0196-206X/94/1506-0430$03.00/0
DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS

Vol. 15, No. 6, December 1994
Printed in U.S.A.

Review Article

Behavioral and Pharmacological Treatments for Tic and Habit Disorders: A Review

ALAN L. PETERSON, PH.D.
Behavioral Health Psychology Service, RAF Lakenheath Hospital

RICK L. CAMPISE, PH.D.
Air Force Services for Exceptional Children Clinic, RAF Lakenheath Hospital, Suffolk, United Kingdom

NATHAN H. AZRIN, PH.D.
Center for Psychological Studies, Nova Southeastern University, Ft. Lauderdale, Florida

ABSTRACT. Children with tic and habit disorders are often seen by pediatricians, psychologists, or psychiatrists for evaluation and treatment. Current knowledge of the treatment-outcome research in these areas can serve as an important guide in the evaluation and treatment planning process. This article reviews the behavior therapy and pharmacological treatment of motor and vocal tic disorders, self-destructive oral habits, trichotillomania (hair pulling), onychophagia (nail biting), and thumb sucking. The research evidence indicates that all of these disorders can be effectively treated with behavioral or pharmacological approaches. *J Dev Behav Pediatr 15:430–441, 1994.* Index terms: *tics, bruxism, trichotillomania, onychophagia, thumb sucking.*

Children with tic and habit disorders can be challenging cases for pediatricians, psychologists, and psychiatrists. The high prevalence of some of these disorders has led to many colloquial ideas and misinformation about appropriate and effective treatment approaches. Practitioners often ponder whether these tic and habit disorders should be ignored, punished, or treated aggressively with behavioral or pharmacological approaches.

There is a lot of published research on the behavioral and pharmacological treatment of tic and habit disorders, including studies employing group treatment-outcome designs, single-subject experimental designs, and case studies approaches. Uncontrolled case studies are usually considered to be completely inadequate as a basis for drawing scientifically valid inferences.[1] However, controlled single-subject experimentation, especially those studies using repeated, objective measurements with reversal or multiple baseline designs, have been shown to have scientific merit and can provide relatively clear information about the impact of treatment.[1,2] A detailed review and comprehensive listing of all published articles on each topic is beyond the scope of the present manuscript; in some areas, well over 100 treatment-outcome studies have been published. We included a selection of what we consider to be the best controlled treatment-outcome studies in each subject area as well as some of the good review articles. In all cases, our literature reviews included more scientific studies and recent publications than the literature reviews provided as references in this manuscript, with the one exception being the recently published review article on Tourette syndrome.[3] Clinicians and researchers should refer to the primary reference sources or review articles should they desire additional information in any area.

MOTOR AND VOCAL TIC DISORDERS

Tics are brief, rapid, repetitive, stereotypic movements or utterances involving contractions of groups of muscles in one or more parts of the body. Tic disorders are often considered to be on a continuum, with the transient tic disorder of childhood on the lower end, chronic motor or vocal tic disorders in the middle, and Tourette syndrome (TS) on the upper, most severe end. The primary distinction between TS and the other two tic disorders is that TS includes multiple motor and one or more vocal tics. In contrast, the chronic motor or vocal tic disorder involves either motor or vocal tics, but not both. The transient tic disorder differs primarily in its duration, which is for at least 2 weeks but no longer than 12 consecutive months, whereas the other two tic disorders occur throughout a period of more than 1 year.

Address for reprints: Alan L. Peterson, Ph. D., Behavioral Health Psychology Service, RAF Lakenheath Hospital, Unit 5210, Box 230, Brandon, Suffolk, IP27 9PN, United Kingdom.
The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of Defense or the United States Government.

The incidence of TS has been estimated to be 0.046%, or approximately 1 in 2000.[4] Transient tic disorders have been estimated to occur in up to 25% of children. The incidence of chronic motor and vocal tic disorders is not known, but it is likely to be somewhere in between the prevalence rates of TS and transient tics disorders. TS has been reported to occur more frequently in males than females, in a ratio of approximately 3.4 to 1.[4] The sex ratio of the other tic disorders is not known but is likely to be similar to that of TS.

Behavioral Treatment

Numerous behavioral approaches have been used in over 50 published treatment-outcome studies of tic disorders and TS, including massed negative practice, contingency management, relaxation training, self-monitoring, and habit reversal [see references (review articles) 3, 5, 6]. Unfortunately, all but three of the studies[7-9] are case studies or single-subject design studies with 1 to 3 subjects, and many include multiple behavioral treatments.

The most frequently studied behavioral treatment approach for tic disorders and TS has been massed negative practice, in which the patient deliberately performs the tic movement as quickly and with as much effort as possible.[3,5,6] The patient performs the movement for a specified period of time (e.g., 30 minutes) interspersed with brief periods of rest (e.g., 4 minutes exercise, 1 minute rest). Out of over 20 published studies, massed negative practice has been found to be one of the least effective of the behavioral treatment approaches for tic disorders. About half of the studies conducted have reported decreases in tics rate in the moderate range of about 50%. Only one controlled group study has been published[7] in which 22 subjects with motor and vocal tics were randomly assigned to either a habit reversal (n = 10) or massed practice (n = 12) group. The results indicated that massed practice reduced tics by 33% on the first day, and at a 4-week follow-up, only 2 out of 12 patients (17%) were tic-free.

Contingency management has been the second most frequently employed behavioral treatment approach for tics.[3,5,6] Over twenty case studies and single-subject design studies have been published, and positive reinforcement and punishment have both been demonstrated to be somewhat effective in reducing the rate of tics. The results are confounded because the studies used multiple behavioral treatments, and no large-scale, randomized study has evaluated reinforcement or punishment as individual treatment components.

All of the studies that have evaluated the use of relaxation training for the treatment of TS have found it to be effective in the reduction of tics.[3,5,6] However, only one study has evaluated the independent effectiveness of relaxation training.[9] This study found that relaxation training reduced tics by an average of 32%. The primary limitation of the study is that it was a laboratory investigation, rather than a clinical treatment-outcome study. No controlled treatment-outcome study on the effectiveness of relaxation training for the treatment of TS or tic disorders has been published.

Self-monitoring is frequently used as a method of obtaining data on tic frequencies. Subjects are instructed to use a wrist counter, small notebook, or other device to record the occurrence of each of their tics for a specified period of time. Some evidence exists that this procedure alone can lead to reductions in tics.[3,5,6] In a study of six TS subjects using a modified counterbalanced design, Peterson and Azrin[9] found that self-monitoring led to an average reduction of 44% in tic frequency over two trials with each subject. The effectiveness of self-monitoring in reducing tics was decreased over the two trials from −54% during the first trial to −33% during the second trial, suggesting that the efficacy of self-monitoring may not last.

Habit reversal is a comprehensive behavior therapy treatment approach including 10 different treatment components.[10,11] For the treatment of tic disorders, habit reversal is distinctive in its use of competing responses to prevent the occurrence of tics. Its additional components incorporate many of the features of awareness training, self-monitoring, contingency management, and relaxation training. The competing response for many tics is the isometric tensing of muscles opposite to the tic movements. The opposing muscles are contracted for 1 to 2 minutes contingent on the emission of, or urge to have, a tic. Habit reversal has been shown to be effective in treating motor tic disorders[7,10,12] as well as TS.[9,13] More specific details on the use of habit reversal for the treatment of tics have been published elsewhere.[5,7,10,11]

Habit reversal is the only behavioral treatment to be used in large-scale, controlled treatment-outcome studies of chronic motor and vocal tic disorders[7,10] and TS.[8] Azrin et al[7] evaluated the effectiveness of habit reversal for the treatment of chronic tic disorders in 22 subjects who exhibited a wide range of simple and complex motor and vocal tics. Habit reversal was used to treat each subject's major or most disruptive tic. A between-groups design was employed, and subjects were randomly assigned to either a habit reversal (n = 10) or massed practice (n = 12) group. The results showed that habit reversal resulted in an 84% reduction in tics on the first day as reported from patients' self-monitoring. At an 18-month follow-up, there was a 97% reduction in tics and 80% of the patients were tic-free.

