Mental Nerve Function After Inferior Alveolar Nerve Transposition for Placement of Dental Implants

(Fonctionnement du nerf mentonnier après une transposition du nerf alvéolaire inférieur pour la mise en place d'implants dentaires)

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Sommaire

Contexte : *Une possibilité pour une mise en place réussie d'implants dentaires sur une mandibule postérieure atrophiée sans blesser le nerf alvéolaire inférieur consiste à transposer ou latéraliser le nerf. Cette technique comporte le risque d'un engourdissement le long de la distribution du nerf. Pourtant elle est utilisée avant tout pour éviter cette complication. L'objectif de la présente étude consistait à évaluer le fonctionnement du nerf mentonnier après une transposition du nerf alvéolaire inférieur.*

Méthodologie : *Nous avons examiné les résultats de 20 interventions de transposition du nerf alvéolaire inférieur chez 12 patients au Queen Elizabeth II Health Sciences Centre, à Halifax, en Nouvelle-Écosse. L'étude comportait des examens objectifs du fonctionnement du nerf sensoriel ainsi qu'une évaluation subjective par les participants.*

Résultats : *Tous les sujets ont déclaré avoir eu dans un premier temps des troubles sensoriels transitoires. Un examen objectif réalisé au moins 6 mois après l'intervention a révélé que chez tous les patients, les zones affectées avaient le même niveau de sensibilité que les zones qui n'avaient pas été opérées. Quatre-vingt pour cent des patients ont déclaré que la sensibilité de leur lèvre inférieure et de leur menton était normale. Les autres patients ont dit que la sensibilité de ces structures n'était pas tout à fait normale, mais que la différence ne tirait pas à conséquence.*

Importance clinique : *L'étude permet de conclure que l'on peut procéder à une transposition du nerf alvéolaire inférieur sans danger et de manière prévisible avec peu de risque pour la sensibilité du nerf mentonnier.*

Mots clés MeSH : *dental implants; mandibular nerve/physiology; mandibular nerve/surgery*

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Osseointegrated dental implants are often placed in the posterior mandible, mostly for support of fixed restorative prostheses. In many cases the bone has atrophied, such that sufficiently long fixtures cannot be placed without encroaching on the inferior alveolar nerve (IAN). In that situation, restorative options include use of short fixtures, onlay bone grafting to increase ridge height, and more complicated and detailed imaging studies to allow positioning of implants alongside and not into the nerve canal during the procedure. Another option is to move the IAN laterally from its canal by either nerve lateralization or nerve transposition.

With nerve lateralization the IAN is exposed and traction is used to deflect it laterally while the implants are placed. The IAN is then left to fall back in against the fixtures. There is no interference with the incisive nerve. With nerve transposition a corticotomy is done about the mental foramen and the incisive nerve is transected, such that the mental foramen is repositioned more posteriorly.

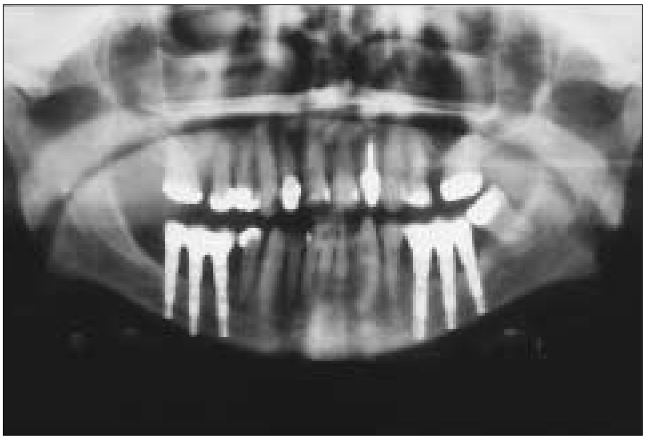

Figure 1: *Post-treatment Panorex image showing implant placement after nerve transposition. The inferior cortex of the mandible is engaged for optimum osseointegration.*

In the posterior mandible the bone quality may not be as good as it is in the anterior mandible. In particular, if shorter implants are used to ensure that there is no encroachment on the nerve canal, initial implant stability will be unicortical. In addition, there is always a risk to the IAN as the operator tries to maximize implant length on the basis of measured available bone height.

Not surprisingly, the advantages of IAN transposition include the ability to place longer fixtures and to engage 2 cortices for initial stability (Fig. 1). These features are especially useful when placing one-stage implants, an approach that is becoming the standard elsewhere in the jaws. Using this technique avoids the need for additional radiation-intensive and costly imaging studies. Simple panoramic radiography and clinical examination are all that is required.

