TBC in both groups, the suction toothbrush group reduced the TBC by almost 90%, the standard toothbrush group reduced the TBC by 81%

| | | Oral cleansing with single-use suction brush vs a standard manual toothbrush | PPB (log base 10) | 0.41 (0.97) | 0.29 (0.92) | 22 | USA | Both groups brushed with an additional chemical agent. A third group (not reported here) used a standard toothbrush and toothpaste | No significant changes in PPB between groups, all changes were reductions for pathogenic bacteria, p. 173 |

PPB: potentially pathogenic bacteria; RCT: randomised controlled trial; SD: standard deviation; TBC: Total Bacteria Count; TOAS: Total Oral Assessment Score.

Table 7.   Special manual toothbrush versus conventional manual toothbrush (RCT): behaviour, attitude and self-efficacy medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
4 months	Bildt 2010	Super-brush vs Oral B manual TB	Frequency of brushing by carer	2.0 (0.7)	2.2 (0.4)	18	Germany	Questionnaire not validated.	No strong evidence of a difference between TBs.
			Level of resistance by people with ID	4.3 (3.2)	6.0 (3.4)	18	Germany	Questionnaire not validated.	No strong evidence of a difference between TBs.
			Experience of carer when brushing	2.0 (1.0)	1.3 (0.5)	18	Germany	Questionnaire not validated.	No strong evidence of a difference between toothbrushes "although the experiences appeared to be more positive" for the carers using the special manual TB, p. 16

			Handling of TB by carer	2.3 (0.8)	1.8 (1.0)	18	Germany	Question-naire not vali-dated.	No strong ev-idence of a difference be-tween TB.

ID: intellectual disability; RCT: randomised controlled trial; SD: standard deviation; TB: toothbrush.

Table 8. Electric versus manual toothbrushes (RCTs): gingival inflammation short term

Duration	Study	Compari-son	Index	Interven-tion mean (SD)	Con-trol mean (SD)	Total		Comments	Summary
2 weeks	Kaschke 2005	Teledyne Water-pik Sonic Speed elec-tric TB vs Oral B manual TB	PBI (scale 0-4)	**Whole mouth 3.9 (0.35)** Sur-face score 7.8 (0.7)	**Whole mouth 4.3 (0.35)** Sur-face score 8.25 (0.7)	54	Germany	Cross-over trial. Data presented for the 2 arms combined. Surface score Mean and SD obtained from au-thor. Data cal-culated from obtained data. Me-dian data pre-sented in pub-lished article	Al-though there was a great re-duction in in-flam-mation for the interven-tion "No sig-nificance dif-ferences were found" for PBI between the 2 groups, p. 68
	Christen 2007	Dentacare-Sonodont electric TB vs Oral B manual TB	PBI (scale 0-4)	**Pooled median 12.3** Self Br 9. 5 Assist Br 13.5 Other Br 14.0	**Pooled median 12.6** Self Br 10. 0 Assist Br 12.5 Other Br 15.5	72	Germany	Cross-over trial. Data pre-sented for the 2 arms com-bined. Pooled me-dian data cal-culated from reported data	No strong ev-idence of a difference in the PBI me-dian at the fi-nal examina-tion and at the initial exami-nation (Fried-man test: P > 0.05), p. 62
21 days	Swallow 1969	Daily brushing; Ronson electric TB vs Colgate-	B&LL& SGI (scale 0-3)	**Pooled 1.24** Male: buccal 2.57, labial 2.	**Pooled 2.43** Male: buccal 2.07, labial 2.	20	UK	Pooled mean calculated from reported data, no SD provided.	Both brushes seemed equally effec-tive. "None of the other fac-

Table 8. Electric versus manual toothbrushes (RCTs): gingival inflammation short term *(Continued)*

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
		Palmolive manual TB		08; female: buccal 0.14, labial 0.15	34; female: buccal 2.63, labial 2.65				tors examined (except frequency) produced an F values approaching the 5% level of significance," p. 377
4 weeks	Shaw 1983	Braun electric TB vs Oral B 30 manual TB	WHOGI (Scale 0 -3)	1.7 (1.9)	1.6 (1.7)	106	UK	Cross-over trial. Data presented for the 2 arms combined.	No strong evidence of a difference in oral hygiene performance when comparing the use of electric and manual TBs. "There were no differences between the two groups. (t=0. 0702, d.f. =/- 52, p > 0.05), " p. 5

Assist Br: assisted brusher; B&LL&SGI: Buccal and Labial surfaces Löe & Silness: scale 0-3; Other Br: other brusher; PBI: Papillary Bleeding Index: scale 0-4; RCT: randomised controlled trial; SD: standard deviation; Self Br: self-brusher; TB: toothbrush; WHOGI: World Health Organization Technical Report No 621 Gingival Index: scale 0-3.

Christen 2007: three-armed cross-over trial; also compared the Superbrush, reported separately. Median and percentile data only reported. Data presented for Self Br, Assist Br and Other Br; pooled data were calculated from these data. Data for buccal and lingual surfaces, maxilla and mandible, also reported. Kaschke 2005: 3-armed cross-over trial; also compared the Superbrush, reported separately. Data for buccal and lingual surfaces, maxilla and mandible and Self Br, Assist Br and Other Br also reported. Swallow 1969: means presented separately for labial and buccal surfaces for males and females with no SD; the pooled means were calculated from these data. Female data at 21 days appeared skewed. Study also compared brushing once a week and twice a week, reported separately.

Table 9. Electric versus manual toothbrushes (RCTs): gingival inflammation medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
3 months	Carr 1997	Interplak electric TB vs Oral B	L&SGI (scale 0-3)	**Pooled 1. 80 (0.32)** Self Br 1.	**Pooled 1. 84 (0.25)**	56	USA	Pooled mean and SD calcu-	No strong evidence of a dif-

		40 manual TB		81 (0.31) Assist Br 1. 78 (0.33)	Self Br 1. 81 (0.28) Assist Br 1. 90 (0.21)			lated from the reported data. Cluster RCT	ference in gingival indices between toothbrushes at 3 months
	Garcia-Carrillo 2016	Sonicare EasyClean, Philips electric TB vs Vitis Access, Dentaid manual TB	BDL& SGI (scale 0-3)	1.31 (0.32)	1.24 (0.32)	64	Spain	Description of ID in this study appeared to include some people with an IQ > 70	No strong evidence of a difference in gingival indices between toothbrushes at 3 months
4 months	Kelner 1963	Automated electric TB (Broxodent) vs conventional TB	SGR	**% Improvement** 53%	**% Improvement** 31%	100	USA	% Improvement calculated from the reported data.	"The automatic electric toothbrush appeared significantly superior to the conventional toothbrush in improving gingival health," p. 108
6 months	Carr 1997	Interplak electric TB vs Oral B 40 manual TB	L&SGI (scale 0-3)	**Pooled 1. 90 (0.20)** Self Br 1. 92 (0.16) Assist Br 1. 86 (0.23)	**Pooled 1. 90 (0.16)** Self Br 1. 88 (0.20) Assist Br 1. 96 (0.12)	56	USA	Pooled mean and SD calculated from the reported data. Cluster RCT	No strong evidence of a difference in gingival indices between toothbrushes at 6 months
	Garcia-Carrillo 2016	Sonicare EasyClean, Philips electric TB vs Vitis Access, Dentaid manual TB	BDL& SGI (scale 0-3)	1.24 (0.28)	1.19 (0.28)	64	Spain	Description of ID in this study appeared to include some people with an IQ > 70	No strong evidence of a difference in gingival indices between toothbrushes at 6 months (P = 0. 37), p. 5

Table 9. Electric versus manual toothbrushes (RCTs): gingival inflammation medium term *(Continued)*

| 12 months | Carr 1997 | Interplak electric TB vs Oral B 40 manual TB | L&SGI (scale 0-3) | **Pooled 1. 25 (0.47)** Self Br 1. 72 (0.30) Assist Br 1. 72 (0.42) | **Pooled 1. 73 (0.61)** Self Br 1. 87 (0.21) Assist Br 2. 0 (0.0) | 56 | USA | Pooled mean and SD calculated from the reported data. Cluster RCT | RM analysis of variance showed the Gingival Index at 12 months was significantly associated with the toothbrush used (P = 0.017) positive for the Interplak electric TB |

Assist Br: assisted brusher; BDL&SGI: Bentley & Disney (four sites per tooth in two randomly (by coin toss) selected quadrants (one in the upper jaw, one in the lower jaw, contralateral); IQ: intelligence quotient; L&SGI: Löe & Silness Gingival Index, Scale 0-3; Other Br: other brusher; RCT: randomised controlled trial; RM: repeat measure; SD: standard deviation; Self Br: self-brusher; SGR: Subjective Gingival Rating Scale, - worse, same, better; TB: toothbrush.
Kelner 1963: subjective data presented. Data also presented for frequency of brushing. Carr 1997: means and SDs presented separately for Self Br and Assist Br; the pooled means and SDs were calculated from these data for the different time points.

Table 10. Electric versus manual toothbrushes (NRS): gingival inflammation short term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
4 weeks	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	L&SGI (scale 0-3)	**Pooled 1. 55 (0.16)** Unaided 1. 5 (0. 2), aided 1. 6 (0.1)	**Pooled 1. 60(0.16)** Unaided 1. 6 (0. 1), aided 1. 6 (0.2)	23	Sweden	Pooled mean and SD calculated from the reported data.	No overall difference in Gingival Index between toothbrushes

L&SGI: Löe & Silness Gingival Index, Scale 0-3; NRS: non-randomised study; SD: standard deviation.
Bratel 1991: mean and SD presented for aided and unaided brushing, pooled mean and SDs were calculated from these data.