Habit reversal is also the only behavioral procedure to be evaluated in a randomized group treatment-outcome study of TS.[8] This study employed a waiting-list control group design to evaluate the effectiveness of the habit reversal treatment in 14 subjects with TS. Subjects were matched by age, medication usage, and tic frequency and were randomly assigned to an immediate or delayed (3 months) treatment group. Tic frequency was measured in the clinic using videotapes taken through a one-way mirror and at home by unobtrusive direct observations by the subject's spouse or parent. Results showed tics to be reduced in the immediate treatment group by 89% in the clinic and by 92% at home after 12 months. The tic frequency in the waiting-list control group remained relatively stable during the control period and then achieved a similar reduction in tics after treatment. The frequency of tics recorded in the clinic decreased by 52% the first month, 65% the second month, and 93% at the end of treatment (8th to 11th month). Analyses showed that the reduction occurred for vocal tics as well as each type of motor tic, at home as well as in the clinic, for the children

as well as the adults, for those subjects receiving TS medications as well as those not doing so, for tic severity as well as tic frequency, with no evidence of symptom substitution. A mean of 20 treatment sessions were given during the 8 to 11 months of treatment.

Miltenberger et al[14] compared the effectiveness of awareness training plus the competing response procedure to the entire habit reversal package. Nine subjects with various motor tics were divided into two treatment groups. One group received the entire habit reversal program (n = 4), and one group received awareness and competing response training (n = 5). Objective measures of tic frequency were obtained through clinic videotapes. The results indicated that the awareness and competing response training were as effective in decreasing tic frequency as the whole habit reversal procedure.

Only one study to date has been conducted to compare the effectiveness of the principal behavioral treatment approaches to TS.[9] This was not a controlled treatment-outcome study, but rather evaluated the efficacy of habit reversal, self-monitoring, and relaxation training in the laboratory setting after one treatment session. Six TS subjects were evaluated, and the results indicated that TS tics were reduced 55% with habit reversal, 44% with self-monitoring, and 32% with relaxation training. Each behavioral procedure was evaluated twice. Across the two trials the effectiveness of self-monitoring decreased (from −54% to −33%), relaxation training remained relatively unchanged (from −31 to −32%), and the effectiveness of habit reversal increased (from −50% to −60%).

Overall, habit reversal has been found to reduce tics by about 90% in the home environment and 80% in the clinic setting. The research conducted to date has found habit reversal to be the most effective behavioral treatment for tic disorders and TS.

Pharmacological Treatment

No less than 20 different drugs have been evaluated in treatment-outcome studies of TS, and over 100 scientific articles have been published. Drug treatments are not often used for chronic vocal or motor tics and are generally limited to patients with moderate to severe tic symptoms in TS. The three medications with the most controlled research trials and that are the most commonly used to treat TS include haloperidol, pimozide, and clonidine hydrochloride.

Five well-controlled double-blind group studies using direct frequency counts of tics have been conducted on the pharmacological treatment of TS.[15-19] The results of these studies indicate that TS tics are reduced by 50 to 60% with either haloperidol or pimozide.[17-19] Clonidine has resulted in either no effect[15] or a slight (−25%) reduction in tics.[16] A significant limitation of pharmacological treatments is that up to 80% of patients discontinue use of TS medications because of the emergence of unwanted side effects.[3]

Summary

The results of research on the pharmacological and behavioral treatments of tic disorders have been promising; both treatments are effective and both approaches have something to offer for patients with tic disorders. Behavioral treatments, especially habit reversal, have been shown to reduce tics in TS and chronic tic disorders by over 90% and are the treatment of choice for chronic motor and vocal tic disorders. Some research also supports the use of relaxation training, self-monitoring, and reinforcement for the treatment of TS and chronic tic disorders.

Pharmacological treatments reduce TS tics by 50 to 60% and are currently the most frequently employed treatment for TS, even though numerous studies indicate TS can be effectively treated with behavioral approaches. A limitation of pharmacological treatment approaches is that they often result in unwanted side effects and many patients discontinue taking the drugs. A potential limitation of the behavioral approach is that it requires a provider trained in the use of behavior therapy for the treatment of tic disorders and demands more time of both the patient and provider as compared medication treatments. Additional research is required to compare the individual and combined efficacy of behavioral and pharmacological treatments for tic disorders.

SELF-DESTRUCTIVE ORAL HABITS

Self-destructive oral habits comprise a variety of behaviors, including nocturnal bruxism, diurnal bruxism, and biting, chewing, or licking of the lips, cheeks, tongue, or palate. The majority of the published studies on self-destructive oral habits are in the area of bruxism (see references 20, 21). The term bruxism in the broadest sense includes not only diurnal and nocturnal teeth grinding but also teeth clenching, gnashing, tapping, or other parafunctional destructive oral habits. The reported incidence of bruxism in children varies widely from 7% to 88%, depending on the definition used and measurement approach employed, and the incidence does not appear to be different between males and females.[21,22]

Bruxism and destructive oral habits can lead to tooth wear, malocclusion, tooth mobility, and damage to the cheeks, lips, palate, and temporomandibular joint. These behaviors are also associated with increased muscular activity and pain in the facial, head, neck, and shoulder areas.

Behavioral Treatment

Thirty treatment-outcome studies have been published on the behavioral treatment of self-destructive oral habits and bruxism. The primary behavioral treatment approaches include nocturnal electromyogram (EMG)-activated alarms, EMG biofeedback, habit reversal, massed practice, punishment, relaxation training, self-monitoring, and stress management.

The most frequently evaluated behavioral treatment for bruxism is nocturnal biofeedback or the use of EMG-activated alarms. This treatment involves using an EMG biofeedback device to monitor nocturnal muscle activity, usually in the masseter area. The alarm is set to sound when a specified threshold is exceeded during a clenching or bruxing episode. Thirteen published studies have evaluated the effects of nocturnal biofeedback for the treatment of bruxism. The largest, best-controlled study was conducted by Pierce and Gale[23] and included 100 subjects randomly

assigned to five groups (n = 20 per group), including nocturnal biofeedback, diurnal biofeedback, massed practice, dental occlusal splint, or a control group. The results indicated that the EMG-measured frequency of bruxing episodes and duration of bruxing activity were reduced by about 50% in the nocturnal biofeedback group. However, the 2-week treatment effects were transient, and bruxing activity returned to baseline levels when treatment was discontinued.

Cassisi and McGlynn[24] also evaluated the use of an EMG-activated alarm for 10 subjects randomly assigned to complete 14 nights of nocturnal biofeedback treatment either before or after 14 nights without treatment. EMG-measured bruxing episodes were recorded for all 28 nights. The results indicated that the nocturnal biofeedback significantly reduced bruxing episodes for 7 out of the 10 subjects with a mean reduction of 57% for all subjects. The treatment did not adversely affect self-reports of sleepiness, vigor, or fatigue. In general, similar treatment-outcome results are reported in the other published studies on the use of EMG-activated alarms, except that a few studies (e.g., reference 25) have indicated decreases in bruxing duration but not frequency.

Diurnal biofeedback training (EMG biofeedback) for bruxism has yielded mixed results. Pierce and Gale[23] found that nocturnal bruxism was not significantly reduced in the 20 subjects receiving diurnal biofeedback. Other published studies, however, have found EMG biofeedback treatment to reduce bruxism.[26,27] Moreover, the research to date has focused on adults, and the efficacy of EMG biofeedback treatment for children with bruxism is not known.