The inherent risk of this surgical procedure is damage to the IAN, with resultant neurosensory disturbance to the mental nerve. It is therefore important to establish the relative risk of this occurring, since avoiding such problems is the very reason the procedure is done in the first place. Since this surgery is delicate, it is best performed under a general anesthetic to eliminate patient movement and to maximize access.

Transposition of the IAN also results in the loss of sensation of its terminal incisive branch. This is of no consequence for people who are edentulous in the anterior mandible, but it may cause some disturbance to residual dental and periodontal sensibility in any remaining anterior teeth.

Kan and others[1] pointed out that the amount of bone superior to the IAN canal is often insufficient for placement of fixtures of the desirable length. In addition, the bone that is present superior to the IAN canal is often of poorer quality than its cortical counterpart. These factors and the fact that shorter implants have been associated with higher failure rates[2,3] have led to the development of methods of IAN displacement that allow placement of longer fixtures; with these methods the inferior cortex of the mandible is engaged, which leads to greater initial stability. Apart from longer implants, IAN transposition allows for use of a greater number of implants, which improves the overall strength of the final prosthesis.[4]

The major clinical difficulty associated with IAN transposition is temporary or permanent dysfunction of the nerve, which patients report as altered sensation of the lower lip and chin. Conflicting results from studies that have determined the incidence of IAN dysesthesia with this procedure have created debate as to its appropriate use.

The first published report of IAN transposition for the placement of osseointegrated implants in the posterior mandible appeared in 1987.[5] According to subjective criteria, sensory function of the mental nerve returned to normal 5 weeks after surgery. Unfortunately, no objective neurosensory testing was performed.

In 1992 Rosenquist[6] reported on 10 IAN transposition operations with implant placement involving mental foramen osteotomy. This modification allowed for more complete dissection of the mental nerve complex and theoretically less traction on the IAN itself. Neurosensory function of the mental nerve was assessed objectively with the 2-point discrimination method. At one year, all 10 sites tested normal, and the success rate for implants placed with this procedure was 96%.

A similar study reported on 9 sites at which IAN transposition with mental foramen osteotomy and incisive nerve transection was performed for placement of posterior mandibular implants.[7] On follow-up at 6 months, sensation in the mental nerve distribution was normal at 7 sites, whereas one site was paresthetic and one site was hypoesthetic.[7] However, no description of the neurosensory testing was provided. These findings are supported by a study reporting on subjective and objective neurosensory testing of the mental nerve region after IAN transposition with mental foramen osteotomy at 10 sites. On follow-up at 12 months, all 10 sites were reported as normal by subjective assessment. According to the objective measure of 2-point discrimination, 9 of the 10 sites were within normal limits.[7] Smiler[8] also reported a low incidence of permanent neurosensory dysfunction with this procedure, stating that none of the 10 patients he described had permanent disturbance of sensation in the mental nerve distribution. Likewise, in a study of 24 posterior mandibular segments where IAN transposition was performed during placement of implants, only 3 sites were abnormal on the basis of objective assessment, and all sites were reported as normal on the basis of subjective assessment.[9]

However, the reported incidence of neurosensory disturbance of the mental nerve after this procedure is not always low. In an investigation of the long-term neurosensory outcome of IAN displacement with and without mental foramen osteotomy, 9 of the 21 operations involved mental foramen osteotomy and incisive nerve transection whereas 12 involved IAN lateralization without incisive nerve transection.[1] Neurosensory testing over a mean follow-up period of 41 months included light touch, brush stroke direction and 2-point discrimination. In the patients who underwent mental foramen osteotomy, 7 of the 9 sites tested abnormal with objective assessment, whereas only 4 of the 12 sites in the nerve lateralization group tested abnormal. Overall, neurosensory deficits existed at 11 of the 21 sites tested.

Because of the variability in results reported thus far, further investigations of the long-term neurosensory outcome of this procedure are needed. Although objective testing may reveal sensory changes in most cases, nerve transposition is a worthwhile surgical procedure that does not cause severe sensory complaints.[10] Before undergoing this procedure, each patient should be advised of the chance of permanent nerve deficit throughout the distribution of the mental nerve.[11]

The aim of this study was to assess mental nerve function after IAN transposition and implant placement.

Materials and Methods

Using a retrospective design, we determined the outcomes of IAN transpositions performed on consecutive patients at the Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia, between September 1994 and December 1999. None of the patients underwent preoperative neurosensory testing. Patients considered eligible for the study had undergone the procedure at least 6 months before assessment, and those who participated gave informed consent. In all cases, the dental implants were placed at the time of nerve transposition. The same surgeon operated in all cases. Any patients who could not report back for objective testing were excluded from the study.