Table 11. Electric versus manual toothbrushes (NRS): gingival inflammation medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
8 weeks	Gertenrich 1967c	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	**Pooled 34%** Group 1: 10%; Group 2: 58%	**Pooled 43%** Group 1: 50%; Group 2: 36%	37	USA	Data presented as mean level of "obvious gingivitis" by % in a graph, pooled % for the reported data were calculated	General reduction in gingivitis in both groups and with both brushes. The greatest reduction was in Group 1 using the electric brush
	Gertenrich 1967a	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	**Pooled 83%** Group 1: 74%; Group 2a: 85%; Group 2b: 100%	**Pooled 54%** Group 1: 50%; Group 2c: 50%; Group 2d:; 65%	38	USA	Data presented as mean level of "obvious gingivitis" by % in a graph, Pooled % for the reported data were calculated	There was a general reduction in both groups and both brushes, with a tendency for greater reduction in those using a standard brush
	Gertenrich 1967d	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	84%	74%	43	USA	Data presented as mean level of "obvious gingivitis" by % in a graph	A general reduction, with no difference between brushes.
8/10 weeks	Gertenrich 1967b	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Py-	SGR (scale 1-3)	**Pooled 57. 5%** Group 1: 45%; Group 2: 70%	**Pooled 77%** Group 1: 54%; Group 2: 100%	70	USA	Data presented as mean level of "obvious gingivitis" by % in a graph, pooled % for the reported	General reduction in gingivitis with both brushes. A greater reduction in Group 1 (participants

		co-pay, Hard, Lactona Jr.)						data were calculated	with Down's syndrome) for both brushes
12 weeks	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	L&SGI (scale 0-3)	**Pooled 1. 65 (0.10)** Group 1: 1.6 (0.1) ; Group 2: 1.7 (0.1)	**Pooled 1. 60 (0.16)** Group 1: 1.6 (0.2) ; Group 2: 1.6 (0.1)	23	Sweden	Pooled mean and SD calculated from the reported data.	No strong evidence of a difference in Gingival Index between the 2 brushes. Group 1 (un-aided) using the electric TB brush was the only subgroup with strong evidence of improvement from baseline at 12 weeks (P < 0.01), p. 25
20 weeks	Gertenrich 1967a	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	**Pooled 100%** Group 1: 100%; Group 2a: 100%; Group 2b: 100%	**Pooled 75%** Group 1: 60%; Group 2a: 85%; Group 2b: 85%	36	USA	Data presented as mean level of "obvious gingivitis" by % in a graph, Pooled % for the reported data were calculated	Levels of observable gingivitis regressed towards baseline levels, with slightly less regression in the those using the standard toothbrush
	Gertenrich 1967d	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	100%	100%	42	USA	Data presented as mean level of "obvious gingivitis" by % in a graph	Regression to baseline levels of gingivitis in both groups, although a "decrease in severity" was noted. No difference between the brushes
21/28 weeks	Gertenrich 1967b	Oral B Automatic	SGR (scale 1-3)	**Pooled 53. 5%** Group	**Pooled 85%**	72	USA	Data presented as	The reduction in obvious

				1: 37%; Group 2: 70%	Group 1: 70%; Group 2: 100%			mean level of "obvious gingivitis" by % in a graph, Pooled % for the reported data were calculated	gingivitis seen at 11 weeks was maintained for both Group 1 (Down's syndrome) and Group 2 (IQ < 20) using the electric TB at this time point. Both groups using the manual TB regressed to baseline levels
		Tooth-brush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)							
34 weeks	Gertenrich 1967c	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SGR (scale 1-3)	**Pooled 42. 5%** Group 1: 40%; Group 2: 45%	**Pooled 40%** Group 1: 30%; Group 2: 50%	36	USA	Data presented as mean level of "obvious gingivitis" by % in a graph, Pooled % for the reported data were calculated	Some reduction in gingivitis was maintained from baseline in both groups. No difference found between the 2 brushes

L&SGI: Löe & Silness Gingival Index, Scale 0-3; NRS: non-randomised study; SD: standard deviation; SGR: Subjective Gingival Rating, measure of "periodontal involvement;" "obvious signs of gingivitis;" "decrease in severity" and "absence of clinical signs of gingivitis." "Obvious signs" and "decrease in severity" were combined on the graph. IQ: intelligence quotient; TB: toothbrush.
Group 1: unaided; Group 2: aided.
Gertenrich 1967b: data presented as % difference separately for two distinct ID groups (Group 1: Down's syndrome; Group 2: intelligence quotient (IQ): ≤ 20) the pooled % differences were calculated from these data. All teeth were brushed by attendants.
Gertenrich 1967c: data presented as % difference separately for two distinct groups with ID (Group 1: hydrocephaly and seizure unit; Group 2: paediatric unit); the pooled % differences were calculated from these data. All teeth were brushed by attendants. Gertenrich 1967a: in Group 1 (people with cerebral palsy with IQ 30-95), all teeth were brushed by attendants. In Group 2 ("trainable patients" with IQ 30-50), teeth of half the participants were brushed by attendants (2a and 2c), the other half self-brushed (2b and 2d). Gertenrich 1967d: all participants were self-brushers with supervision and assistance from the attendants. Bratel 1991: mean and SD presented for unaided brushing (Group 1), aided brushing (Group 2), and pooled mean and SDs were calculated from these data. Wear and tear on toothbrushes was reported as having no difference, no data provided. Participants in the intervention group preferred the electric toothbrush, no data provided for the control group.

Table 12. Electric versus manual toothbrushes (NRS): gingival inflammation long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
16 months	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	L&SGI (scale 0-3)	**Pooled 1. 75 (0.16)** Group 1: 1.7 (0.1) ; Group 2: 1.8 (0.2)	**Pooled 1. 70 (0.20)** Group 1: 1.7 (0.2) ; Group 2: 1.7 (0.2)	23	Sweden	Data presented for aided and unaided with SD, overall pooled mean and SD calculated from the reported data	No strong evidence of a difference in gingivitis between the brushes. The unaided electric TB subgroup showed greater improvement at 16 months (P < 0.05). The aided manual TB subgroup showed greater deterioration at 16 months (P < 0. 01)

Group 1: unaided; Group 2: aided; L&SGI: Löe & Silness Gingival Index, Scale 0-3; NRS: non-randomised study; SD: standard deviation; TB: toothbrush.

Bratel 1991: mean and SD presented for unaided (Group 1) and aided (Group 2) brushing; pooled mean and SDs were calculated from these data.

Table 13. Electric versus manual toothbrushes (RCTs): plaque short term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
1 week	Dôgan 2004	Braun Plaque Control 3D electric TB vs Oral B Cross Action 35/ 40 manual TB	MQHPI (scale 0-5)	1.54 (0.71)	2.15 (0.58)	15	Turkey	Cross-over trial. Data presented for the 2 arms separately at the final examination. Participant number at baseline un-	Strong evidence of a difference in the Plaque Index between the Braun 3D electric TB and Oral B Cross Action TB (P

								clear: assumed to be the same as at final time point	< 0.001) in favour of the electric TB
2 weeks	Christen 2007	Dentacare-Sonodont electric TB vs Oral B manual TB	MQHPI (scale 0-5)	**Pooled median 25.8** Self Br 23.0 Assist Br 27.5 Other Br 27.0	**Pooled median 28.3** Self Br 26.0 Assist Br 28.0 Other Br 31.0	72	Germany	Cross-over trial. Data presented for the 2 arms combined. Pooled median data calculated from reported data	No strong evidence of a difference in the QH median across all participants between the 3 different toothbrushes in the final examination (Friedman test: P > 0.05), p. 55
	Kaschke 2005	Teledyne Waterpik Sonic Speed electric TB vs Oral B manual TB	MQHPI (scale 0-5)	**Whole mouth 3.1 (0.09)** Surface score 36.1(1.2)	**Whole mouth 3.25 (0.10)** Surface score 38.9 (1.9)	54	Germany	Cross-over trial. Data presented for the 2 arms combined. Surface score Mean and SD obtained from author. Data calculated from tooth surface scores. Median presented in published article	Strong evidence that the mean Plaque Index for the Teledyne Waterpik was lower than the Oral B manual toothbrush (P < 0.05), p. 68
4 weeks	Shaw 1983	Braun electric TB vs Oral B 30 manual TB	S&LPI (scale 0-3)	**Total mouth 0.59 (0.26)** Surface score 14.1 (6.2)	**Total mouth 0.57 (0.2)** Surface score 13.6 (4.7)	106	UK	Cross-over trial. Data presented for the 2 arms combined. Data calculated from tooth surface scores	No strong evidence of a difference in oral hygiene performance when comparing the use of electric and manual TBs. "There was no

Table 13. Electric versus manual toothbrushes (RCTs): plaque short term   *(Continued)*

									sig. diff between the groups (t= 0.833, d.f.52, p > 0.05)," p. 5

Assist Br: assisted brusher; MQHPI: Modified Quigley-Hein Plaque Index, scale 0-5; Other Br: other brusher; QH: Quigley-Hein; RCT: randomised controlled trial; S&LPI: Silness & Löe Plaque Index, scale 0-3; SD: standard deviation; Self Br: self-brusher; TB: toothbrush.

