Nerve Retraction During Inferior Alveolar Nerve Repositioning Procedure: A New Simple Method and Review of the Literature

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Nerve repositioning surgery is one of the treatments chosen for the patients with edentulous posterior atrophic mandible. Like any other treatments, this therapy has its advantages and disadvantages, indications and contraindications. The most important complication of this procedure is neurosensory disturbance. This problem may occur at different stages of the treatment. One common time when nerve damage happens is when the nerve is located outside the canal and drilling and insertion of the implant are performed. Accordingly, this report describes a simple and feasible method to retract and protect nerves outside the canal during the treatment of nerve transposition. This will reduce the risk of nerve damage.

Key Words: inferior alveolar nerve repositioning, inferior alveolar nerve lateralization, inferior alveolar nerve transposition, nerve retraction, inferior alveolar nerve injury

INTRODUCTION

Nerve repositioning (N.R.) surgery is one of the treatments chosen for patients with an edentulous posterior atrophic mandible. As with any other treatments, this therapy has its advantages and disadvantages, indications and contraindications. In this method, after an osteotomy, the inferior alveolar nerve (IAN) will be pushed aside, and the implants will be inserted under direct vision up to the basal bone and eve, the mandibular inferior cortex. Then IAN will be placed back in the site passively. Some advantages of this method are use of longer length implants and shortening the duration of treatment. The resistance against occlusal pressures will increase and a proportion will be made between the implant and prosthesis following the N.R. and using longer length implants.[1–3] It has also been revealed that using longer implants following the N.R will spread forces better than using shorter length implants without the N.R. Thus, atrophy of the coronal bone around the shorter length implant will be more than the longer length implant.[4] The disadvantages of this method include neurosensory problems, temporary mandibular weakness, and lack of anatomic reconstruction of atrophic mandible.[1–3]

The most important complication of this procedure is neurosensory disturbance. Accordingly, the key of success is prevention of this problem. This problem may occur at different stages of the treatment, including the osteotomy, removal of the nerve from the canal, preserving the nerve outside the canal, and during drilling and inserting implants. One time that the nerve damage happens is when the nerve is outside the canal and the drilling and inserting of the implant are performed.

Accordingly, this report describes a simple and feasible method to retract and protect the nerve outside the canal during the treatment of the nerve transposition.

MATERIALS AND METHODS

A literature search was carried out using PubMed (1977–2012) with the following keywords: *IAN lateralization*, *IAN transposition*, *IAN reposition*, *nerve retraction, inferior alveolar nerve injury*. The articles were written in English. In this review, 50 articles were found; of these, 24 were selected. Articles that described only the N.R. procedure without describing the nerve retracting method or articles that had done the N.R. for another goal apart from implant treatment—such as the tumor ablation with IAN mobilization—were excluded. Only 12 articles explained their retraction method; we evaluated their methods and compared

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DOI: 10.5163/AAID-JOI-D-13-00108

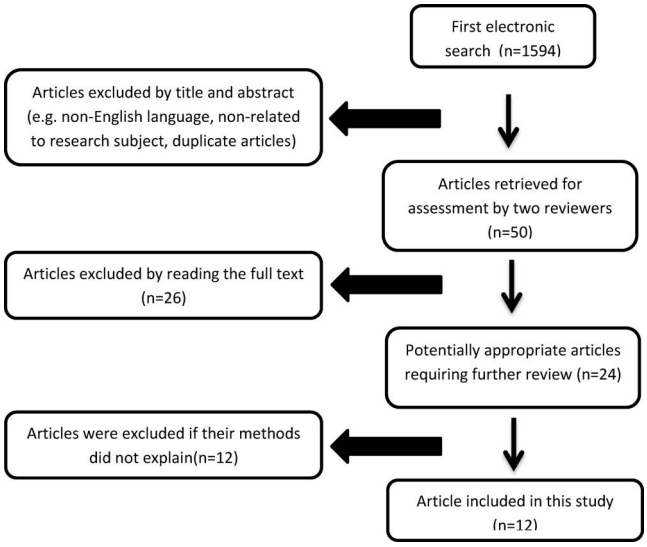


Figure 1. Search strategy.

them with our method (Figure 1). In addition, we used other articles' details in this current article.