Habit reversal has been used in three published studies of the treatment of self-destructive oral habits.[28-30] The only group study published to date specifically focused on treating a variety of self-destructive oral habits was conducted by Azrin et al.[28] This study included 10 subjects (including three children) randomly assigned to a habit reversal (n = 5) or negative practice (n = 5) treatment groups. All subjects exhibited oral habits, such as biting, chewing, licking, or pushing of the cheeks, lips, teeth, or palate. The habit reversal treatment was administered in a single 2-hour session. The competing responses involved repositioning exercises with the teeth, jaw, tongue, lips, and cheeks and used specific behaviors that were incompatible with the habit and could provide immediate control. The negative practice procedure involved completing a brief exercise for 30 seconds every waking hour that simulated the habit motion without doing any damage. The results indicated that the patients receiving the habit reversal treatment reduced the oral habits by 97% during the first week of treatment with a mean reduction of 99% at a 22-month follow-up. The negative practice group showed a mean reduction of about 66% during the first week after treatment and remained at about a 60% habit reduction over the 4-week follow-up.

Two additional single-subject experimental design studies using habit reversal have been published.[29,30] Peterson et al[29] employed a multiple base line across subjects design to evaluate the use of habit reversal and found significant improvement for two out of the three subjects in regards to decreased self-reported pain, decreased pain upon muscle palpation, and increased maximum mandibular opening. Rosenbaum and Ayllon[30] found marked reduction in the frequency of bruxing behavior in four subjects treated with just one session of habit reversal. Subsequently, relaxation training and stress management techniques were used with two of the subjects resulting in reductions in pain ratings and medication use.

Massed practice has been used in several published studies with mixed results. Azrin et al[28] found that massed practice reduced self-destructive oral habits by about 60% in five subjects treated with this approach. Other studies have found massed practice to be either ineffective in reducing bruxism[31] or to slightly increase the frequency and duration of nocturnal bruxism episodes.[23]

The effectiveness of relaxation training, stress management, and punishment for the treatment of oral habits and bruxism is not clear. Rosenbaum and Ayllon[30] found that the effectiveness of habit reversal was enhanced by the addition of relaxation training and stress management for two subjects. Casas et al[32] found that stress-reduction behavioral counseling (cognitive-behavior therapy) resulted in significant reductions in nocturnal EMG measurements in eight subjects. The results by Casas et al[32] are interesting in that they suggest that stress reduction skills learned while awake can effect nocturnal behavior. The results are consistent with many descriptive studies that have found significant positive correlations between stress and bruxism (see references 20, 21). Several case studies and single-subject experimental design studies have demonstrated the effectiveness of punishment for the treatment of diurnal bruxism. However, no large-scale, well-controlled study with long-term follow-up has evaluated the independent effectiveness of relaxation training, stress management, or punishment for the treatment of self-destructive oral habits or bruxism.

The most common dental treatment for bruxism is the use of an interocclusal appliance or "splint." Splints are designed to prevent wear on the teeth from grinding, provide stabilization of the temporomandibular joint, and prevent bruxism. Many uncontrolled studies have evaluated the efficacy of splint therapy and reported significant reductions in bruxing and myofascial pain. The most commonly used and most empirically validated splint is the flat-plane splint fabricated out of hard plastic or acrylic. Okeson[33] compared the use of hard and soft splints in 10 subjects using an A-B-A-C-A design. The results indicated that the use of a hard occlusal splint significantly reduced nocturnal muscle activity in 8 out of the 10 subjects, whereas the soft splint increased muscle activity in 7 of the subjects.

Pierce and Gale[23] found that the frequency and duration of nocturnal bruxism episodes were reduced by about 45% in 20 patients wearing a maxillary flat-plane acrylic splint, but the bruxism symptoms returned to baseline levels after discontinuation of the splint use. Similar results were found by Sheikholeslam et al[34] in their study of 31 patients with nocturnal bruxism before, during, and after 3 to 6 months of treatment with a full maxillary acrylic splint. Outcome was measured using diurnal EMG recordings in the clinic and a standardized dental screening consisting of measures of pain, tenderness, and mandibular range of motion. The results indicated that signs and symptoms of bruxism were

significantly reduced in 87% of the patients during the treatment phase. However, after discontinuing use of the splint the symptoms returned to the pretreatment level in 78% of the subjects within 4 weeks. In another study by these same researchers[35] on nocturnal bruxism, it was found that the use of an occlusal splint did not stop nocturnal bruxism. In 61% of the patients, wear facets on the splint were observed at every visit, and in the remaining patients, facets were observed from time to time. The facets occurred in the same location, with the same pattern, and were caused mainly by grinding.

Another dental treatment sometimes used as a treatment for bruxism is occlusal equilibration, or spot grinding of the teeth. This approach is based on the notion that bruxism is caused by discrepancies in the bite and that diurnal or nocturnal bruxism is a psychophysiological reaction in an attempt to eliminate occlusal disharmony. However, there is little credible scientific research to support this hypothesis, and deviations from ideal occlusion in children are statistically normal and have been found to occur in over 95% of 5- and 10-year-old children.[36]

Pharmacological Treatment

The use of medication for the treatment of oral self-destructive habits in children has not been evaluated. Some preliminary evidence suggests that short-term use of tricyclic antidepressants[37] or minor tranquilizers[38] may be helpful for adults with severe nocturnal bruxism. Further research is necessary to determine the indications for use and potential efficacy of medication treatments for children with oral self-destructive habits and bruxism.

Summary

Nocturnal biofeedback is the most frequently investigated behavioral treatment for bruxism and has been demonstrated in several studies to be effective in reducing the nocturnal bruxing episodes and duration of bruxing by about 50%. The primary limitation of nocturnal biofeedback treatment is that the results appear to dissipate after discontinuation of treatment. No controlled treatment-outcome study has been conducted to evaluate whether the results of nocturnal biofeedback continue during an extended follow-up period or if patients are willing to comply with a treatment that requires frequent nighttime awakenings over an extended period of time.

Habit reversal has been demonstrated to be effective in reducing oral destructive habits by over 90%, decreasing bruxism, and lessening the symptoms of temporomandibular disorders. There is some evidence to suggest that relaxation training, self-monitoring, and punishment may be effective treatments for bruxism, but more rigorous research is required. Massed practice is not recommended as a treatment for self-destructive oral habits or bruxism because of the lack of solid research support and risk of possible structural damage during massed practice exercises. Similarly, occlusal equilibration is not recommended for children because it is a nonreversible procedure and lacks sufficient empirical research support for its efficacy.

The use of dental occlusal splints is the most common treatment for bruxism. Splints do not appear to eliminate bruxism, but may reduce the frequency and duration of bruxism episodes by about 45% and prevent structural damage caused by bruxism. The main limitation is that splints may need to be worn nocturnally on a continuous basis for them to be effective, and the long-term effects of splint use in growing children with changing dentition are not known. Additionally, the use of splints to reduce other parafunctional self-destructive oral habits has not been evaluated.

TRICHOTILLOMANIA

Trichotillomania (hair pulling) is a disorder of unknown etiology in which individuals pull out their own hair, which results in alopecia (hair loss). Individuals often have a sense of tension immediately before pulling, with gratification or a sense of relief when pulling out the hair.[39] Hairs on the scalp are the ones most commonly pulled, although other areas often involved include the eyelashes, eyebrows, beard, or pubic area. Trichotillomania is often a rather secretive disorder; many individuals conceal their hair-pulling behavior and hair loss, and many do not seek treatment.

Trichotillomania usually begins in childhood and is apparently more common in females, although the available data are contradictory, and the disorder may be more common among males in the preschool age group.[39,40] The prevalence of hair pulling in adults has been reported to be as high as 10%, although in those cases of hair pulling that also result in alopecia and that cause significant distress the prevalence is about 1 to 2%.[41,42] The number of children with trichotillomania is thought to be seven times higher than for adults.[43] Trichotillomania may be accompanied by mouthing of the hair or trichophagia (hair eating). A potential medical complication of trichophagia is trichobezoars, hairballs that form in the stomach, which can result in significant gastrointestinal difficulties.