Dôgan 2004: three-armed cross-over trial; also compared the Superbrush, reported separately. Data presented were for the final examination, number of participants were adjusted accordingly. Data for age groups and surfaces also reported. Christen 2007: three-armed cross-over trial; also compared the Superbrush, reported separately. Median and percentile data only reported. Data presented for Self Br, Assist Br and Other Br, pooled data were calculated from these data. Data for buccal and lingual surfaces, maxilla and mandible also reported. Kaschke 2005: three-armed cross-over trial; also compared the Superbrush, reported separately. Data for buccal and lingual surfaces, maxilla and mandible and Self Br, Assist Br and Other Br also reported. Shaw 1983: two-armed cross-over trial. Data presented for tooth surfaces with SD, mean total mouth score and SD calculated.

Table 14. Electric versus manual toothbrushes (RCTs): plaque medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
3 months	Carr 1997	Interplak electric TB vs Oral B 40 manual TB	SG&VDI (scale 0-3)	**Pooled 1. 31 (0.57)** Self Br 1. 39 (0.42); Assist Br 1. 19 (0.68)	**Pooled 1. 21 (0.68)** Self Br 1. 14 (0.49); Assist Br 1. 39 (0.82)	56	USA	Pooled mean and SD calculated from reported data. Cluster RCT	No strong evidence of a difference in plaque levels between the tooth brushes at 3 months
	Garcia-Carrillo 2016	Sonicare EasyClean, Philips electric TB vs Vitis Access, Dentaid manual TB	BDS&LPI (scale 0-3)	1.02 (0. 33)	1.12 (0. 33)	64	Spain	The description of ID in this study appeared to include some people with an IQ > 70	No strong evidence of a difference in plaque levels between the tooth-brushes at 3 months
4 months	Kelner 1963	Automated electric TB (Broxodent) vs conven-	SOHR	% improvement 27%	% improvement 18%	100	USA	% improvement calculated from the reported data.	"The automatic electric toothbrush appeared significantly superior to the

		tional TB							conventional toothbrush in improving oral hygiene."
6 months	Carr 1997	Interplak electric TB vs Oral B 40 manual TB	SG&VDI (scale 0-3)	**Pooled 1. 55 (0.67)** Self Br 1. 60 (0.53) Assist Br 1. 46 (0.78)	**Pooled 1. 34 (0.41)** Self Br 1. 07 (0.51) Assist Br 2. 03 (0.29)	56	USA	Pooled mean and SD calculated from reported data. Cluster RCT	No strong evidence of a difference in plaque levels between the tooth brushes at 6 months
	Garcia-Carrillo 2016	Sonicare EasyClean, Philips electric TB vs Vitis Access, Dentaid manual TB	BDS&LPI (scale 0-3)	1.12 (0. 35)	1.04 (0. 35)	64	Spain	The description of ID in this study appeared to include some people with an IQ > 70	No strong evidence of a difference in plaque levels between toothbrushes at 6 months (P = 0.87), p. 4
12 months	Carr 1997	Interplak electric TB vs Oral B 40 manual TB	SG&VDI (scale 0-3)	**Pooled 1. 35 (0.57)** Self Br 1. 25 (0.51); Assist Br 1. 15 (0.63)	**Pooled 1. 49 (0.51)** Self Br 1. 25 (0.42); Assist Br 2. 10 (0.58)	56	USA	Pooled mean and SD calculated from reported data. Cluster RCT	No reported strong evidence of a difference in plaque levels between tooth brushes at 12 months

Assist Br: assisted brusher; BDS&LPI: Bentley & Disney Modified Silness & Löe Plaque Index, scale 0-3; ID: intellectual disability; IQ: intelligence quotient; RCT: randomised controlled trial; SD: standard deviation; Self Br: self-brusher; SG&VDI: Simplified Green & Vermillion Debris Index, scale 0-3; SOHR: Subjective Oral Hygiene Rating, scale poor, fair, good; TB: toothbrush.

Kelner 1963: subjective data presented, % improvement has been calculated from the differences between the combined fair and good ratings pre and post. Data also presented by age groups (aged 4-14 years, 15-32 years). Carr 1997: means and SDs presented separately for Self Br and Assist Br, the pooled means and SDs were calculated from these data for the different time points. Some differences noted between Self Br and Assist Br. "There was a marginally significant difference in the pattern of debris index across time for the two brushing assistance status groups (p = 0.054)," p. 135. Garcia-Carrillo 2016 reported the mean IQ as 60.6, ranging between 44 and 87.

Table 15. Electric versus manual toothbrushes (NRS): plaque short term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
4 weeks	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	S&LPI (scale 0-3)	**Pooled 1.5 (0.3)** Unaided 0.8 (0.3); aided 1.3 (0.5)	**Pooled 1.5 (0.35)** Unaided 1.1 (0.4); aided 1.0 (0.3)	23	Sweden	Pooled mean and SD calculated from the reported data.	No overall difference in Plaque Index between toothbrushes.

NRS: non-randomised study; S&LPI: Silness & Löe Plaque Index, Scale 0-3; SD: standard deviation.

Bratel 1991: mean and SD presented for aided and unaided brushing, pooled mean and SDs were calculated from these data.

Table 16. Electric versus manual toothbrushes (NRS): plaque medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
0-8/10 weeks	Gertenrich 1967b	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pyco-pay, Hard, Lactona Jr.)	SOHR (scale 1-4)	**Pooled MD 0.75 (0.64)** Group 1: 0.63 (0.71); Group 2: 1.18 (0.56)	**Pooled MD 0.59 (0.91)** Group 1: 0.32 (1.08); Group 2: 1.12 (0.70)	55	USA	Pooled mean difference and SD calculated from the reported data	The results showed that both groups reduced plaque levels during the supervised brushing period, with the electric TB being "somewhat better."
0-8 weeks	Gertenrich 1967c	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Py-	SOHR (scale 1-4)	**Pooled MD 1.26 (0.50)** Group 1: 1.70 (0.47); Group 2: 0.66 (0.53)	**Pooled MD 1.45 (0.73)** Group 1: 1.57 (0.68); Group 2: 1.25 (0.77)	37	USA	Pooled MD and SD calculated from the reported data.	An improvement in oral hygiene in both ID groups and with both

		co-pay, Hard, Lactona Jr.)							brushes (P 0.05- 0.001). No strong evidence of a difference in oral hygiene between the 2 brushes
0-8 weeks	Gertenrich 1967a	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pycopay, Hard, Lactona Jr.)	SOHR (scale 1-4)	Group 1 MD 2.21 (0.60)	Group 1 MD 1.72 (0.55)	Group 1: 15	USA	MD and SD reported for Group 1. Mean square difference was reported for Group 2. Type of brush - mean Sq (F) 2. 67 (10.35). Author reports raw data no longer available	A reduction in plaque levels in both ID groups and with both brushes (P 0.05-0. 001) . No strong evidence of a difference between the 2 brushes
0-8 weeks	Gertenrich 1967d	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Pycopay, Hard, Lactona Jr.)	SOHR (scale 1-4)	MD 1.36 (0.88)	MD 1.33 (0.58)	43	USA	MD presented in this study.	There was an improvement in oral health with both brushes (P = 0. 001) but no strong evidence of a difference in oral hygiene between the 2 brushes

12 weeks	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	S&LPI (scale 0-3)	**Pooled 1. 10 (0.14)** Unaided 0. 9 (0. 3); aided 1. 3 (0.2)	**Pooled 1. 11 (0.30)** Unaided 1. 2 (0. 3); aided 1. 0 (0.3)	23	Sweden	Pooled mean and SD calculated from the reported data.	Some strong evidence of a difference in sub-groups (manual aided (P < 0.01) and electric unaided (P < 0.05); however, no strong overall difference in Plaque Index between toothbrushes
8-20 weeks	Gertenrich 1967a	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Py-co-pay, Hard, Lactona Jr.)	SOHR (scale 1-4)	Group 1: -0.71 (0. 59)	Group 1: -0.79 (0. 65)	14	USA	MD and SD reported for Group 1. Mean square difference was reported for Group 2. Type of brush - mean Sq (F) 1.05 (1.54), "not a significant change". Author reported raw data no longer available	No strong evidence of a difference in oral hygiene between the 2 toothbrushes at this time point. "There was a significant regression in oral hygiene in both groups" at this time point. p. 158
8-20 weeks	Gertenrich 1967d	Oral B Automatic Toothbrush - Arcu-	SOHR (scale 1-4)	-0.57 (0. 54)	-0.88 (0. 65)	42	USA	MD presented in this study.	A slight regression in the improvements

		ate actions vs manual brush (Py-co-pay, Hard, Lactona Jr.)							made in oral hygiene with both the electric and manual toothbrushes (P = 0.001) , no strong evidence of a difference in oral hygiene between the 2 brushes
10-28 weeks	Gertenrich 1967b	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Py-co-pay, Hard, Lactona Jr.)	SOHR (scale 1-4)	Group 1: 0.24 (0.55)	Group 1: 0.03 (1.37)	52	USA	MD presented in this study for Group 1 only. Group 2 control joined Group 2 intervention after week 8	No strong evidence of a difference in oral hygiene between the 2 brushes at this time point
20-34 weeks	Gertenrich 1967c	Oral B Automatic Toothbrush - Arcuate actions vs manual brush (Py-co-pay, Hard, Lactona Jr.)	SOHR (scale 1-4)	**Pooled 0. 36 (0.49)** Group 1: -0.10 (0. 62); Group 2: 0.94 (0. 30)	**Pooled 0. 69 (0.47)** Group 1: 0.32 (0. 61); Group 2: 1.28 (0. 25)	36	USA	Pooled MD and SD calculated from the reported data.	Strong evidence of an improvement in oral hygiene in Group 2 in both the electric and manual toothbrushes (P = 0.05). No strong evidence of an improvement in either brush in Group 1

MD: mean difference; NRS: non-randomised study; S&LPI: Silness & Löe Plaque Index, scale 0-3; SD: standard deviation; SOHR: Subjective Oral Hygiene Rating (good, fair, poor and very poor), scale 1-4.