Technique

One of the most important steps in the N.R. procedure is nerve retraction during the drilling and insertion of implant. In this technique, a low-thickness elastic tape, such as pre-packaged sterile Latex Penrose Drain (Medline Industries, Mundelein, Ill) or low-thickness Latex tape (a piece of sterile surgeon's gloves) can be used. In patients who are at the risk for Latex reaction, the pre-packaged sterile Latex-free (silicone) Penrose Drains (Medline Industries, Mundelein) or a piece of Latex-free surgeon's gloves can be used as a retractor.

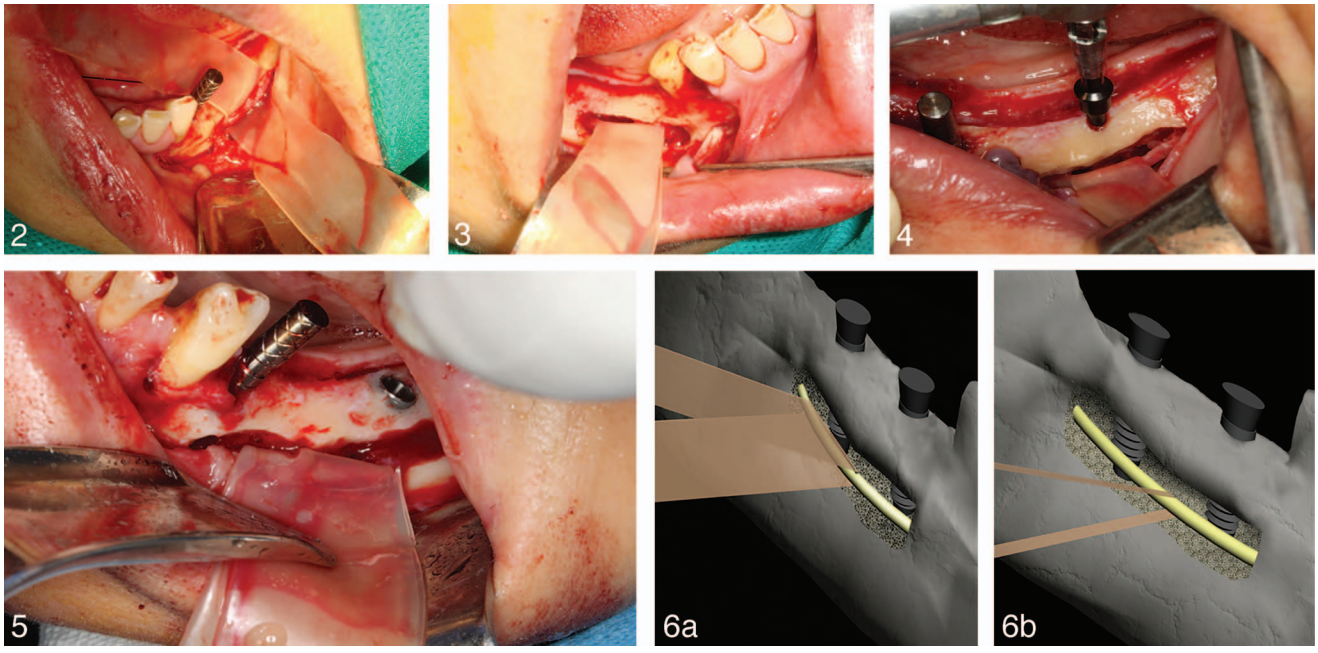
After removing the bone from the buccal wall of the canal, the nerve will be released and gently removed from the canal using a nerve hook. The hook should be rounded at the end and polished. At this point, to keep the nerve away from the drilling position and avoiding nerve damage, the nerve should be kept far from the area during the procedure.

At this point, a low-thickness elastic tape with a width of approximately 20 mm (the width can be changed according to the surgical site) will be prepared and cautiously passed along the exposed released nerve and exit the other side (Figure 2). By applying moderate force, the nerve moves away from the surgery site during the drilling and implant insertion. Then, both ends of the tape can be harnessed through a hemostat forceps and kept away from the site (Figures 3–5). At the end of the surgery and after inserting the implants, the elastic tape will be slowly removed and the nerve will be placed in the canal beside the implants.

