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Neurosensory issues after lateralisation of the inferior alveolar nerve and simultaneous placement of osseointegrated implants

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Abstract

Our aim was to evaluate neurosensory symptoms after lateralisation of the inferior alveolar nerve (IAN). We studied a retrospective case series with one-year follow up that included 139 procedures in 123 patients. After the IAN had been located it was deflected from the mandibular body and the implant placed. Sensitivity was mapped 24 hours, one month, six months, and one year after the intervention by gently pressing the skin and lips with the tip of a probe. A total of 337 implants were placed in 123 patients aged between 44 and 68 years.

There were 33 men and 90 women and they all recovered. The IAN was mobilised by one of two procedures, one that involves the nerve directly (transposition) and one that does not (lateralisation). During lateralisation the nerve is deflected laterally through a mandibular osteotomy, while the mental nerve and mental foramen are not manipulated. The resulting hypoaesthetic area was drawn on a graph to assess its extension. Although different techniques are available for placing implants in atrophic jaws, mobilisation of the IAN is indicated in certain cases in which other techniques are not feasible or have a high risk of complications.

Keywords: bone implant interactions; wound healing; implant; lateralization; soft tissue management; surgical procedure

Introduction

There are two valid techniques for lateral mobilisation of the inferior alveolar nerve (IAN), transposition and lateralisation (Fig. 1). Transposition is the lateral mobilisation of the IAN through an osteotomy of the mandibular body (from, and including the mental foramen) to a point distal to the insertion of the furthest planned implant, and moving both the IAN and the mental nerve. Lateralisation consists in the lateral deflection of the IAN through an osteotomy of the mandibular body, without manipulating the IAN or the mental foramen. The incisor nerve is preserved, as is the emergence of the IAN through the mental foramen.

The main goal of this study was to evaluate the development of nervous symptoms after lateralisation of the IAN.

Material and methods

We retrospectively studied a case series with a one-year follow up that included a total of 139 operations on 123 patients by the same surgeon. During the preoperative examination, patients were asked to sign a consent form and were given the American Society of Anesthesiologists' (ASA) questionnaire. The exclusion criteria were: earlier radiotherapy of the involved area; taking bisphosphonates; mouth opening of less than 25 mm; previous implants in the mandible; smoking; and

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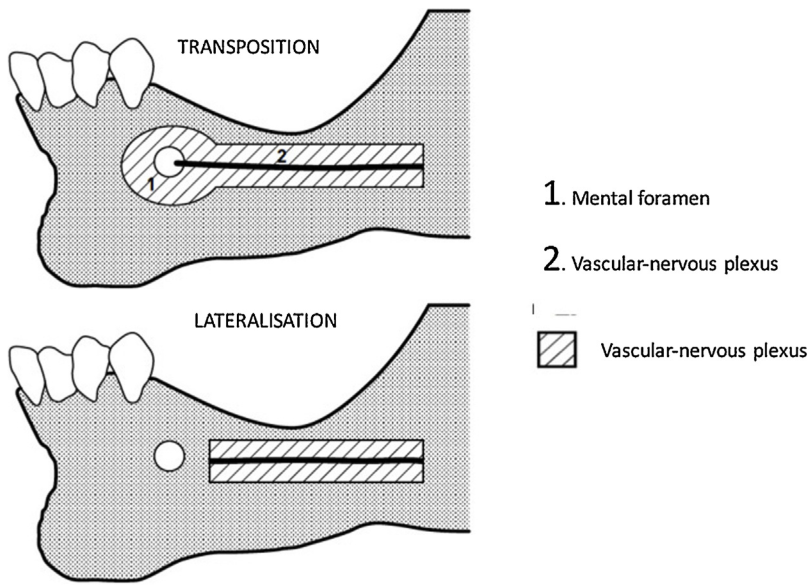

Fig. 1. Technique of transposition compared with lateralisation.

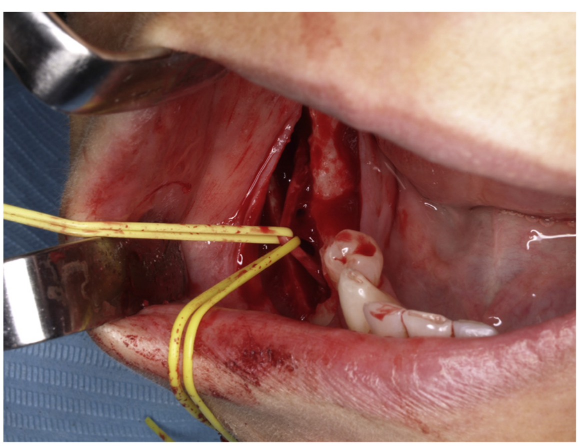

Fig. 2. Lateralisation of the inferior alveolar nerve.