Gertenrich 1967b: means and SDs presented separately for two distinct groups with ID (Group 1: Down's syndrome; Group 2: intelligence quotient (IQ); ≤ 20), the pooled mean and SD were calculated from these data. All participants' teeth were brushed by attendants. "Although the results obtained using the automatic units in a controlled regime were more stable and generally some what better (Figure 1) compared to the results with the hand brushing on a controlled regime, it is clear that these added benefits can vanish soon after the controlled regime is discontinued," p. 148. Gertenrich 1967c: means and SDs presented separately for two distinct ID groups (Group 1: hydrocephaly and seizure unit; Group 2: paediatric unit) the pooled mean and SD were calculated from these data. All participants' teeth were brushed by attendants. Gertenrich 1967a: two distinct groups with ID (Group 1: participants with cerebral palsy with IQ 30-95; Group 2 "trainable patients" with IQ 30-50). In Group 1, all were brushed by attendants. In Group 2, half the participants were brushed by attendants the other half self-brushed. In Group 2, "The most significant improvement occurred in the group that was brushed by attendants using the automated toothbrush," p. 157. Gertenrich 1967d: all participants were self-brushers with supervision and assistance from the attendants. Bratel 1991: mean and SD presented for aided and unaided brushing, pooled mean and SDs were calculated from these data.

Table 17. Electric versus manual toothbrushes (NRS): plaque long term

Duration	Study	Comparison	Index	Intervention mean/SD	Control mean/SD	Total	Country	Comments	Summary
16 months	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	S&LPI (scale 0-3)	Pooled 1. 30 (0.35) Unaided 1. 2 (0. 3); aided 1. 4 (0.4)	Pooled 1. 40 (0.30) Unaided 1. 4 (0. 3); aided 1. 4 (0.3)	23	Sweden	Pooled mean and SD calculated from the reported data.	"No significant changes concerning plaque index were found in or between groups after 16 months," p. 6

NRS: non-randomised study; S&LPI: Silness & Löe Plaque Index, scale 0-3; SD: standard deviation.

Bratel 1991: mean and SD presented for aided and unaided brushing; pooled mean and SDs were calculated from these data.

Table 18. Electric versus manual toothbrushes (RCTs): calculus medium term

Duration	Study	Comparison	Index	Intervention Mean (SD)	Control Mean (SD)	Total No.	Country	Comments	Summary
4 months	Kelner 1963	Automated electric TB (Broxodent) vs conventional TB	SCR	% Improvement 13%	% Improvement 10%	100	USA	% Improvement calculated from the reported data.	"The automatic electric toothbrush appeared significantly superior to the conven-

								tional toothbrush in improving deposits," p. 108
6 months	Garcia-Carrillo 2016	Sonicare EasyClean, Philips electric TB vs Vitis Access, Dentaid manual TB	BDCI (scale 0-1)	0.18 (0.12)	0.16 (0.12)	64	Spain	The description of ID in this study appeared to include some people with an IQ > 70	No strong evidence of a difference in the effect of toothbrush group on the Calculus iIndex (P = 0.40)
6 months	Carr 1997	Interplak electric TB vs Oral B 40 manual TB.	SG&VCI (scale 0-3)	**Pooled 0.78 (0.39)** Self Br 0.70 (0.41); Assist Br 0.91 (0.37)	**Pooled 0.90 (0.47)** Self Br 0.77 (0.55); Assist Br 1.23 (0.37)	56	USA	Pooled mean and SD calculated from the reported data. Cluster RCT	No evidence of a difference between groups for the Calculus Index
12 months		Interplak electric TB vs Oral B 40 manual TB.	SG&VCI (scale 0-3)	**Pooled 0.76 (0.50)** Self Br 1.81 (0.31); Assist Br 1.78 (0.33)	**Pooled 0.93 (0.40)** Self Br 1.81 (0.31); Assist Br 1.78 (0.33)	56	USA	Pooled mean and SD calculated from the reported data. Cluster RCT	No evidence of a difference between groups could be found for the Calculus Index

Assist Br: assisted brusher; BDCI: Bentley & Disney Calculus Index, present or absent; ID: intellectual disability; IQ: intelligence quotient; RCT: randomised controlled trial; SD: standard deviation; SCR: Subjective Calculus Rating - none, moderate, extreme; Self Br: self-brusher; SG&VCI: Simplified Green & Vermillion Calculus Index, scale 0-3.

Kelner 1963: subjective data presented; the term 'deposits' was described as "the presence and amount of stain, soft and hard deposits," p. 102. % improvement calculated from the differences between the combined 'extreme' ratings pre and post. Data also presented by age groups (aged 4-14 years, 15-32 years). Carr 1997: means and SDs presented separately for Self Br and Assist Br; the pooled means and SDs were calculated from these data for the different time points.

Table 19. Electric versus manual toothbrush: self-efficacy long term

Duration	Study	Comparison	Index	Intervention (yes/no)	Control (yes/no)	Number of participants	Country	Comments	Summary
16 months	Bratel 1991	Braun 3D Electric toothbrush vs Butler 411 manual toothbrush	SE (yes/no)	**Pooled 4/8** Aided 1/5; unaided 3/3	**Pooled 3/7** Aided 2/3; unaided 1/4	23	Sweden	Data calculated for pooled aided and unaided participants for each group	No evidence of a difference between the groups.

SE: self-efficacy: "Do you find it difficult to brush your patient's teeth?"

Table 20. Training of carers versus no training of carers (RCTs): gingival inflammation medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
8 weeks	Phlypo 2016	Carers provided with an Information booklet and information session with practical skills	MGI (scale 0-3)	1.2 (0.36)	1.5 (0.24)	36	Belgium	MD data were reported; intervention 0.1 (SD 0.61); control 0.003 (SD 0.32)	No strong evidence of a difference was found in Gingival Index between the intervention and control group pre- and post-test. (P = 0.14), However, when the individual post-test data were considered, there was strong evidence of a difference (P = 0.02) in Gingival Index between the in-

Table 20.   Training of carers versus no training of carers (RCTs): gingival inflammation medium term   *(Continued)*

									tervention and control group, p. 15
6-9 months	Mac Giolla Phadraig 2015	Staff received training via a pyramidal training programme vs no training	LMGI (scale 0-4)	2.47 (1. 21)	2.20 (1. 18)	63	Ireland	-	"The difference in mean MGI and PI between groups was not statistically significant (p > 0.05, ANCOVA)," p. 95. "In this instance distal outcomes such as residents oral health and hygiene did not improve in the presence of proximal improvements in oral health-related knowledge, attitudes and self-efficacy, and reported behaviours of carers," p. 96

ANCOVA: analysis of covariance; LMGI: Lobene Modified Gingival Index (non-invasive); MD: mean difference; MGI: Modified Silness & Löe on buccal and lingual surfaces of 6 standard teeth; PI: Plaque Index; RCT: randomised controlled trial; SD: standard deviation.

Table 21.   Training of carers versus no training of carers (RCTs): plaque medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
8 weeks	Phlypo 2016	Carers provided with an Informa-	MPI (scale 0-3)	1.4 (0.38)	1.5 (0.24)	36	Belgium	MD also reported (P = 0. 50)	No strong evidence of a difference

		tion book-let and in-formation session with prac-tical skills							in MPI (P = 0. 35), p. 15.
6-9 months	Mac Giolla Phadraig 2015	Staff received training via a pyra-midal training pro-gramme on oral health and oral hy-giene vs no training	MPI (scale 0-3)	1.89 (1. 05)	1.78 (0. 97)	63	Ireland	Brushing was carried out equally by the people with ID and the staff	"The differ-ence in mean MGI and PI be-tween groups was not statis-tically signifi-cant (p > 0.05, ANCOVA)," p. 95

ANCOVA: analysis of covariance; ID: intellectual disability; MD: mean difference; MPI: Modified Silness & Löe Plaque Index (6 standard teeth, no probe used, surfaces visible to the researcher); RCT: randomised controlled trial; SD: standard deviation.

Table 22. Training of carers versus no training of carers (NRS): plaque short term

Duration	Study	Compari-son	Index	Interven-tion mean (SD)	Con-trol mean (SD)	Total	Country	Comments	Summary
21 days	Lange 2000	Training of carers with and with-out ac-countabil-ity (Group 1 + Group 2) vs no training (Group 3)	MRPDI (scale 0-3)	**Pooled data 1.09 (0.26)** Group 1: 0.23 (0. 02); Group 2: 2.12 (0. 37)	1.78 (0.45)	34	USA	Pooled mean and SD cal-culated from reported data for Group 1 and Group 2	The Plaque Index for Group 1 (with account-ability) was lower than that of Group 2 (without ac-count-ability) (P = 0. 004) and the control group (P = 0.0001)
		Training of carers with account-ability	MRPDI (scale 0-3)	0.23 (0.02)	2.12 (0.37)	24	USA	SD calculated from reported data for	"Fisher's LSD in-dicted signif-

Table 22. Training of carers versus no training of carers (NRS): plaque short term   *(Continued)*

		(Group 1) vs training without (Group 2) account-ability						Group 1 and Group 2.	icantly lower plaque indexes for experi-mental Group I vs Group 2 (p=.00001), " p. 208

LSD: Least Significant Difference; MRPDI: Modified Ramfjord Periodontal Disease index - plaque only; SD: standard deviation.
Lange 2000: mean and standard error presented separately for "with accountability" (Group 1) and "without accountability" (Group 2) of trainers, and for control (Group 3); SDs calculated from these data, mean and SD pooled for Group 1 and Group 2 in Comparison 1 and compared in Comparison 2.