The assessment of treatment-outcome in studies of trichotillomania has included measures of both rate and severity. In outpatient settings, the rate of hair pulling has generally been determined by self-report of the patient by having him or her count the episodes of hair pulling, count the number of hairs that have been pulled out, or count the number of urges to pull hair. In inpatient settings, direct observation and frequency counts have been used. The severity of trichotillomania has been determined by measuring the size of bald spots, counting the number of hairs per bald spot, subjective ratings of photographs of bald spots, and global subjective measures of improvement completed by the clinician or subject. The measurement of improvement in published treatment-outcome studies has varied widely. Many uncontrolled case studies rely solely on general impressions of improvement, which are inadequate as a basis for drawing scientifically valid inferences.

Behavioral Treatment

Fifty-one studies have been published using behavioral approaches for the treatment of trichotillomania (see also references 40, 44). Out of these studies, only one[45] is a controlled group study with random assignment to treatment groups. The other 59 studies are case studies including 1 to 6 subjects, with 51 of the studies including 1 or 2 subjects.

Approximately one-half of the studies are uncontrolled case studies lacking the scientific rigor to provide clear information about the impact of treatment. However, most of the other studies employed rigorous single-subject designs with objective outcome measures, including reversal and multiple-baseline designs, which can provide useful information regarding treatment efficacy.

Numerous behavioral treatment strategies have been used in the treatment-outcome literature on trichotillomania, including habit reversal, punishment, reinforcement, response cost, response prevention, time out, competing responses, overcorrection, self-monitoring, relaxation training, cognitive-behavior therapy, hypnosis, covert sensitization, and negative practice. In general, most treatment-outcome studies have found behavioral treatments to be effective in reducing or eliminating hair pulling, including studies of hair pullers capable of conducting their own treatment, as well as for developmentally handicapped hair pullers who require therapist-mediated approaches (see reference 44). However, because of the uncontrolled case study or single-subject experimental designs, valid inferences cannot be made regarding definitive efficacy rates for each of the different behavioral procedures.

Punishment is the most frequently evaluated behavioral approach for the treatment of trichotillomania and has resulted in 20 published manuscripts, none of which are randomized group studies. The use of punishment has included electrical aversion therapy, ammonia inhalation, verbal reprimands, self-administered snap of a rubber band, and aversive taste substances applied to the thumb in cases in which thumb sucking was a covarying habit disorder. Overall, the results of these studies have been promising in that most of the studies have resulted in significant reductions in hair pulling. However, because of the lack of controlled studies, definitive statements regarding the efficacy of punishment cannot be made.

Reinforcement has been used in 18 published treatment-outcome studies of trichotillomania in the form of attention, hugs, praise, token economies, and behavioral contracting for the acquisition of social and secondary reinforcers. No randomized group treatment-outcome study has been conducted using reinforcement as the primary or sole treatment. The published case studies have found reinforcement to be an effective behavioral treatment for children, although the level of efficacy is not clear.

Self-monitoring in combination with other behavioral treatments components has been used in at least 15 published studies of the behavioral treatment of trichotillomania. The exact frequency of its use is unclear because it is often used as a treatment-outcome measure. Self-monitoring may increase awareness of hair pulling, serve to increase motivation for treatment, or be conceptualized as an outright treatment itself. However, the effectiveness of self-monitoring for the treatment of hair pulling is not known because no published group study or well controlled single-subject experimental design study has investigated the independent efficacy of self-monitoring.

Habit reversal is the most thoroughly evaluated behavioral treatment for trichotillomania. Ten treatment-outcome studies on the use of habit reversal for trichotillomania have been published, including the one randomized group study. Azrin et al[45] studied 34 subjects with trichotillomania (including four children) randomly assigned to a habit reversal (n = 19) or a negative practice group (n = 15). Treatment-outcome was measured by having the subjects record each instance of hair pulling. Two subjects recorded the hair pulling in terms of duration instead of number because the habit was continuous rather than episodic. The habit reversal training consisted of 13 distinctive components.[45] The habit reversal competing reaction component involved teaching the subject an inconspicuous competing response of grasping or clenching the hands for 3 minutes whenever hair pulling has occurred or is likely to occur. The negative practice group subjects were instructed to set an hourly timer, stand in front of the mirror, and to act out the motions of hair pulling without doing any damage. They were instructed to repeat this procedure every hour, acting out the hair pulling for 30 seconds every hour. The results of the study showed that the habit reversal subjects showed a 99% reduction in hair pulling on the first day after training. At the 4-week follow-up, hair pulling was reduced by an average of 97% and hair pulling was eliminated in 67% of the subjects. At the 22-month follow-up, hair pulling was reduced by 87%. The negative practice group reduced hair pulling by 58% on the first day. At the 4-week follow-up, hair pulling was reduced by 71%, and 36% of the subjects had eliminated hair pulling.

The efficacy of habit reversal was supported in a subsequent study of four subjects with trichotillomania.[46] A multiple-baseline design was employed and outcome was measured using self-recording. The results were of similar magnitude as in the study by Azrin et al.[45] Reliability measures were obtained by corroborating reports from individuals who frequently interacted with the subjects.

Three single-subject experimental design studies are noteworthy because they suggest that both thumb sucking and trichotillomania can be treated concurrently.[47–49] In each of these studies, the children had both chronic thumb sucking and trichotillomania. When thumb sucking was treated as the target behavior using a combination of behavioral treatments, both thumb sucking and trichotillomania were eliminated.

Pharmacological Treatment

Twenty-four treatment-outcome studies have been published on the pharmacological treatment of trichotillomania using a variety of medications including fluoxetine, clomipramine, imipramine, buspirone, amitriptyline, pimozide, trazodone, chlorpromazine, lithium carbonate, haloperidol, isocarboxide, and serotonin reuptake blockers. Most of the studies have been case reports or open clinical trials. However, two randomized, double-blind studies have been published.[50,51]

Swedo et al[51] completed a double-blind comparison of clomipramine and desipramine in the treatment of 14 women with trichotillomania. Treatment-outcome was measured using (1) a self-report severity symptoms scale (ratings from 0 to 5); (2) a self-report impairment index (ratings from 0 to 11); and (3) a physician-rated patient clinical progress scale (ratings from 0 to 20 with 0 = absence of symptoms,

10 = pretreatment baseline level, and 20 = incapacitating symptoms). All medications were discontinued for at least 1 month before entry into the study. After completing a 2-week single-blind placebo phase, all subjects were randomly assigned to complete two consecutive 5-week periods of treatment with either clomipramine or desipramine administered in a double-blind manner. One subject became asymptomatic during the placebo phase and was not entered into the active treatment phase. The results for the 13 subjects who completed the study indicated that clomipramine was clearly superior to desipramine in the treatment of trichotillomania as indicated by statistically significant and clinically meaningful differences on all three measures. Nine of the 13 subjects (69%) had at least a 50% reduction in the severity of symptoms, and three had complete remissions during the 5 weeks of clomipramine treatment. No subjects discontinued treatment during the study because of unwanted side effects. Follow-up information obtained by telephone updates 4 years later indicated there was a 40% (moderate) reduction in the severity of symptoms.[52] One subject had a complete remission after medication withdrawal. The other patients required continued medication use to reduce symptoms.

Christenson et al[50] studied the effects of fluoxetine in a placebo-controlled, double-blind crossover study of 21 subjects with trichotillomania. Sixteen subjects completed at least a partial trial of both fluoxetine or placebo, and 15 completed the entire 18-week trial (1-week assessment, 6 weeks drug 1, 5-week washout, 6 weeks drug 2). In addition to the robust experimental design, a significant strength of the study was the extensive, objective outcome measures, including (1) hair-pulling episodes per week; (2) estimated amount of hair pulled per week; (3) counted number of hairs pulled per week; (4) weekly subject ratings of severity of the urge to pull hair; and (5) weekly subject rating of severity of hair pulling. The results indicated no significant differences between fluoxetine and placebo in weekly subject ratings of hair pullings, weekly subject ratings of the urge to pull hair, weekly assessments of the number of hair-pulling episodes, or the estimated amount of hair pulled per week. The data on counted number of hairs pulled per week were too sporadic for statistical analysis. Overall, the study failed to demonstrate the short-term efficacy of fluoxetine in the treatment of trichotillomania. These results are in contrast to nine previous published case studies or open clinical trials reporting the effectiveness of fluoxetine for the treatment of trichotillomania.