The authors have used this technique in more than 25 cases of N.R. surgery. The technique is simple and feasible, and the retraction and protection of the nerve is well performed.

Discussion

Following the N.R. surgery, complications such as neurosensory problems, infection, osteomyelitis, and temporary weakness of the mandible may occur along with an increased risk of mandibular fractures. The most common sensory complications following the nerve reposition are hypoesthesia, paresthesia, and hyperesthesia. The most common causes of nerve



Figures 2–6. Figure 2. A low-thickness wide elastic tape will be prepared and cautiously passed along the exposed and released nerve, exiting on the other side. **Figure 3–5.** By applying moderate force, the nerve moves away from the surgery site during the drilling and implant insertion. **Figure 6.** Contact between the nerve and the retractor should be in the form of (a) a contact area rather than (b) a contact point. Avoid forming a contact point between the retracting tape and the nerve.

Table

Most important papers concerning the nerve retraction method during nerve repositioning

Authors	Number of patients	Retraction technique	Follow-up (Month)	Comments
Nock & Jensen[10]	1	Looped suture	30	Severe contact point, without elastic property, high risk of ischemia and neurosensory disturbance.
Rosenquist[11]	10	Vessel loop	18	More than contact point but insufficient, insignificant elastic property and high risk of ischemia
Rosenquist[12]	100	Vessel loop	12–18	
Kan et al[13]	15	Vessel loop	1–67	
Del Castillo-Pardo et al[14]	1	Vessel loop	6	
Bovi et al[15]	1	Vessel loop	4	
Bovi et al[16]	9	Vessel loop	36	
Babbush[17]	Not described	Umbilical tapes	Not described	Contact area, but without elastic property
Hashemi[19]	11	Green cloths	6	More than contact point but not sufficient; high risk of sudden movement (high tension to the nerve, especially for rubber piston)
Hashemi[20,21]	87	A piece of a suture cover Half of the rubber piston of a dental cartridge	12	
Vasconcelos et al[1]	1	Delicate spatula	7	More than contact point, Without any elastic property, risk of sudden tension to nerve, difficult handling.
Hassani et al	25	Elastic tape	20 (Mean)	Elastic property, contact area and cover large part of the nerve.

dysfunction include mechanical trauma to the nerve, ischemia following extracting the bundle from the canal, nerve traction during the surgery, edema, and probable hematoma or chronic compression after the surgery.[1–6] According to Hirsch and Branemark,[5] the main cause of sensory disturbances is impairment of the metabolic supply due to the disturbed microvascular circulation of the nerve fibers by the mechanical trauma. This problem usually occurs in all patients and will resolve in about 97% of patients after 6–12 months if no serious damage was caused to the nerve.[2,7–9] The nerve damage and subsequent sensory disturbances may occur in various procedures of the N.R surgery: in the stage of flap design, ostectomy, removing the nerve from the canal, getting the nerve out of the canal, keeping it away from the site, and returning the nerve to the canal. One of the most important times that nerve damage can happen is when the nerve is outside the canal and drilling for implant insertion is being conducted. At this time, since the nerve has maintained its extension along the canal, it tends to return to the canal because it is under tension. If the nerve returns to the canal at this time, it will suffer irreparable mechanical damage in collision with rotary instruments. Therefore, the importance of nerve retraction is clear at this point.

To date, several methods have been reported for nerve retraction. In 1987, Nock and Jensen[10] performed the N.R for the first time for dental implant insertion in the posterior areas of the mandible. They used a looped suture as a nerve retractor to keep the nerve away from the surgical site.[10] In 1992, Rosenquist[11] conducted the first case series on 10 patients using 26 implants.

Rosenquist,[11,12] Kan et al,[13] Del Castillo-Pardo et al,[14] and Bovi et al[15,16] used vessel loops in their surgeries as nerve retractors. Babbush[17,18] proposed the use of umbilical tapes for retracting the nerve during the surgery. In different reports, Hashemi[19–21] proposed the use of green cloths, a piece of a suture cover, and half of the rubber piston of a dental cartridge. Vasconcelos et al[1] used a delicate spatula as a nerve retractor in their surgeries (Table).