Fig. 3. Mapping of the fine touch test.

previous neurosensory issues as a result of trauma, tumour, or cancer. The inclusion criteria were: posterior partial edentulism with the occlusal vertical dimension preserved.

The distance between the ridge and the position of the mental foramen was measured on a panoramic radiograph (Pax-Flex 3D, Vatech Global). Given that the apparatus was equipped with 3-dimensional technology, it was possible to make accurate measurements on the 2-dimensional image of the site of the alveolar nerve relative to the bony ridge and of the buccal and lingual bony plates.

Once the nerve had been located it was moved away from the jaw. As soon as it was verified that the nerve was free from the bony duct, gentle traction was applied with a nerve hook. One or two vessel loops (Sterion® Vessel Loop) were placed around it to separate it from the mandibular body, and the implants were put in place (Fig. 2). Sensitivity was mapped for 24 hours, one month, six months, and one year postoperatively by gently pressing the skin and lips with the tip of a probe (Fig. 3).

Results

The results are shown in Table 1. All patients recovered completely, although at different times after the intervention.

Discussion

Jensen and Nock in 1987 were the first to associate mobilisation of the IAN with placement of osseointegrated implants.[1] In 1992 Rosenquist presented 10 cases of transposition of the IAN followed by placement of implants[2] and reported disturbances in two cases six months postoperatively, and complete full functional recovery one year later. Two years later, he published a series that included his first 100 cases.[3]

Table 1
Results in 123 patients.

Variable	Number
Sex:	
Male	33
Female	90
Mean (range) age (years)	55(44-68)
No. of implants:	
One	147
Two	85
Five	5
Total	337
Site of implants:	
Unilateral	107
Bilateral	16
Total	139
Extent of improvement at 139 sites:	
No impairment of function of the nerve	7
Improvement after one month	34
Improvement after six months	72
Improvement after a year	26

The IAN is mobilised by one of two different techniques, one that involves the nerve directly (transposition) and one that does not (lateralisation). During transposition, an osteotomy is made of the mandibular body from (and including) the mental foramen to a point distal to the insertion of the furthest planned implant. The nerve is then deflected laterally, together with the mental nerve. A new, more posterior mental foramen is created for the IAN to emerge, and the incisor bundle is transected. This procedure entails a risk of paraesthesia and should not be used if other options are available.[4] Testing of the vitality of the lower teeth by irrigation and innervation yields unhelpful results in most cases, as verified by Khajehahmadi et al with pulse oximetry and electric testing of the pulp.[5] Conversely, lateralisation of the IAN consists of its lateral reflection by an osteotomy of the mandibular body without manipulating the mental nerve and foramen. The incisor bundle is preserved, and the IAN emerges through the mental foramen.

Neurosensitivity can be studied objectively using various clinical tests.[6] We used the light touch test and sensitivity mapping by applying moderated pressure with a periodontal probe to depress the skin by 1–2 mm. We have shown the hypoaesthetic area as a graphic to illustrate its extension (Fig. 4). Such testing was used on the day after operation, and one, six, and 12 months later. We chose this technique because it selects the dysfunction of rapidly-adapting long myelinated fibres, which are 90% of the fibres of the IAN.[7] Conversely, other techniques, such as two-point discrimination, selectively assess low-adapting long myelinated fibres, which are only 10% of the fibres of the IAN.

Kan et al compared 21 procedures to mobilise the nerve: nine transpositions and 12 lateralisations.[7] They found nervous disturbances in seven of the transpositions and four of the lateralisations. To study neurosensory disturbances, they combined the light touch test, assessment of the direction of the brush stroke, and the two-point discrimination test, and reported that 11/21 patients were affected 10 months after the intervention, but they did not monitor the patients at any other time.

Fig. 4. The hypoaesthetic area.

Disturbed areas gradually reduced, with a similar pattern in all patients. First, hypoaesthesia was seen in the integuments close to the treated hemimandible, skin, and vestibular gum. The lingual gum was not disturbed by this, because it depends on the lingual nerve that detaches from the inferior dental nerve higher up. As sensitivity gradually recovered there was progressive reduction of the hyposensitive area, which retracted centripetally towards the high mental and sublabial regions. As recovery from hyposensitivity approached, patients reported annoying intermittent, electric shock-like sensations and later some patients also reported tickling, and some reported burning, sensations.