Summary

The research conducted to date indicates that habit reversal reduces hair pulling by over 90%, eliminates hair pulling in about two-thirds of the cases, and is the most effective behavioral treatment for trichotillomania. Although some studies have suggested that punishment, reinforcement, and self-monitoring are also efficacious treatments, more rigorous investigations are require to determine their actual efficacy. Additionally, because ample research indicates that trichotillomania can be effectively treated using other behavioral approaches, it is recommended that punishment be considered only in cases in which other treatment strategies have not been successful. Clomipramine has been shown to be an effective drug treatment for trichotillomania, resulting in a clinically significant reduction (at least 50%) in hair pulling in about 70% of subjects. Additional research is required to evaluate the individual or combined efficacy of behavioral and pharmacological treatments for trichotillomania.

NAIL BITING

The effects of onychophagia (nail biting) range in severity from mild cosmetic unattractiveness to skin infections, scarring, nail loss, and even dental problems such as temporomandibular disorders.[53] The incidence of nail biting appears to increase until the teen-age years when it peaks at 45%[54] and then falls with age until it reaches a low of 4.5% for individuals in their sixties.[55]

Behavioral Treatment

Research on the behavioral treatment of nail biting has resulted in 29 published studies during the past 20 years with the vast majority published in the 1970s (see reference 56). Behavioral treatment approaches employed in the published literature include self-monitoring, aversion, habit reversal, competing responses, negative practice, covert sensitization, reinforcement, cue-controlled relaxation, contingency contracting, and overcorrection with artificial nails. Improvement in nail biting has been measured in most studies by increases in nail length, elimination of nail biting, and reduction in the number of nail-biting episodes. However, many studies failed to provide details on the specific outcome measures used. Many of the published studies also used multiple behavioral treatments and contain significant methodological flaws, lack detail in outlining the methodology, and do not provide adequate data to accurately determine treatment efficacy.

Eight studies have examined the efficacy of self-monitoring and found some benefit in its use for the treatment of nail biting. Those studies lacking adequate methodological controls have reported much greater benefit than those studies with increased scientific rigor. Only two of the studies[57,58] have sufficient scientific rigor to provide useful information about the impact of self-monitoring as a behavioral treatment approach.

Silber and Haynes[57] evaluated the use of self-monitoring alone (n = 7) or in combination with either a bitter tasting substance (n = 7) or a competing response (n = 7). At the end of 4 weeks of treatment, self-monitoring alone reduced nail-biting episodes by 18% and nail-biting urges by 21%, and one out of seven of the subjects (14%) completely eliminating nail biting. Nail-biting episodes were reduced by 45% when self-monitoring was combined with the bitter substance and by 90% when combined with the competing response.

In another study of self-monitoring, Vargas and Adesso[58] compared the effectiveness of negative practice (n = 16), shock (n = 16), a bitter substance (n = 16), and an attention-placebo control (n = 13). Additionally, one-half of the subjects in each group engaged in self-monitoring. After six treatment sessions, the results indicated that all treatment

groups reduced nail biting at posttest and follow-up, with the self-monitoring subjects experiencing significantly greater increases in nail growth. In the one group evaluating the independent efficacy of self-monitoring, only one out of six subjects (17%) had eliminated nail biting at the 3-month follow-up. In the other three groups in which self-monitoring was combined with another treatment, 33% of the self-monitoring subjects eliminated nail biting at the 3-month follow-up versus 21% of the subjects who did not self-monitor.

Eight published studies have examined the efficacy of aversive treatments for nail biting, including the use of a bitter tasting substance painted on the nails or electric shock. Silber and Haynes[57] evaluated the use of aversion, a competing response, and self-monitoring for the treatment of nail biting. The aversive treatment involved the use of a bitter-tasting substance (Stop 'n Grow, Mentholatum Company, Ltd. Twyford, United Kingdom) painted on the nails of subjects. The results indicated that when the aversive treatment was combined with self-monitoring it reduced nail-biting episodes by 45% and reduced nail-biting urges by 32%, but only one out of seven subjects (14%) completely eliminated nail biting. The elimination of nail biting with the use of the bitter substance was no greater than in the group in which self-monitoring was used alone.

In another study of the use of aversive treatments, Vargas and Adesso[58] evaluated the effectiveness of shock, a bitter-tasting substance and negative practice for the treatment of nail biting. The shock group consisted of 10-minute periods of response-contingent shock to the fingers conducted in the experimental setting. Approximately 12 times per minute the experimenter said "bite," the subject engaged in nail biting, and the contingent shock was administered. After six treatment sessions, the two aversive treatment approaches eliminated nail biting in 8 out of 25 subjects (32%), and the results were maintained at a 3-month follow-up evaluation. Nail biting was eliminated in 2 out of 13 subjects (15%) with the shock treatment and 6 out of 12 subjects (50%) with the bitter substance.

Seven published studies have examined the efficacy of habit reversal for the treatment of nail biting (see references 11, 59 for complete details of the habit reversal treatment for nail biting). The competing response component of the habit reversal treatment involved teaching the subjects to engage in a behavior incompatible with nail biting, such as making a fist or grasping an object. The subjects were instructed to engage in the competing response for about 3 minutes upon the initiation of nail biting or picking. Subjects were also instructed to employ the competing response upon identification of the earliest precursor to nail biting or picking, such as placing the fingers in or near the mouth or feeling the nails or cuticles for rough spots. Additionally, subjects were instructed to groom the nails and cuticles on a regular basis to eliminate irregularities or rough spots that may be triggers for nail biting or picking.

In the first published study of the use of habit reversal for the treatment of nail biting, Nunn and Azrin[60] evaluated 13 subjects (including two children) using a pretest-posttest design. Habit reversal was used in a 2-hour treatment session and nail biting was reduced by 90% the first day and 99% by the end of the first week. Nail-biting episodes were reduced by 100% during the 4- to 16-week follow-up period.

In a subsequent study, Azrin et al[59] randomly assigned 97 nail biters to a habit reversal (n = 45) or negative practice (n = 52) group. After one 2-hour treatment session, the habit reversal group reduced nail-biting episodes 98% from the first day as compared to 60% for the negative practice group, and the reductions were maintained for both groups throughout a 5-month follow-up. Analysis of the individual subject data indicated that 40% of the subjects in the habit reversal group eliminated episodes of nail biting by the third month, and an additional 44% of subjects were appreciably improved with a 51 to 99% reduction. Overall, 84% of the subjects treated with habit reversal significantly reduced (50% or greater reduction) nail-biting episodes. In contrast, 42% of the subjects treated with negative practice significantly reduced nail-biting episodes; 15% eliminated nail biting, and 27% were appreciably improved.

Frankel and Merbaum[61] evaluated 70 subjects randomly assigned to three different variations of the habit reversal procedure. Members of the first group (n = 23) were seen individually once a week for 5 weeks of habit reversal treatment and were given a copy of a habit reversal treatment manual.[11] Members of the second group (n = 23) evaluated the efficacy of habit reversal with minimal therapist contact. Members of this group were given a copy of the habit reversal treatment manual and were provided with 10-minute telephone contact with the therapist once a week for 5 weeks. Members of the third group (n = 24) were given the treatment manual with no therapist contact. The results indicated that all three groups made statistically and clinically significant gains in nail length, with 72% of all subjects no longer biting their nails 1 week after treatment.