It should be noted that the inferior alveolar nerve is a polyfascicular nerve. The smaller the number of nerve fascicles and thicker the epineurium make the IAN more resistant to pressure and vice versa. (The greater the number of fascicles and the thinner the epineurium, the less resistant the nerves are to pressure.[22,23])

Given that the number and volume of fascicules are greater than epineurium in the nerve bundles of the inferior alveolar nerve, it is more susceptible to damage in mechanical traumas, especially pressure trauma.[24] Therefore, it should be noted that pressure on the nerve should be avoided as much as possible.

To achieve this result, the contact area of the retractor and the nerve are very important. According to physics law, there is an inverse relationship between the pressure and the contact area. With constant force, if the contact area is increased, the pressure to the nerve will decrease (pressure = force/area). Therefore, we suggest using the wide elastic tape based on the increase of the contact area of the retractor with the inferior alveolar nerve, that is, conversion of the contact point into the contact surface and, subsequently, the decrease of pressure on the nerve (Figure 6). Using a looped suture and vessel loop through creating a point contact between the retractor and the nerve leads to applying a great deal of pressure at the contact area to the nerve and, thus, causes ischemia, nerve damage, and an increased risk of sensory disturbances. Moreover, using green cloths, a piece of a suture cover, and half of a rubber piston may be slightly associated with increase of the contact area to the looped suture. Not only is this contact surface insufficient, the probability is very high of sudden shift and movement of these retractors and the collision of nerve with rotary instruments during drilling. Among the methods, using umbilical tape (wide elastic tape) can reduce the pressure on the nerve and subsequently reduce the risk of sensory problems after the surgery by increasing the contact surface between the retractor and the nerve.

However, two points distinguish these two methods from each other: First, elastic properties. When umbilical tape is used, the entire retraction force will be applied to the nerve because of the absence of elastic properties. This will again increase the risk of local ischemia. However, when the wide elastic tape is used, a part of retraction force will be neutralized due to the elastic properties of this tape, and the minimum pressure will be applied to the nerve. Moreover, due to the wide nature of elastic tape, a large part of the nerve relocated from the canal will be covered by the retractor and protected from possible local damage. These points decrease the risk of local ischemia and, subsequently, reduce the risk of neurosensory disturbances after the surgery. The second point is the glossy surface of elastic tape. The surface of umbilical tape is rough because it is made of gauze; if the umbilical tape gets dry for any reason, it can cause surface damage to the nerve. However, in regard to the surface properties of elastic tape at the time of its application as a retractor, the contact area between the nerve and the elastic is constantly wet, and the nerve is in contact with a smooth surface at all times; the risk of nerve damage is decreased.

Therefore, during and after the surgery, care must be taken to decrease factors affecting the incidence of ischemia and mechanical damage. Moreover, to achieve the goal, it is necessary to try to convert the contact and tension points into the contact surfaces during the N.R, and avoid any excessive tension and pressure to the nerve.

Conclusion

Repositioning of the inferior alveolar nerve is a procedure that carries a risk of permanent damage to the nerve. As we know, the most important complication of this procedure is neurosensory disturbance. Accordingly, the key to success is prevention of this problem. This method is very simple and can protect the IAN in a safe place during the procedure. In addition, use of elastic material can reduce the risk of nerve damage during retraction.

Abbreviations

IAN: inferior alveolar nerve

N.R.: nerve repositioning

References

1. Vasconcelos Jde A, Avila GB, Ribeiro JC, Dias SC, Pereira LJ. Inferior alveolar nerve transposition with involvement of the mental foramen for implant placement. *Med Oral Patol Oral Cir Bucal*. 2008;13:E722–725.

2. Chrcanovic BR, Custodio AL. Inferior alveolar nerve lateral transposition. *Oral Maxillofac Surg*. 2009;13:213–219.

3. Karlis V, Bae RD, Glickman RS. Mandibular fracture as a complication of inferior alveolar nerve transposition and placement of endosseous implants: a case report. *Implant Dent*. 2003;12:211–216.

4. Vasco MA, Hecke MB, Bezzon OL. Analysis of short implants and lateralization of the inferior alveolar nerve with 2-stage dental implants by finite element method. *J Craniofac Surg*. 2011;22:2064–2071.

5. Hirsch JM, Branemark PI. Fixture stability and nerve function after transposition and lateralization of the inferior alveolar nerve and fixture installation. *Br J Oral Maxillofac Surg*. 1995;33:276–281.