Table 23. Training of carers versus no training of carers (NRS): plaque medium term

Duration	Study	Compari-son	Index	Interven-tion mean	Control mean	Total	Country	Comments	Summary
4-5 months	Glassman 2006	Effect of knowledge acquisition on carers behaviour and their clients oral hygiene behaviour	SOHI (scale 0-3)	Range 1.6-0.3	N/A	11	USA	Data in pub-lished article unclear. Mul-tiple attempts to contact au-thors failed	"Improve-ment from baseline through the coaching phase of from 18.89% to 72. 5%," p. 43

N/A: not available; NRS: non-randomised study; SOHI: Simplified Green & Vermillion Oral Hygiene Index, debris only, scale 0-3.

Table 24. Training of carers versus no training of carers (RCTs): knowledge short and medium term

Duration	Study	Compari-son	Index	Interven-tion mean (SD)	Con-trol mean (SD)	Total	Country	Comments	Summary
90 minutes	Gonzalez 2013	Oral health lec-ture with hands on training (90 min-utes) vs oral health discussion (30 minutes)	Knowl-edge and com-prehen-sion (scale 0-1 for 20 questions)	**18. 29 (1.98)** MD 0.061 (0.086)	**17.7 (1. 49)** MD 0. 035 (0. 094)	24	USA	MD reported. Assess-ment was im-mediately pre- and postinter-vention	Both groups improved their knowledge from baseline; however, there was no sig-nificant differ-ence between the groups

| 8 weeks | Phlypo 2016 | Carers provided with an information booklet and information session with practical skills | Knowledge (scale 0-1 for 10 questions) | 6.8 (1.43) | 5.9 (1.33) | 34 | Belgium | Subgroup analyses reported. | Post-test, overall no strong evidence of differences were reported in K-index scores between and within groups, p. 6 |
| 6.5-11 months | Mac Giolla Phadraig 2015 | Staff received training via a pyramidal training programme vs no training | Knowledge (scale 0-1 for 10 questions) | 7.86 (1.27) | 7.21 (1.32) | 155 | Ireland | Cluster RCT | Strong evidence of a difference in favour of the intervention was reported (P = 0.002) |

MD: mean difference; RCT: randomised controlled group; SD: standard deviation.

Gonzalez 2013: "Both groups show an increase in scores, however, the experimental group shows almost twice the increase as the control group (0.061 vs 0.035). The standard deviation of both of these groups is fairly large (around 0.09)," p. 296. Mean and SD calculated from individual data provided (Table 2, p. 296). Phlypo 2016: subgroup analysis of those in the intervention group who read the information booklet compared to those in the control group who did not showed strong evidence of an improvement in knowledge (P = 0.05). Mac Giolla Phadraig 2015: "Using independent-samples t-test, a significant difference between control and intervention is noted for K Index" (P = 0.002), p. 188 and Table 6, p. 189. The level of significance was adjusted to P = 0.026, using the approximate false discovery rate.

Indices: multiple-choice questionnaires designed specifically for the studies for Gonzalez 2013 and Mac Giolla Phadraig 2015. Phlypo 2016 used the questionnaire used in Mac Giolla Phadraig 2015.

Table 25.   Training of carers versus no training of carers (RCTs): behaviour, attitude and self-efficacy medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
8 weeks	Phlypo 2016	Carers provided with an Information booklet and information session with prac-	BAS (14 questions)	4.7 (1.72)	5.2 (1.49)	34	Belgium	Subgroup analyses was reported on those who read the information booklet	Post-test, overall no strong evidence of differences were found in BAS scores between and

Table 25.   Training of carers versus no training of carers (RCTs): behaviour, attitude and self-efficacy medium term   *(Continued)*

		tical skills							within groups (P = 0.38), p. 6
8-11 months	Mac Giolla Phadraig 2015	Staff received training via a pyramidal training programme vs no training	BAS (14 questions)	5.42 (1.51)	4.9 (1.55)	155	Ireland	Level of significance adjusted to P = 0.028, using the approximate false discovery rate	"There was no difference in BAS scale scores (p = 0.040) between control and intervention at post-test," p. 188

BAS: behaviour (rating of -2 or +2) 4 questions, attitude (rating of -2, -1, 1, 2) 5 questions, self-efficacy (rating of -2, -1, 1, 2) 5 questions; RCT: randomised controlled trial; SD: standard deviation.

Table 26.   Training of carers versus no training of carers (RCTs): behaviour short term

Duration	Study	Comparison	Index	Intervention %	Control %	Total	Country	Comments	Summary
4 weeks	Olmos 2016	Training of carers vs no training of carers	Pre and post survey of carers	1. 61.10% 2. 70.40% 3. 54.10% 4. 78.60% 5. 98.90%	1. 25.50% 2. 17.90% 3. 2.10% 4. 29.50% 5. 64.20%	193	Germany	3-headed toothbrush (Superbrush) used in this study.	Strong evidence of a difference in self-reported behaviour from baseline in the intervention group (P < 0.01)

RCT: randomised controlled trial.

Olmos 2016: changes in behaviour assessed: 1. use of a special toothbrush, 2. use of fluoride toothpaste, 3. application of fluoride weekly, 4. toothbrushing after breakfast, and 5. duration of toothbrushing.

Table 27.   Training of carers versus no training of carers (NRS): behaviour and self-efficacy medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
100 days	Kissel 1983	Training of carers to assist people	Carers' use of training	MD 44% on average (Increase)	N/A	4	USA	% MDs reported narratively. 2 other life skills were	General increases in correct use of all as-

		with ID to brush their teeth using verbal instruction, physical guidance, rewards and self-management procedures						also taught to other residents by the staff in this study	sistance techniques during training; physical assistance, verbal instruction and rewards. All staff used all types of assistance correctly on average > 94% during the maintenance phase, p. 404
		Training of carers to assist people with ID to brush their teeth using verbal instruction, physical guidance, rewards and self-management procedures	Level of assistance with toothbrushing needed by person with ID	MD physical assistance 15. 5% (reduction) self-initiation "upward trend"	N/A	4	USA	2 other life skills were also taught to other residents by the staff in this study	Need for physical assistance - Baseline 47% - 60%, reduced to 38% at end of training. Verbal Instruction was inconsistent at end of training. 'Upward trends' in self-initiated behaviour (varied by resident), p. 404
4-5 months	Glassman 2006	Effect of knowledge acquisition on carers' behaviour	Caregivers' presence (yes/ no) during the brushing session	MD 37-89% (increase)	N/A	11	USA	Data in Figure 1 presented unclearly in published article. Multiple attempts to contact authors failed. Data presented as a mean for each phase of the	"The phase mean for caregiver presence during oral hygiene sessions was 100% for all clients after the coaching phase," p. 42

		train-ing (classroom sessions and coaching ses-sions) in the text	

Duration of brushing	Sec-onds spent brushing	MD 484% (increase)	N/A	11	USA	Data pre-sented in Fig-ure 1 unclear in published article. Multi-ple attempts to contact au-thors failed	Dura-tion of brush-ing increased from a phase mean of 20.5-73.8 seconds at baseline to 57.9-215. 4 seconds af-ter coaching, p. 42
Carers per-ception of client's ap-titudes	Social Vali-dation Question-naire (scale 0-6)	MD 0.0-0. 75	N/A	11	USA	-	"The average scores showed only a slight increase," p. 43.

ID: intellectual disability; N/A: not available; NRS: non-randomised study.

Glassman 2006: carers received training in the classroom (training phase) and were also provided with ongoing coaching and feedback (coaching phase) during their oral hygiene care sessions with the people with ID for whom they cared.

Table 28. Training of people with ID versus no training of people with ID (RCTs): gingival inflammation short term

Duration	Study	Compari-son	Index	Interven-tion mean (SD)	Con-trol mean (SD)	Total	Country	Comments	Summary
6/7 weeks	Lange 1985	Self-modelling training in oral hy-giene skills with daily use of plaque dis-closing agents vs no training but daily	S&LGI (scale 0-3)	**Pooled data** 0.98 (0.54)	**Pooled data** 1.26 (0.46)	10	USA	Mean and SD calculated from individ-ual means	"The gingi-val indices [for those in treat-ment] improved from 12% to 50%," p. 260. The results of the Gingival Index for the control group

| | | plaque scoring | | | | | | | was variable, with slight improvement, which was attributed to daily brushing |

ID: intellectual disability; RCT: randomised controlled trial; S&LGI: Silness & Löe Gingival Index; SD: standard deviation.
Lange 1985: data presented by individuals, pooled mean and SD calculated from these data.