Some researchers contend that not all 13 components of Azrin and Nunn's[10] habit reversal treatment package are required for treatment success. Four studies have examined the efficacy of the competing response component of habit reversal for the treatment of nail biting. Silber and Haynes[57] evaluated the efficacy of a competing response as compared with an aversive substance and self-monitoring. The results indicated that the competing response was the most effective approach and reduced nail-biting episodes by 90%, reduced nail-biting urges by 84%, and eliminated nail biting in 57% of subjects after 4 weeks of treatment.

Horne and Wilkinson[62] randomly assigned 40 habitual nail biters to one of four experimental groups (1) competing response and nail care instructions, (2) competing response, nail care instructions, and goal setting, (3) nail care instructions and goal setting, and (4) a waiting-list control group. At a 4-week follow-up the results indicated that nail biting was eliminated in 70% of the subjects in the competing response plus nail care group and 60% of subjects in the competing response, nail care, and goal setting group. At the 8-week follow-up 40% of both groups were still free of nail biting. In contrast, only 20% of the nail care and goal setting group and 10% of the waiting-list group eliminated nail biting at follow-up.

Two well-controlled studies have evaluated the use of negative practice for treating nail biting. Azrin et al[59] compared habit reversal (n = 45) and negative practice (n = 52)

and found that negative practice reduced nail-biting episodes 60% from the first day. At the 3-month follow-up, nail biting was eliminated in 15% of the subjects and significantly reduced (51 to 99% reduction) in an additional 27% of subjects.

As previously noted, Vargas and Adesso[58] compared negative practice to shock, a bitter substance, and an attention-placebo control. At the 3-month follow-up, the results indicated that negative practice eliminated nail biting in 42% of the subjects, as compared to 32% in the aversive treatment groups and 17% in the control group.

Pharmacological Treatment

Only one published study has evaluated the pharmacological treatment of nail biting. Leonard et al[53] evaluated 25 adult subjects in a 10-week double-blind cross-over trial of clomipramine hydrochloride and desipramine hydrochloride. The results indicated that only 14 of the 25 subjects (56%) who entered the investigation completed the study. Out of the 14 subjects who completed the study, two (14%) treated with the clomipramine stopped biting their nails completely and an additional five had at least a 30% decrease in the amount and severity of nail biting. Including dropouts, only 2 out of 25 of the subjects (8%) eliminated nail biting with the clomipramine. The clomipramine was significantly better than the desipramine in eliminating nail biting and in regards to measures of nail-biting severity, nail-biting impairment, and overall clinical progress. The researchers noted significant difficulty in recruiting subjects to participate in the study. Only 25 (7%) of the subjects who initially inquired entered the study, and only 14 (4%) completed it, in contrast to a previous study by the authors using these same drugs to treat trichotillomania in which there were no dropouts.[51]

Summary

Many behavioral approaches have been evaluated for the treatment of nail biting with varying degrees of success. Habit reversal has been shown to eliminate nail biting in 40% of the cases, significantly reduce nail biting (50% or greater reduction) in 84% of subjects, and appears be the treatment of choice based on the best treatment-outcome studies published to date.

Several other approaches have also been demonstrated to eliminate nail biting, including self-monitoring (15%), bitter tasting substances (15%), competing responses (40% to 57%), and negative practice (15%). Advantages of self-monitoring include its ease of administration and usefulness in monitoring treatment progress. The use of commercially available bitter tasting substances are easy to administer and inexpensive. Although the habit reversal competing response may be the most important treatment component, the best outcome appears to result when the entire habit reversal treatment program is employed.

THUMB SUCKING

Thumb sucking is a relatively common activity among young children, with an incidence rate between 30 to 40% in preschoolers and 10 to 20% in children 6 years or older.[63] If unresolved, this initially benign activity can adversely impact a child's dental health and has been associated with an anterior open bite, malocclusions, narrowing of the dental arches, mucosal trauma, and digital deformities.[64-67] Thumb sucking also has an impact on the social standing of children. Social acceptance is lower among children who suck their thumbs, and they are viewed by their peers as being less intelligent, happy, attractive, likable, or fun, and less desirable as a friend, playmate, seatmate, classmate, or neighbor.[68] Friman and Leibowitz[69] have suggested that the treatment of thumb sucking is appropriate if the child is at least 4 years old, the problem is chronic, complications have arisen in the medical, dental, or social realm, or the child requests assistance. The treatment of thumb sucking may be inappropriate for children under 4 years of age, older children who have experienced a traumatic loss or a serious physical accident, or older children who infrequently suck their thumbs.[69]

Behavioral Treatment

Thirty-six studies have been published on the use of behavioral treatments for thumb sucking (see reference 56). Unfortunately, 34 of the studies are case studies or single-subject experimental design studies with one to three subjects. Most studies have measured improvement in thumb sucking in terms of frequency, rather than duration, of sucking. Research approaches to the behavioral treatment of diurnal and nocturnal thumb sucking have included reinforcement (20 studies), punishment (9 studies), aversion (12 studies), response prevention (9 studies), habit reversal (2 studies), overcorrection (2 studies), and self-monitoring (1 study). Some tentative research evidence is available to support each of these behavioral treatment approaches. However, the limited sample sizes and outcome measures in most studies make it difficult to make definitive statements regarding treatment efficacy. Nevertheless, two well designed studies have been published[65,70] that provide valuable information regarding the behavioral treatment of thumb sucking.

Azrin et al[70] compared the effects of habit reversal (n = 18) and a bitter tasting substance (n = 14) applied to the thumb or finger twice per day. The results indicated that the habit reversal method reduced the episodes of thumb sucking by 88% the first day, by 95% at the 3-month follow-up, and 89% at the 20-month follow-up. In contrast, the bitter tasting substance reduced thumb sucking by 34 to 44% during the 3-months of follow-up. In regards to stopping thumb sucking, 47% of the habit reversal subjects had eliminated thumb sucking as compared to 10% with the bitter tasting substance at the 3-month follow-up.

Christensen and Sanders[65] evaluated the behavioral treatment of thumb sucking by randomly assigning 30 children (10 per group) to a habit reversal, differential reinforcement of other behavior (DRO), or a wait list control group. The results indicated that the intervals of observed thumb sucking were reduced by about 72% with the habit reversal and about 56% with the DRO. The habit reversal method eliminated thumb sucking in three children (30%) at post-training and in two (20%) at the 3-month follow-up, whereas the differential reinforcement group eliminated sucking in

two children (20%) at posttest and in one (10%) at follow-up.

Pharmacological Treatment

No treatment-outcome studies have been published using prescription medications for the treatment of thumb sucking. However, two published studies[69,71] have evaluated the effectiveness of "Stop-zit," a bitter-tasting substance available over-the-counter at most drug stores (Purepac Pharmaceutical Co. Elizabeth, New Jersey). Friman et al[71] evaluated the effectiveness of Stop-zit for the treatment of thumb sucking in seven children using a multiple-baseline across subjects design. The parents were instructed to coat the children's thumbs or fingers once in the morning upon awakening, once just before bedtime, and once each time they observed an instance of thumb sucking. The results indicated that thumb sucking was rapidly reduced to zero rates for all seven children. Abrupt withdrawal of the treatment resulted in a brief relapse for two children. Reintroduction of the treatment again eliminated thumb sucking in both children. After a gradual reduction of the treatment, zero rates were maintained for all children at the 3- and 6-month follow-up periods.

Friman and Leibowitz[69] evaluated the effectiveness of Stop-zit in combination with a reward system in children with nocturnal and diurnal thumb sucking assigned to an immediate (n = 11) or delayed (n = 11) treatment group. Parents were instructed to coat their child's thumbnail (or fingernail) with the substance when the children awoke in the morning, before bed, and each time sucking was observed. The reward system provided children with access to a grab bag of reinforcers (total cost less than $10) if they went without thumb sucking. The results at the 3-month follow-up indicated that the percentage of intervals with observed thumb sucking were reduced by 73%, and 50% of the children eliminated both nocturnal and diurnal thumb sucking. At the 1-year follow-up, 95% of all subjects had eliminated thumb sucking.