6. Proussaefs P. Inferior alveolar nerve transposing in a situation with minimal bone height: a clinical report. *J Oral Implantol*. 2005;31:180–185.

7. Jensen J, Reiche-Fischel O, Sindet-Pedersen S. Nerve transposition and implant placement in the atrophic posterior mandibular alveolar ridge. *J Oral Maxillofac Surg*. 1994;52:662–668.

8. Peleg M, Mazor Z, Chaushu G, Garg AK. Lateralization of the inferior alveolar nerve with simultaneous implant placement: a modified technique. *Int J Oral Maxillofac Implants*. 2002;17:101–106.

9. Friberg B, Ivanoff CJ, Lekholm U. Inferior alveolar nerve transposition in combination with Branemark implant treatment. *Int J Periodontics Restorative Dent*. 1992;12:440–449.

10. Jensen O, Nock D. Inferior alveolar nerve repositioning in conjunction with placement of osseointegrated implants: a case report. *Oral Surg Oral Med Oral Pathol*. 1987;63:263–268.

11. Rosenquist B. Fixture placement posterior to the mental foramen with transpositioning of the inferior alveolar nerve. *Int J Oral Maxillofac Implants*. 1992;7:45–50.

12. Rosenquist B. Implant placement in combination with nerve transpositioning: experiences with the first 100 cases. *Int J Oral Maxillofac Implants*. 1994;9:522–532.

13. Kan JY, Lozada JL, Goodacre CJ, Davis WH, Hanisch O. Endosseous implant placement in conjunction with inferior alveolar nerve transposition: an evaluation of neurosensory disturbance. *Int J Oral Maxillofac Implants*. 1997;12:463–471.

14. Del Castillo Pardo de Vera JL, Chamorro Pons M, Cebrin Carretero JL. Repositioning of the inferior alveolar nerve in cases of severe mandibular atrophy. A clinical case. *Med Oral Patol Oral Cir Bucal*. 2008;13:E778–E782.

15. Bovi M. Mobilization of the inferior alveolar nerve with simultaneous implant insertion: a new technique. Case report. *Int J Periodontics Restorative Dent*. 2005;25:375–383.

16. Bovi M, Manni A, Mavriqi L, Bianco G, Celletti R. The use of piezosurgery to mobilize the mandibular alveolar nerve followed immediately by implant insertion: a case series evaluating neurosensory disturbance. *Int J Periodontics Restorative Dent*. 2010;30:73–81.

17. Babbush CA. Transpositioning and repositioning the inferior alveolar and mental nerves in conjunction with endosteal implant reconstruction. *Periodontol 2000*. 1998;17:183–190.

18. Babbush CA, Hahn JA, Krauser JT, Rosenlicht JL. *Dental Implants: The Art and Science*. 2nd ed. London, UK: Saunders Elsevier; 2010.

19. Hashemi HM. Neurosensory function following mandibular nerve lateralization for placement of implants. *Int J Oral Maxillofac Surg*. 2010;39:452–456.

20. Hashemi HM. A modified technique of inferior alveolar nerve repositioning: results in 11 patients. *Acta Medica Iranica*. 2006;44:273–276.

21. Hashemi HM. Retraction of the inferior alveolar nerve during implant insertion using the rubber piston of a dental anaesthetic cartridge. *Asian J Oral Maxillofac Surg*. 2006;18:134–135.

22. Hassani A, Saadat S. Nerve repositioning injuries of the trigeminal nerve. In: Miloro M, ed. *Trigeminal Nerve Injuries*. 1st ed. Berlin: Springer-Verlag; 2013:109–135.

23. Colella G, Cannavale R, Vicidomini A, Lanza A. Neurosensory disturbance of the inferior alveolar nerve after bilateral sagittal split osteotomy: a systematic review. *J Oral Maxillofac Surg*. 2007;65:1707–1715.

24. Hassani A, Kalantar Motamedi MH, Saadat S. Inferior alveolar nerve transpositioning for implant placement. In: Kalantar Motamedi MH, ed. *A Textbook of Advanced Oral and Maxillofacial Surgery*. 1st ed. Coatia: InTech; 2013:659–693.