Table 29. Training of people with ID versus no training of people with ID (RCTs): plaque short term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
5 weeks	Albino 1979	Desensitisation session and 11 practical training sessions in oral hygiene vs a desensitisation session only	K&API (scale 0-5)	2.31	3.04	26	USA	Data presented is the Adjusted Post Test scores. Some confusion re data between the 2 reports	"Indicating a statistically significant change for the experimental group compared to the control group," Schwartz, p. 20. Analysis of covariance: F = 6.38; df = 1/23; P < 0.025. Albino, p. 27
6/7 weeks	Lange 1985	Self-modelling training in oral hygiene skills with daily use of plaque disclosing agents vs no training but daily plaque scoring	G&VPI (scale 0-3)	**Pooled data** 0.35 (0.46)	**Pooled data** 0.82 (0.24)	10	USA	Mean and SD calculated from individual means.	The plaque level reduced for the intervention group from baseline to follow-up by 30%, p. 260. There was a general increase in plaque levels from baseline in the control group

df: degrees of freedom; G&VPI: Green & Vermillion Plaque Index; ID: intellectual disability; K&API: Kobayashi & Ash Plaque Index (six teeth scored, facial and lingual surfaces only); RCT: randomised controlled trial; SD: standard deviation.

Lange 1985: data presented by individuals, pooled mean and SD calculated from these data.

Table 30.   Training of people with ID versus no training of people with ID (NRS): self-efficacy medium and long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
Unclear	Abramson 1972	Oral hygiene training for people with ID using discrimination, reinforcement and modelling	Steps in a toothbrushing routine (19)	**Pooled data** MD 6.3 steps (increase)	N/A	8	USA	Group mean and SD calculated from the reported data.	1-tailed t-tests for correlated data showed strong evidence of positive MDs in toothbrushing behaviour (range P < 0.005 to P < 0.0005), Table 3, p. 8
100 days	Bouter 1979	Oral hygiene training for people with ID using assistance, feedback and duration training	Steps in a toothbrushing routine (15)	62.5% (increase)	N/A	8	The Netherlands	Number of training and duration training sessions varied considerably between participants	62.5% of participants learned to brush their teeth and continued to do so after 8-15 days of no training
30 weeks	Jarman 1983	Oral hygiene training for people with ID using a token reinforcement programme with single and	Completing the toothbrushing skill	60.2-71.9% of participants (increase)	N/A	40	USA	Individual performance criteria were determined at baseline. 5 other life skills were also taught in this study	Mean weekly performance of tooth brushing increased by 60.2% using single contingency reinforcement and by

		chained response contingency phases							71.9% using chained contingency reinforcement
19 months	Snell 1989	Oral hygiene training for people with ID using verbal and physical prompts that were gradually faded	Steps in a toothbrushing routine (17)	Difference 5-12 steps (increase)	N/A	3	USA	Results reported narratively and are unclear.	"Training was not consistently followed by maintenance of effects. Although Sara's performance was durable, Jake and Frank did not maintain all their skills without receiving 'booster' training sessions," p. 224

ID: intellectual disability; MD: mean difference; N/A: not available; NRS: non-randomised study; SD: standard deviation.
Abramson 1972: mean individual data reported (no SD reported), group mean and SD calculated from these data.

Table 31. One-, three- or six-monthly dental recall versus no regular dental recall (RCTs): gingival inflammation long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
24 months	Shaw 1991	1-, 3- and 6-monthly dental recall vs no regular dental recall	WHOGPI (scale 0-2)	R1: 0.3 (0.8); R3: 0.4 (0.7); R6: 0.5 (0.9)	0.9 (1.4)	304	UK	All participants also had supervised daily toothbrushing.	Strong evidence of differences between the groups for Code 1 GPI at 3, 6, 12 and 24 months (P < 0.01-0.05)

GPI: Gingival Pocket Index; R1: one-month recall; R3: three-month recall; R6: six-month recall; RCT: randomised controlled trial; SD: standard deviation; WHOGPI: World Health Organization Gingival Pocket Index, scale 0-2 (0: 0-3.5 mm; 1: > 3.5-5.5 mm; 2: > 5.5 mm).

Shaw 1991: data also reported for 3, 6, 12 and 18 months, not reported here as participant numbers were not provided. Data for "mean number of sextants scored as Code 1." No strong evidence of a difference for Code 2, but the actual number of effected sextants was very low.

Table 32. One-, three- or six-monthly dental recall versus no regular dental recall (RCTs): gingival bleeding long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
24 months	Shaw 1991	1-, 3- and 6-monthly dental recall vs no regular dental recall	WHOBI (scale 0-1)	R1: 2.2 (1.9); R3: 2.3 (1.9); R6: 2.6 (1.8)	2.4 (2.0)	304	UK	All participants also had supervised daily toothbrushing.	Strong evidence of differences in BI at the 3-, 6- and 12-month time points (P < 0.01) were not observed at 18 or 24 months

BI: Bleeding Index; R1: one-month recall; R3: three-month recall; R6: six-month recall; RCT: randomised controlled trial; SD: standard deviation; WHOBI: World Health Organization Bleeding Index, scale 0-1; presence or absence of bleeding after 20 seconds.

Shaw 1991: data also reported for 3, 6,12 and 18 months, not reported here as participant numbers not provided.

Table 33. One-, three- or six-monthly dental recall versus no regular dental recall (RCTs): plaque long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
24 months	Shaw 1991	1-, 3- and 6-monthly dental recall vs no regular dental recall	WHOPI (scale 0-3)	R1: 1.2 (1.7); R3: 1.3 (1.7); R6: 1.3 (1.5)	2.0 (1.9)	304	UK	All participants also had supervised daily toothbrushing.	Strong evidence of differences for Plaque Index at 12 (P < 0.01) and 24 months (P < 0.05); the greatest differences were seen in the 1- and 3-monthly intervals

R1: one-month recall; R3: three-month recall; R6: six-month recall; SD: standard deviation; WHOPI: World Health Organization Plaque Index; data were for "mean number of sextants scored as Code 2."

: data also reported for 3, 6, 12 and 18 months, not reported here as participant numbers not provided. "The difference between the one-monthly and three monthly hygienist input (Recall visit) were not clinically very apparent after two years," p. 144.

Table 34. One-, three- or six-monthly dental recall versus no regular dental recall (RCTs): calculus long term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
24 months	Shaw 1991	1-, 3- and 6-monthly dental recall vs no regular dental recall	WHOCI (scale 0-1)	R1: 1.6 (1.7); R3 2.2 (1.9); R6: 3.5 (2.0)	3.6 (2.1)	304	UK	All participants also had supervised daily toothbrushing.	Strong evidence of differences in confidence intervals at 6, 12, 18 and 24 months (P < 0.01)

R1: one-month recall; R3: three-month recall; R6: six-month recall; RCT: randomised controlled trial; WHOCI: World Health Organization Calculus Index, scale 0-1 (presence or absence).

Shaw 1991: data also reported at 3, 6, 12 and 18 months, not reported here as participant numbers not provided.

Table 35. Individual clinical photographs used as motivators compared to no motivators for people with ID (RCTs): plaque medium term

Duration	Study	Comparison	Index	Intervention mean (SD)	Control mean (SD)	Total	Country	Comments	Summary
6 months	Bickley 1990	Discussion of clinical photographic records vs no discussion	WHOPI (scale 0-12)	7.3 (2.8)	7.4 (2.0)	29	UK	Disclosing solution was also used.	"There was no significant changes after 6 months in either of the groups," p. 4
			ESI (%)	37.7% (18.2)	40.3% (26.4)	29	UK	Disclosing solution was also used.	"The test group was considerably lower but just failed to achieve statistical significance (t = 1.721, df =15)," p. 4

df: degrees of freedom; ESI: Extrinsic Stain Index Shaw & Murray (% plaque on anterior teeth); SD: standard deviation; WHOPI: World Health Organization Plaque Index (4 surfaces per tooth, scored 0-3 resulting in a scale of 0-12).

Table 36. Frequency of brushing (RCTs): gingival inflammation short term

Duration	Study	Comparison	Index	Intervention mean	Control mean	Total	Country	Comments	Summary
21 days	Swallow 1969	Daily vs twice weekly brushing	B&LL&SGI (scale 0-6)	**Pooled 1. 84** Electric 1. 24; manual 2.43	**Pooled 2. 05** Electric 1. 59; manual 2.51	40	UK	Pooled mean calculated from reported data	Brushing twice a week reduced gingival disease by approximately 46% and brushing daily by 51%, p. 378
		Daily vs once weekly brushing	B&LL&SGI (scale 0-6)	**Pooled 1. 84** Electric 1. 24; manual 2.43	**Pooled 3. 42** Electric 3. 26; manual 3.57	40	UK	Pooled mean calculated from reported data	Brushing once a week reduced gingival disease by approximately 26% and brushing daily by 51%, p. 378
		Daily brushing vs usual care	B&LL&SGI (scale 0-6)	**Pooled 1. 84** Electric 1. 24; manual 2.43	4.27	60	UK	Pooled mean calculated from reported data	Brushing daily differed strongly from usual care - decreasing levels of gingivitis by 51%, p. 378

B&LL&SGI: buccal and labial surfaces Löe & Silness, scale 0-6; RCT: randomised controlled trial.

Swallow 1969: data presented separately for electric and manual toothbrushes, labial and buccal surfaces, and males and females; no SD reported. The data for the females using the electric toothbrush daily and twice weekly appeared unrealistically low; author could not be contacted to clarify. Pooled means were calculated from these data. Usual care group "rarely received any regular form of oral hygiene."