Summary

The most effective treatment for chronic thumb sucking appears to be the use of an aversive tasting substance applied to the thumb or fingers in combination with a reward system, which has been shown to eliminate thumb sucking in 95% of the cases as compared to about 30% to 50% with habit reversal. As noted previously, the treatment of chronic thumb sucking in cases in which trichotillomania is a covarying behavior is effective in eliminating both the thumb sucking and the hair pulling.

CONCLUSIONS

Approximately 350 treatment-outcome studies have been published on the behavioral and pharmacological treatment of tics, oral habits, hair pulling, nail biting, and thumb sucking. Controlled treatment-outcome studies have shown that the most effective behavioral treatments reduce the frequency of these tic and habit disorders by over 90% and eliminate the disorders in 40 to 70% of the cases. Although many behavioral approaches have been demonstrated to be effective and may be useful in the treatment of an individual case, habit reversal is the one behavioral approach with the most consistently demonstrated treatment efficacy. Some of the advantages of habit reversal include its (1) brevity, with some treatments being performed in one 2-hour session; (2) immediacy, with significant reductions often occurring the first day of treatment; (3) efficacy, with symptoms being reduced by over 80% in most cases; (4) durability, with treatment gains being maintained at follow-up; (5) flexibility, with treatment success resulting in some cases whether subjects are treated by a behavior therapist or simply provided with a detailed treatment manual; and (6) consistency, with similar results being obtained by several independent research groups. The primary limitation of behavioral treatments is that they often require significantly more time of the patient and provider as compared to pharmacological treatment approaches. Additionally, the treatment of some of the more difficult tic and habit disorders, such as Tourette syndrome (TS) and trichotillomania, may require a behavior therapist with specific training in the behavioral treatment of these disorders.

Much treatment-outcome research has also been published on the pharmacological treatment of tic and habit disorders. Several double-blind, placebo-controlled studies have demonstrated that drug treatments are effective for both TS and trichotillomania. An advantage of pharmacological treatments is that they often require significantly less time of the patient and provider. Two disadvantages of drug treatments are that they must often be continued in order to maintain treatment effects and unwanted side effects develop in many cases. Much less evidence is available in support of drug treatments for bruxism or nail biting. The use of commercially available bitter tasting substances combined with behavior therapy have been shown to be effective in eliminating thumb sucking in 95% of the cases.

Tic and habit disorders can be effectively treated with behavioral and pharmacological treatment approaches. Pediatricians, psychologists, and psychiatrists who are knowledgeable of the treatment-outcome literature on tic and habit disorders have a variety of treatment options to consider with their patients.

Acknowledgment. We gratefully acknowledge the assistance of Carol Payne, Sherry Nave, and Phyllis Harper in the completion of this manuscript.

REFERENCES

1. Kazdin AE: Drawing valid inferences from case studies, in Kazdin AE (ed): Methodological Issues and Strategies in Clinical Research. Washington, DC, American Psychological Association, 1992, pp 475–490

2. Barlow DH, Hersen M: Single Case Experimental Designs: Strategies for Studying Behavior Change. New York, NY, Pergamon, 1984
3. Peterson AL, Azrin NH: Behavioral and pharmacological treatments for Tourette syndrome: A review. Appl Prev Psychol 2:231–242, 1993
4. Cohen DJ, Leckman JF, Shaywitz BA: A Physician's Guide to Diagnosis and Treatment of Tourette syndrome: A Neurological Multiple Tic Disorder. New York, NY, Tourette Syndrome Association, 1984
5. Azrin NH, Peterson AL: Behavior therapy for Tourette syndrome and tic disorders. in Cohen DJ, Leckman JF, Bruun RD (eds): Tourette Syndrome and Tic Disorders: Clinical Understanding and Treatment. New York, NY, John Wiley & Sons, 1988, pp 237–255
6. Turpin G: The behavioral management of tics disorders: A critical review. Adv Behav Res Ther 5:203–245, 1983
7. Azrin NH, Nunn RG, Frantz SE: Habit reversal vs. negative practice treatment of nervous tics. Behav Ther 11:169–178, 1980
8. Azrin NH, Peterson AL: Treatment of Tourette syndrome by habit reversal: A waiting-list control group comparison. Behav Ther 21:305–318, 1990
9. Peterson AL, Azrin NH: An evaluation of behavioral treatments for Tourette syndrome. Behav Res Ther 30:167–174, 1992
10. Azrin NH, Nunn RG: Habit reversal: A method of eliminating nervous habits and tics. Behav Res Ther 11:619–628, 1973
11. Azrin NH, Nunn RG: Habit control in a day. New York, NY, Pocket Books, 1977
12. Azrin NH, Peterson AL: Reduction of an eye tic by controlled blinking. Behav Ther 20:467–473, 1989
13. Azrin NH, Peterson AL: Habit reversal for the treatment of Tourette syndrome. Behav Res Ther 26:347–351, 1988
14. Miltenberger RG, Fuqua RW, McKinley T: Habit reversal: Replication and component analysis. Behav Ther 16:39–50, 1985
15. Goetz CG, Tanner CM, Wilson RS, et al: Clonidine and Gilles de la Tourette's syndrome: Double-blind study using objective rating methods. Ann Neurol 21:307–310, 1987
16. Leckman JF, Hardin MT, Riddle MA, et al: Clonidine treatment of Gilles de la Tourette's syndrome. Arch Gen Psychiatry 48:324–328, 1991
17. Ross MS, Moldofsky H: A comparison of pimozide and haloperidol in the treatment of Gilles de la Tourette's syndrome. Am J Psychiatry 135:585–587, 1978
18. Shapiro AK, Shapiro E: Controlled study of pimozide vs. placebo in Tourette's syndrome. J Am Acad Child Adolesc Psychiatry 23:161–173, 1984
19. Shapiro E, Shapiro AK, Fulop G, et al: Controlled study of haloperidol, pimozide, and placebo for the treatment of Gilles de la Tourette's syndrome. Arch Gen Psychiatry 46:722–730, 1989
20. Biondi M, Picardi A: Temporomandibular joint pain-dysfunction syndrome and bruxism: Etiopathogenesis and treatment from a psychosomatic integrative viewpoint. Psychother Psychosom 59:84–98, 1993
21. Glaros AG, Melamed BG: Bruxism in children: Etiology and treatment. Appl Prevent Psychol 1:191–199, 1992
22. Cash RG: Bruxism in children: Review of the literature. J Periodontol 12:107–127, 1988
23. Pierce CJ, Gale EN: A comparison of different treatments for nocturnal bruxism. J Dent Res 67:597–601, 1988
24. Cassisi JE, McGlynn FD: Effects of EMG-activated alarms on nocturnal bruxism. Behav Ther 19:133–142, 1988
25. Rugh JD, Johnson RW: Temporal analysis of nocturnal bruxism during EMG biofeedback. J Periodontol 52:263–265, 1981
26. Lund JP, Widmer CG: An evaluation of the use of surface electromyography in the diagnosis, documentation, and treatment of dental patients. J Craniomandib Disord 3:125–137, 1989
27. Rugh JD, Solberg WK: Electromyographic studies of bruxist behavior before and during treatment. J Calif Dent Assoc 3:56–59, 1975
28. Azrin NH, Nunn RG, Frantz-Renshaw SE: Habit reversal vs. negative practice treatment of self-destructive oral habits (biting, chewing, or licking of the lips, cheeks, tongue, or palate). J Behav Ther Exp Psychiatry 13:49–54, 1992
29. Peterson AL, Dixon DC, Talcott GW, Kelleher WJ: Habit reversal treatment of temporomandibular disorders: A pilot investigation. J Behav Ther Exp Psychiatry 24:49–55, 1993
30. Rosenbaum MS, Ayllon T: Treating bruxism with the habit-reversal technique. Behav Res Ther 19:87–96, 1981
31. Heller RF, Forgione AG: An evaluation of bruxism control: Massed negative practice and automated relaxation training. J Dent Res 54:1120–1123, 1975
32. Casas JM, Beemsterboer P, Clark GT: A comparison of stress-reduction behavioral counseling and contingent nocturnal EMG feedback for the treatment of bruxism. Behav Res Ther 20:9–15, 1982
33. Okeson JP: The effects of hard and soft occlusal splints on nocturnal bruxism. J Am Dent Assoc 114:788–791, 1987
34. Sheikholeslam A, Holmgren K, Riise C: A clinical and electromyographic study of the long-term effects of an occlusal splint on the temporal and masseter muscles in patients with functional disorders and nocturnal bruxism. J Oral Rehabil 13:137–145, 1986
35. Holmgren K, Sheikholeslam A, Riise C: Effect of a full-arch maxillary occlusal splint on parafunctional activity during sleep in patients with nocturnal bruxism and signs and symptoms of craniomandibular disorders. J Prosthet Dent 69:293–297, 1993
36. Kirveskari P, Alanen P, Jamasa T: Association between craniomandibular disorders and occlusal interferences in children. J Prosthet Dent 60:98–105, 1992
37. Ware JC, Rugh JD: Destructive bruxism: Sleep stage relationship. Sleep 11:172–181, 1988
38. Montgomery MT, Nishioka GJ, Rugh JD, Thrash WJ: Effect of diazepam on nocturnal masticatory muscle activity. J Dent Res 65:180, 1986
39. American Psychiatric Association: Diagnostic Statistical Manual of Mental Disorders, 4th ed, Washington DC, 1994
40. Swedo SE, Rapoport JL: Trichotillomania. J Child Psychol Psychiatry 32:401–409, 1991
41. Christensen GA, Pyle RL, Mitchell JE: Estimated lifetime prevalence of trichotillomania in college students. J Clin Psychiatry 52:415–417, 1991
42. Rothbaum BO, Shaw L, Morris R, Ninan PT: The prevalence of trichotillomania in a college freshman population. J Clin Psychiatry 54:72, 1993
43. Mehregan AH: Trichotillomania: A clinicopathologic study. Arch Dermatol 102:129–133, 1970
44. Friman PC, Finney JW, Christophersen ER: Behavioral treatment of trichotillomania: An evaluative review. Behav Ther 15:249–265, 1984
45. Azrin NH, Nunn RG, Frantz SE: Treatment of hair pulling (trichotillomania): A comparison study of habit reversal and negative practice training. J Behav Ther Exp Psychiatry 11:13–20, 1980
46. Rosenbaum MS, Ayllon T: The habit reversal technique in treating trichotillomania. Behav Ther 12:473–481, 1981
47. Knell SM, Moore DJ: Childhood trichotillomania treated indirectly by punishing thumb sucking. Behav Res Ther 19:305–310, 1988
48. Friman PC, Hove G: Apparent covariation between child habit disorders: Effects of successful treatment for thumb sucking on untargeted chronic hair pulling. J Appl Behav Anal 20:421–425, 1987
49. Watson TS, Allen KD: Elimination of thumb-sucking as a treatment for severe trichotillomania. J Am Acad Child Adolesc Psychiatry 32:830–834, 1993
50. Christensen GA, Mackenzie TB, Mitchell JE, Callies AL: A placebo-controlled, double-blind crossover study of fluoxetine in trichotillomania. Am J Psychiatry 148:1566–1571, 1991
51. Swedo SE, Leonard HL, Rapoport JL, et al: A double-blind comparison of clomipramine and desipramine in the treatment of trichotillomania (hair pulling). N Engl J Med 321:497–501, 1989
52. Swedo SE, Lenane MC, Leonard HL: Long-term treatment of trichotillomania (hair pulling). N Engl J Med 329:141–142, 1993
53. Leonard HL, Lenane MC, Swedo SE, Rettew DC, Rapoport JL: A double-blind comparison of clomipramine and desipramine treatment of severe onychophagia (nail biting). Arch Gen Psychiatry 48:821–827, 1991
54. Odenrick L, Brattstrom V: Nail biting. Br J Orthod 12:78–81, 1985
55. Ballinger B: The prevalence of nail biting in normal and abnormal populations. Br J Psychiatry 117:445–446, 1970
56. Adesso VJ: Habit disorders, in Bellack AS, Hersen M, Kazdin AE (eds): International Handbook of Behavior Modification and Therapy, 2nd ed, New York, NY, Plenum Press, 1990, pp 857–867
57. Silber KP, Haynes CE: Treating nailbiting: A comparative analysis of mild aversion and competing response therapies. Behav Res Ther 30:15–22, 1992
58. Vargas JM, Adesso VJ: A comparison of aversion therapies for nail biting behavior. Behav Ther 7:322–329, 1976