Painful stimuli are the first signs of recovery of normal function. When they are an initial symptom, but persist for more than a month, re-examination is necessary under anaesthesia. If the blockade does not relieve the pain, disturbance of the central rather than the peripheral nerve should be suspected.

Variations of the technique have been proposed to improve its results. Fernández-Díaz and Naval Gías[8] postulated that the use of ultrasound equipment to create the surgical window and remove the spongy tissue surrounding the IAN could shorten the time required to recover normal nervous function, probably because of milder local inflammation as a result of the cavitation phenomenon described for this equipment. However, Gasparini et al[9] failed to find any significant differences between the use of a piezotome and the use of rotary burs mounted on a handpiece, diamond discs, or dental saws.

A further way to improve the nerve response to this technique is to protect it after moving it back to its site against the fixtures. Replacing the osteotomy window when it has been removed en bloc,[2] or placing a biological barrier prepared from the patient's blood with platelet-rich plasma, have been tried.[10] We used fibrin glue (Tissucol) in 14 cases (among the first in the series), but found no differences in the nerve response, so we do not think that it helps to prevent disturbances in nervous function.

Ferrigno et al reported 19 lateralisations,[11] although the title of their study refers to transposition. They used a round diamond bur for osteotomy, curettes to remove the medullary layer, and resorbable membranes to close the window, and they followed up their patients two weeks postoperatively and then at months 1, 2, 3, 6, 12, and 24. Two weeks after the intervention nine patients had no nervous disturbance, but they found nervous disturbances in six cases at one month, in two at six months, and in one at one year postoperatively. One also presented with some disturbance after one year, and another patient had a spontaneous fracture three weeks after the intervention.

In a trial in rabbits that were treated by lateralisation and placement of an implant, Yoshimoto et al[12] studied possible nervous alterations microscopically. They found that all these changes produced structural damage to the nerve tissue and that this tissue regenerated in response – a process that lasted about eight weeks. They also postulated that regeneration of the surrounding bone provided protection to the nerve by isolating it from non-osseous tissue (through the surgical window) and from the implant. These data are in line with ours, where 100 (81%) of 123 patients recovered normal function within the first six months postoperatively. These figures also correlate with those from Fernández et al,[8] Gasparini et al,[9] and Hashemi.[13] Hashemi carried out 110 procedures in 87 patients (23 bilateral) and found nervous disturbances in all cases one week postoperatively (81 sites presented with anaesthesia, nine with hypoaesthesia, nine with a burning sensation, eight with dysaesthesias, two with itching, and one with tingling). In 26 of the patients this was still present at one month, and in three at six months (and in the three it remained permanent, although it corresponded to a tingling sensation).[13]

Fernández-Díaz and Naval-Gías[8] reported 19 operations in 15 patients who were managed with piezotome lateralisation, and recorded disturbances of some kind in all patients during the first week, but they persisted in only one patient eight weeks later. Two years later, only one patient reported slight hypoaesthesia. Unlike us and others, these authors reported a higher normalisation rate over a shorter period, which we think could be related to the use of a piezotome for the osteotomy. The piezotome cuts only the bone through ultrasound vibrations, which preserves the soft tissues. In addition, through the cavitation phenomenon (microvascular obstruction), it considerable reduces oedema at the surgical site (which may compress the nerve).

Rosenquist[2] recorded neurosensory disturbances that persisted 18 months after the intervention in six patients out of 100, and other authors reported persistence of nervous disturbance some months or years after lateral mobilisation of the alveolar nerve.[1,2,12,14–16] In our study, normal function was observed in all cases by one year after the intervention, and we had no case of permanent disturbance.

In 2014, Vetromilla et al [17] published a review of 24 papers, which included 125 patients treated with lateralisation and 150 treated with transposition. The authors reported that neurosensory disturbances were initially found in 120 of the patients treated by lateralisation. However, by the end of follow up, disturbances persisted in only four of them. Regarding transposition, 88 patients presented with initial neurosensory disturbances, while a striking 33 still had disturbances by the end of follow-up. Two conclusions can be drawn from this study. First, transposition seems to generate fewer neurosensory disturbances in the immediate postoperative period and, secondly, more patients who present with initial alterations have long-term neurosensory consequences when treated with transposition than with lateralisation (up to 10 times more: 3.54% compared with 37.5%). However, the number of authors involved in this review may be an issue, as when the studies were analysed individually the results were highly disparate.