Table 37. Disclosing agent versus no disclosing agent (NRS): gingival inflammation short term

Duration	Study	Comparison	Index	Intervention mean	Control mean	Total	Country	Comments	Summary
10 days	Teitelbaum 2009	Toothpaste with a disclosing agent vs a regular	GBI (scale 0-1)	% mean difference 18	% mean difference 8	40	Brazil	Cross-over trial. Data presented for 2 arms combined.	Strong evidence of a difference in Bleeding Index in

		toothpaste							favour of the intervention (P < 0.001), p. 466

GBI: Gingival Bleeding Index Ainamo & Bay (present or absent); NRS: non-randomised study.

Teitelbaum 2009: included two other experimental groups using chlorhexidine, which are not relevant to this review. The toothpaste containing a plaque-disclosing agent produced a reduction in gingival inflammation similar to the dentifrice with chlorhexidine (18%) (not reported here). Exact data in Figure 2 unclear; requested from authors, but no response.

Table 38. Disclosing agent versus no disclosing agent (NRS): plaque short term

Duration	Study	Compari-son	Index	Interven-tion mean	Control mean	Total	Country	Comments	Summary
10 days	Teitel-baum 2009	Toothpaste with a dis-closing agent vs a regular toothpaste	SG& VOHI (scale 0-3)	% mean dif-ference 65	% mean dif-ference 15	40	Brazil	Cross-over trial. Data pre-sented for 2 arms com-bined.	Strong evi-dence of a dif-fer-ence in plaque levels in favour of the inter-vention (P < 0. 0001), p. 466

NRS: non-randomised study; SG&VOHI: Simplified Green & Vermillion Oral Hygiene Index - plaque only. Scoring of disclosed plaque on buccal surfaces of 4 teeth and lingual surfaces of 2 teeth.

Teitelbaum 2009: included two other experimental groups not relevant to this review. Exact data in Figure 2 unclear. Requested from authors, but no response.

Table 39. Individualised care plan versus usual care (NRS): plaque medium term

Duration	Study	Compari-son	Index	Interven-tion mean	Control mean	Total	Country	Comments	Summary
12 months	Altabet 2003	Individ-ualised oral care plan vs usual care (general oral care policy)	SOHR (scale 1-5)	2.97	3.10	79	USA	The inter-vention group was monitored, monthly - quarterly, with staff feedback and review as required. No monitor-ing of the con-trol group	"People in the treatment group showed statis-tically signifi-cant improve-ment, t (39) = 3.82, p < .001) ," p. 442

Table 39. Individualised care plan versus usual care (NRS): plaque medium term *(Continued)*

			Improvement differential	38%	5%	79	USA	The intervention group was monitored, monthly - quarterly, with staff feedback and review as required. No monitoring of the control group	"The results indicate that practices can be implemented to improve oral hygiene in individuals with mental retardation living at a state residential facility," p. 442

NRS: non-randomised study; SOHR: Subjective Oral Hygiene Rating, scale 1-5 (1 excellent: no plaque on teeth, 2 good; plaque present on less than 15% of total tooth surface (tts), 3 fair; plaque present on 15-50% of tts, 4 poor; plaque present on 50-90% of tts, 5 plaque present on greater than 90% of tts), p. 441. Numerical ratings were averaged over the two designated time periods. Improvement differential: difference between percentage of individuals with improvement rating minus the % individuals with poorer rating over same time period.

APPENDICES

Appendix 1. Search strategies for identification of studies

Cochrane Oral Health's Trials Register search strategy

Cochrane Oral Health's Trials Register is available via the Cochrane Register of Studies. For information on how the register is compiled, see oralhealth.cochrane.org/trials

1. MESH DESCRIPTOR Intellectual disability EXPLODE ALL AND INREGISTER
2. MESH DESCRIPTOR Developmental disability AND INREGISTER
3. ((intellectual or mental) and "developmental disorder") AND INREGISTER
4. ((intellectual* or mental* or learning) NEAR5 (disabl* or disabilit* or deficien* or impair* or handicap*)) AND INREGISTER
5. ((deficien* or low*) NEAR3 (cognition or "cognitive function*" or reason* or intelligence))
6. ("special needs" or (special NEAR3 child$) or retard* or "slow learner*") AND INREGISTER
7. ("Down* syndrome" or mongol* or "De Lange syndrome" or "Prader Willi syndrome" or "Labhart Willi syndrome" or "Royer syndrome" or "Rubinstein-Taybe syndrome" or "Rubinstein syndrome" or "WAGR syndrome" or "Williams syndrome" or "Broad Thumb Hallux syndrome") AND INREGISTER
8. #1 or #2 or #3 or #4 or #5 or #6 or #7

Cochrane Central Register of Controlled Clinical Trials (CENTRAL) search strategy

1. MESH DESCRIPTOR Dental care for disabled AND CENTRAL:TARGET
2. MESH DESCRIPTOR Oral hygiene EXPLODE ALL AND CENTRAL:TARGET

3. MESH DESCRIPTOR Oral health AND CENTRAL:TARGET
4. MESH DESCRIPTOR Periodontal diseases EXPLODE ALL AND
5. CENTRAL:TARGET
6. MESH DESCRIPTOR Periodontics EXPLODE ALL AND CENTRAL:TARGET
7. (periodont* or gingiv*) AND CENTRAL:TARGET
8. MESH DESCRIPTOR Dental Health Surveys EXPLODE ALL AND CENTRAL:TARGET
9. (toothbrush* or tooth-brush* or floss* or "chewing stick*" or "wood stick*" or toothpick*) AND CENTRAL:TARGET
10. (caries or carious) AND CENTRAL:TARGET
11. MESH DESCRIPTOR Dental caries EXPLODE ALL AND CENTRAL:TARGET
12. ((dental or oral or mouth or interdental or interproximal or tooth or teeth or orthodontic or denture* or brace* or bracket*) NEAR3 (irrigat* or clean* or brush* or clens* or aid*)) AND CENTRAL:TARGET
13. ((oral or dental) NEAR2 (hygiene or care)) AND CENTRAL:TARGET
14. ((mouth or teeth) NEAR3 care) AND CENTRAL:TARGET(plaque* NEAR5 (remov* or control*)) AND CENTRAL: TARGET
15. ("dental plaque index" or "dental plaque indices" or "DMF* index" or "DMF indices" or "dmf* index" or "dmf* indices" or "periodontal index" or "periodontal indices" or "oral hygiene index" or "oral hygiene indices" or "gingival index") AND CENTRAL: TARGET
16. MESH DESCRIPTOR Dental plaque AND CENTRAL:TARGET
17. MESH DESCRIPTOR Health Education, Dental AND CENTRAL:TARGET
18. ((health* NEAR3 promot*) and (dental or teeth or mouth or periodont* or gingival* or "oral health")) AND CENTRAL: TARGET
19. #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18
20. MESH DESCRIPTOR Intellectual disability EXPLODE ALL AND CENTRAL:TARGET
21. MESH DESCRIPTOR Developmental disability AND CENTRAL:TARGET
22. ((intellectual or mental) and "developmental disorder") AND CENTRAL:TARGET
23. ((intellectual* or mental* or learning) NEAR5 (disabl* or disabilit* or deficien* or impair* or handicap*)) AND CENTRAL: TARGET
24. ((deficien* or low*) NEAR3 (cognition or "cognitive function*" or reason* or intelligence)) AND CENTRAL:TARGET
25. ("special needs" or (special NEAR3 child$) or retard* or "slow learner*") AND CENTRAL:TARGET
26. ("Down* syndrome" or mongol* or "De Lange syndrome" or "Prader Willi syndrome" or "Labhart Willi syndrome" or "Royer syndrome" or "Rubinstein-Taybe syndrome" or "Rubinstein syndrome" or "WAGR syndrome" or "Williams syndrome" or "Broad Thumb Hallux syndrome") AND CENTRAL:TARGET
27. #20 or #21 or #22 or #23 or #24 or #25 or #26
28. #19 and #27

MEDLINE Ovid search strategy

1. Dental care for disabled/
2. exp Oral hygiene/
3. Oral health/
4. exp Periodontal diseases/
5. exp Periodontics/
6. (periodont$ or gingiv$).ti,ab.
7. exp Dental health surveys/
8. (toothbrush$ or tooth-brush$ or floss$ or "chewing stick$" or "wood stick$" or toothpick$).ti,ab.
9. (caries or carious).ti,ab.
10. exp dental caries/
11. ((dental or oral or mouth or interdental or interproximal or tooth or teeth or orthodontic or denture$ or brace$ or bracket$) adj3 (irrigat$ or clean$ or brush$ or clens$ or aid$)).ti,ab.
12. ((oral or dental) adj2 (hygiene or care)).ti,ab.
13. ((mouth or teeth) adj3 care).ti,ab.
14. (plaque$ adj5 (remov$ or control$)).ti,ab.