59. Azrin NH, Nunn RG, Frantz SE: Habit reversal vs. negative practice treatment of nailbiting. Behav Res Ther 18:281–285, 1980
60. Nunn RG, Azrin NH: Eliminating nailbiting by the habit reversal procedure. Behav Res Ther 14:65–67, 1976
61. Frankel MJ, Merbaum M: Effects of therapist contact and a self-control manual on nail biting reduction. Behav Ther 13:125–129, 1982
62. Horne D, Wilkinson J: Habit reversal treatment for fingernail biting. Behav Res Ther 18:287–291, 1980
63. Sarles RM, Heisler AB: Self-stimulating behaviors, in Hoekelman RA, Friedman SB, Nelson NM, Seidel HM (eds): Primary Pediatric Care. 2nd ed. St Louis, MO, Mosby, 1991, pp 733–735
64. Brenchley ML: Is digit sucking of significance? Br Dent J 171:357–362, 1991
65. Christensen AP, Sanders MR: Habit reversal and differential reinforcement of other behavior in the treatment of thumb sucking: An analysis of generalization and side-effects. J Child Psychol Psychiatry 28:281–295, 1987
66. Mahalski PA, Stanton WR: The relationship between digit sucking and behavior problems: A longitudinal study over 10 years. J Child Psychol Psychiatry 33:913–923, 1992
67. Rayan GM, Turner WT: Hand complications in children from digital sucking. J Hand Surg 14:933–936, 1989
68. Friman PC, McPherson KM, Warzak WJ, Evans J: Influence of thumb sucking on peer social acceptance in first-grade children. Pediatrics 91:784–786, 1993
69. Friman PC, Leibowitz JM: An effective and acceptable treatment alternative for chronic thumb- and finger-sucking. J Pediatr Psychol 15:57–65, 1990
70. Azrin NH, Nunn RG, Frantz-Renshaw S: Habit reversal treatment of thumb sucking. Behav Res Ther 18:395–399, 1980
71. Friman PC, Barone VJ, Christophersen ER: Aversive taste treatment of finger and thumb sucking. Pediatrics 78:174–176, 1986.

Historical Note

In early medical writings masturbation is often cited as a cause for various illnesses, including "hysterical affections." Some questioned the validity of this theory but could not entirely disregard it.

I have been unable to find any definite causes in a single case. In general, the female sex and the development of puberty predispose to their occurrence, and all these affections, especially chorea magna, have been brought into intimate relationship with the latter. But inasmuch as boys and younger children of nine to eleven years are not by any means exempt from the condition described, other etiological factors must also be active. These were sought in irritation of the genitalia, and onanism was regarded on many sides as the main cause of these nervous disorders. I will not deny that constant practice of this vice, when there is a strongly marked "nervous predisposition," may be etiologically important; but, from its wide-spread practice, the cases in question should be observed much more frequently than is really the case. . . . However, you will do well to bear this factor in mind and to repress the vice, whenever it is discovered, since although it may not be the real cause of the disease, the irritation of the nervous system, to which it gives rise, may prepare the way for its development and retard recovery. *(Henoch E: Lectures on Diseases of Children. New York, William Wood and Co, 1882)*

Noted by Sam Yancy