Abayev and Juodzbalys[18] systematically reviewed 21 papers, which comprised 638 procedures on 378 patients. Ten of the studies concerned transposition and seven lateralisation, and four concerned both procedures. They found that 634/638 procedures generated transient nervous disturbances of some kind, while only 2/378 caused permanent disturbances.

Conclusion

Although different surgical techniques are available for placing implants in atrophic jaws, mobilisation of the IAN is indicated in certain cases in which other techniques are not feasible.

Ethics statement/confirmation of patients' permission

All investigations and procedures conformed to the Declaration of Helsinki, and patients gave their signed informed consent.

Conflict of interest

We have no conflicts of interest.

References

1. Jensen O, Nock D. Inferior alveolar nerve repositioning in conjuntion with placement of osseointegrated implants: a case report. *Oral Surg Oral Med Oral Pathol* 1987;**63**:263–8.
2. 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.
3. Rosenquist B. Seek and you shall find. *J Oral Maxillofac Surg* 1994;**52**:431.

4. Oikarinen K, Raustia AM, Hartikainen M. Prosthetic possibilities using endosseal implants as anchorages - an epidemiological study in 65-year-old subjects. *J Oral Rehabil* 1995;**22**:403–7.
5. Khajehahmadi S, Rahpeyma A, Bidar M, et al. Vitality of intact teeth anterior to the mental foramen after inferior alveolar nerve repositioning: nerve transpositioning versus nerve lateralization. *Int J Oral Maxillofac Surg* 2013;**42**:1073–8.
6. Bhat P, Cariappa KM. Inferior alveolar nerve déficits and recovery following surgical removal of impacted mandibular third molars. *J Maxillofac Oral Surg* 2012;**11**:304–8.
7. Kan J, Lozada JL, Goodacre CJ, et al. Endosseous implant placement in conjunction with inferior alveolar nerve transposition: an evaluation of neurosensory disturbance. *Int J Oral Maxillofac Implants* 1997;**12**:463–71.
8. Fernández Díaz JO, Naval Gías L. Rehabilitation of edentulous posterior atrophic mandible: inferior alveolar nerve lateralization by piezotome and immediate implant placement. *Int J Oral Maxillofac Surg* 2013;**42**:521–6.
9. Gasparini G, Boniello R, Saponaro G, et al. Long term follow-up in inferior alveolar nerve transposition: our experience. *Biomed Res Int* 2014;**2014**:170602.
10. Kjølle GK, Bjørnland T. Low risk of neurosensory dysfunction after mandibular third molar surgery in patients less than 30 years of age. A prospective study following removal of 1220 mandibular third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;**116**:411–7.
11. Ferrigno N, Laureti M, Fanali S. Inferior alveolar nerve trasnposition in conjuntion with implant placement. *Int J Oral Maxillofac Implants* 2005;**20**:610–20.
12. Yoshimoto M, Watanabe I, Martins M, et al. Microstructural and ultrastructural assessment of inferior alveolar nerve damage following nerve lateralization and implant placement: an experimental study in rabbits. *Int J Oral and Maxillofac Implant* 2009;**24**:859–65.
13. Hashemi HM. Neurosensory function following mandibular nerve lateralization for placement of implants. *Int J Oral Maxillofac Surg* 2010;**39**:452–6.
14. Friberg B, Ivanoff CJ, Lekholm U. Inferior alveolar nerve transposition in combination with Branemark implant treatment. *Int J Periodontics Restorative Dent* 1992;**12**:440–9.
15. Hori M, Sato T, Kaneko K, et al. Neurosensory function and implant survival rate following implant placement with nerve transpositioning: a case study. *J Oral Sci* 2001;**43**:139–44.
16. Proussaefs P. Inferior alveolar nerve transposing in a situation with minimal bone height: a clinical report. *J Oral Implantol* 2005;**31**:180–5.
17. Vetromilla BM, Moura LB, Sonego CL, et al. Complications associated with inferior alveolar nerve repositioning for dental implant placement a systematic review. *Int J*. *Oral Maxillofacial Surg* 2014;**43**:1360–6.
18. Abayev B, Juodzbalys G. Inferior alveolar nerve lateralitation and transposition for dental implant placement Part II: a systematic review of neurosensory complications. *J Oral Maxillofac Res* 2015;**6**:e3.