15. ("dental plaque index" or "dental plaque indices" or "DMF$ index" or "DMF indices" or "dmf$ index" or "dmf$ indices" or "periodontal index" or "periodontal indices" or "oral hygiene index" or "oral hygiene indices" or "gingival index").ti,ab.
16. Dental plaque/
17. Health education, dental/
18. ((health$ adj3 promot$) and (dental or teeth or mouth or periodont$ or gingival$ or "oral health")).ti,ab.
19. or/1-18
20. exp Intellectual disability/
21. Developmental disabilities/
22. ((intellectual or mental) and "developmental disorder").ti,ab.
23. ((intellectual$ or mental$ or learning) adj5 (disabl$ or disabilit$ or deficien$ or impair$ or handicap$)).ti,ab.
24. ((deficien$ or low$) adj3 (cognition or "cognitive function$" or reason$ or intelligence)).ti,ab.
25. ("special needs" or (special adj3 child$) or retard$ or "slow learner$").ti,ab.
26. ("Down$ syndrome" or mongol$ or "De Lange syndrome" or "Prader Willi syndrome" or "Labhart Willi syndrome" or "Royer syndrome" or "Rubinstein-Taybe syndrome" or "Rubinstein syndrome" or "WAGR syndrome" or "Williams syndrome" or "Broad Thumb Hallux syndrome").ti,ab.
27. or/20-26
28. 19 and 27

Embase Ovid search strategy

1. Mouth hygiene/
2. exp Periodontal disease/
3. exp Periodontics/
4. (periodont$ or gingiv$).ti,ab.
5. (toothbrush$ or tooth-brush$ or floss$ or "chewing stick$" or "wood stick$" or toothpick$).ti,ab.
6. (caries or carious).ti,ab.
7. exp dental caries/
8. ((dental or oral or mouth or interdental or interproximal or tooth or teeth or orthodontic or denture$ or brace$ or bracket$) adj3 (irrigat$ or clean$ or brush$ or clens$)).ti,ab.
9. (dentifrice$ or mouthwash$ or mouthrins$ or mouth-wash$ or mouth- rins$).ti,ab.
10. ((oral or dental) adj2 (hygiene or care)).ti,ab.
11. ((mouth or teeth) adj3 care).ti,ab.
12. (plaque$ adj5 (remov$ or control$)).ti,ab.
13. ("dental plaque index" or "dental plaque indices" or "DMF$ index" or "DMF indices" or "dmf$ index" or "dmf$ indices" or "periodontal index" or "periodontal indices" or "oral hygiene index" or "oral hygiene indices" or "gingival index").ti,ab.
14. Tooth plaque/
15. Dental health education/
16. ((health$ adj3 promot$) and (dental or teeth or mouth or periodont$ or gingival$ or "oral health")).ti,ab.
17. or/1-16
18. exp Intellectual impairment/
19. Developmental disorder/
20. ((intellectual or mental) and "developmental disorder").ti,ab.
21. ((intellectual$ or mental$) adj5 (disabl$ or disabilit$ or deficien$ or impair$ or handicap$)).ti,ab.
22. ((deficien$ or low$) adj3 (cognition or "cognitive function$" or reason$ or intelligence)).ti,ab.
23. ("special needs" or (special adj3 child$) or retard$).ti,ab.
24. ("Down$ syndrome" or mongol$ or "De Lange syndrome" or "Prader Willi syndrome" or "Labhart Willi syndrome" or "Royer syndrome" or "Rubinstein- Taybe syndrome" or "Rubinstein syndrome" or "WAGR syndrome" or "Williams syndrome" or "Broad Thumb Hallux syndrome").ti,ab.
25. or/18-24
26. 17 and 25

PsycINFO Ovid search strategy

1. Oral health/
2. (periodont$ or gingiv$).ti,ab.
3. (toothbrush$ or tooth-brush$ or floss$ or "chewing stick$" or "wood stick$" or toothpick$).ti,ab.
4. (caries or carious).ti,ab.
5. ((dental or oral or mouth or interdental or interproximal or tooth or teeth or orthodontic or denture$ or brace$ or bracket$) adj3 (irrigat$ or clean$ or brush$ or clens$)).ti,ab.
6. (dentifrice$ or mouthwash$ or mouthrins$ or mouth-wash$ or mouth- rins$).ti,ab.
7. ((oral or dental) adj2 (hygiene or care)).ti,ab.
8. ((mouth or teeth) adj3 care).ti,ab.
9. (plaque$ adj5 (remov$ or control$)).ti,ab
10. ("dental plaque index" or "dental plaque indices" or "DMF$ index" or "DMF indices" or "dmf$ index" or "dmf$ indices" or "periodontal index" or "periodontal indices" or "oral hygiene index" or "oral hygiene indices" or "gingival index").ti,ab.
11. ((health$ adj3 promot$) and (dental or teeth or mouth or periodont$ or gingival$ or "oral health")).ti,ab.
12. or/1-11
13. exp Intellectual development disorder/
14. exp Developmental disabilities/
15. exp Learning disorders/
16. ((intellectual or mental) and "developmental disorder").ti,ab.
17. ((intellectual$ or mental$) adj5 (disabl$ or disabilit$ or deficien$ or impair$ or handicap$)).ti,ab.
18. ((deficien$ or low$) adj3 (cognition or "cognitive function$" or reason$ or intelligence)).ti,ab.
19. ("special needs" or (special adj3 child$) or retard$).ti,ab.
20. ("Down$ syndrome" or mongol$ or "De Lange syndrome" or "Prader Willi syndrome" or "Labhart Willi syndrome" or "Royer syndrome" or "Rubinstein- Taybe syndrome" or "Rubinstein syndrome" or "WAGR syndrome" or "Williams syndrome" or "Broad Thumb Hallux syndrome").ti,ab.
21. or/13-20
22. 12 and 21

US National Institutes of Health Ongoing Trials Register (ClinicalTrials.gov) search strategy

intellectual and "oral health"
intellectual and dental
"developmental disorder" and "oral health"
"developmental disorder" and dental

World Health Organization International Clinical Trials Registry Platform search strategy

intellectual and "oral health"
intellectual and dental
"developmental disorder" and "oral health"
"developmental disorder" and dental
"special needs" and "oral health"
"special needs" and dental

Appendix 2. Characteristics of studies template

Methods	Study design Date of study Study duration Setting Ethical approval Consent
Participants	Description of ID used Conversion to ICD description Age range (mean) Gender Comorbidity reported/details Number of participants at baseline Number of participants at final evaluation Selection of the participants for the intervention Country
Intervention	**Comparison** Group 1 Group 2 etc
Outcomes	Outcomes measured 1. 2. Timing of outcome assessments
COM-B system characteristics	Potential sources of behaviour change Potential intervention functions
Stakeholder involvement	Formal or non-formal carer With or without dental professional involvement Other stakeholder involvement
Notes	Strengths and weaknesses Modifications to the intervention Adverse effects Funding sources

for a study of respite care in intellectual disabilities; and I currently hold an H2020 grant on a topic unrelated to this review. I was co-author on an included RCT, but other review authors dealt with its inclusion in this review. I was co-author on an included RCT, but other review authors dealt with its inclusion in this review.

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Erica Donnelly-Swift: none.

Mike J Clarke: none. I have a variety of roles within Cochrane including serving as Co-ordinating Editor of the Methodology Review Group.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Following a pilot of a small number of studies of the full-text reading process by the review team, we made some amendments and clarifications.

1. In relation to the definition of oral hygiene, we made the following clarification.

   i) Interventions focusing on the chemical removal of plaque alone were excluded. The use of a chemical agent, which is used on a toothbrush and arguably removes plaque both mechanically and chemically, is complex, as the measurement of the resulting reduction of plaque cannot be assigned to either solely the mechanical or chemical action. These studies were excluded, except for those studies using a conventional non-prescription toothpaste normally used by the participants or using a non-conventional chemical agent for both the intervention and control groups in studies comparing the mechanical removal of plaque. For example, a study comparing a manual toothbrush with an electric toothbrush where both were used with a non-conventional toothpaste such as chlorohexidine or extra-strength fluoride toothpaste.

2. In relation to the study designs we made the following clarifications:

   i) The study designs to be included in this review used the EPOC terminology and definitions except for quasi-randomised trials, which used the Cochrane glossary definition (Cochrane 2018; EPOC 2017).

   ii) The study designs included quasi-randomised trials.

iii) Cluster-randomised trials, non-random controlled trials and controlled before-after studies were included even if there was only one intervention site and one control site, as long as the underlying differences between the sites would not overwhelm the true difference between the intervention and the control. For example, if an intervention was used for people living in a residential care home setting while the control was with people who were living in their own homes, the populations might be too different to begin with. These types of study designs with only one intervention and one control site are commonly used in interventions for populations with ID where randomised controlled trials can be more difficult to implement. Therefore, to make this review relevant, it was important to include these studies so that the effectiveness of these types of interventions could be analysed.

iv) Quasi-randomised trials were defined as; methods of allocating people to a trial that were not random but were intended to produce similar groups when used to allocate participants. Quasi-random methods included: allocation by the person's date of birth, by the day of the week or month of the year, by a person's medical record number or just allocating every alternate person. In practice, these methods of allocation are relatively easy to manipulate, introducing selection bias.

v) Interrupted time series, where multiple data points were collected before and after the intervention and the intervention effect was measured against the preintervention trend and repeated measure studies, where these measures were taken on the same people at each time point, were only included if they had a clearly defined point in time when the intervention occurred and at least three data points before and three after the intervention.

3. The descriptions of the some of the secondary outcomes were amended to more clearly describe what was being measured: skills and adherence to routines were combined and renamed as 'behaviour, attitude and self-efficacy.'

4. Of the two tools identified for possible use in relation to the assessment of risk of bias in the non-controlled trials, we opted to use the more practical Effective Practice and Organisation of Care (EPOC) criteria for assessing risk of bias (EPOC 2016; Sterne 2016), rather than the more cumbersome Risk Of Bias In Non-randomised Studies - of Interventions (ROBINS-I) assessment tool.