Surgical Technique

The same surgical procedure, IAN transposition, was performed on each patient. In this procedure, a mucosal incision superior to the mental foramen is extended from the midline area to the second molar region. The mental nerve is identified and the periosteum freely dissected from the surrounding mandibular bone. A unicortical lateral osteotomy is then fashioned around the mental foramen and is extended inferiorly and anteriorly so any “loop” of nerve is not interfered with during the osteotomy. Minimal retraction of the nerve is required, and there is no need for dissection of the nerve as it enters the soft tissue of the lip and chin.

Once the cortex has been removed, the incisive branch and the distal end of the IAN can be visualized. The incisive branch is severed with a scalpel, and the mental nerve and its IAN proximal portion can be freed from the canal. This allows the posterior course of the IAN in the canal to be appreciated. The lateral corticotomy is then extended posteriorly adjacent the canal. With the cortex removed, it is relatively easy to remove any remaining overlying bone with an instrument and to tease the nerve out of the mandible.

Once this has been done, the implants can be placed under direct vision through the canal and into or through the inferior cortex (Fig. 2). Finally, the excised bone can be replaced laterally around the implants as a bone graft. This is done simply to have bone surrounding the implant, on the assumption that this will encourage better integration. The IAN can then be left to lie passively alongside. In essence, the mental foramen has been moved posteriorly.

Figure 2: *Intraoperative view of nerve retraction and implant placement with direct visualization of engagement of the inferior cortex.*

Subjective Assessment

A questionnaire was administered to patients for subjective assessment of outcome. The questionnaire consisted of the following questions:

1. When you had your implants placed in conjunction with moving the nerve in your jaw, did you experience any of the following: numbness, pain, tingling?
2. If you experienced any of these how long did it last?
3. Do you presently have any areas of numbness, tingling or pain? Describe. If so, does this abnormal or lack of sensation bother you? Indicate on the diagram where this affected area is located.
4. Does it interfere with normal daily activities such as eating, speech or other functions?
5. Would you have had this procedure done, all things considered, knowing how you feel now and how you function with your implants?

Objective Assessment

In addition, patients underwent objective assessment of outcome. The following objective tests were performed:

1. 2-point discrimination test with sharp calipers;
2. static light touch test with cotton-tipped applicator;
3. brush-stroke directional discrimination with cotton-tipped applicator;
4. sharp/dull discrimination using caliper tip and pencil eraser.

The rationale for and an explanation of the testing were given to each patient. The results for the treated sites were

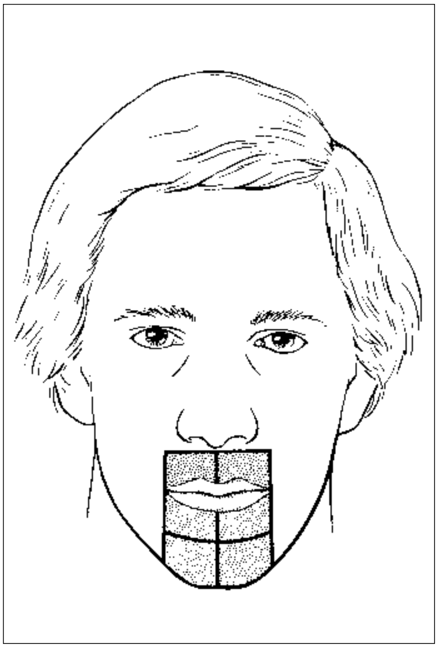

Figure 3: *Diagram used in objective neurosensory assessment. Shaded areas depict test and control sites.*

compared with results for the unoperated contralateral lip and chin area (in patients who underwent unilateral surgery) and the upper lip and paranasal regions (the infraorbital nerve distribution) for patients who underwent bilateral surgery. For each of the 4 tests, 20 randomly selected locations were tested: 5 in each mental nerve and infraorbital nerve distribution site (Fig. 3).

For the static light touch test, brush-stroke directional testing and sharp/dull discrimination, a correct response 80% of the time was considered to indicate normal sensibility.

Results

Fifteen patients underwent a total of 26 IAN transpositions between September 1994 and December 1999. Only 12 patients, accounting for 20 operative sites, were available for testing; the others could not return to Halifax for objective testing but stated that they had experienced no sensory or other disturbances with the lip or chin other than immediately after surgery. During telephone conversations with the investigators, each reported that sensation in the lip and chin had returned to normal. Of the 12 patients tested, 8 had undergone bilateral surgery and 4 unilateral surgery. The mean time to neurosensory testing was 16 months (range 6–60 months).

All of the patients reported initial change in sensation lasting approximately one month. According to long-term subjective assessment, 80% of the sites had returned to normal. Four patients (4 sites in total) reported that the change in sensation was persistent. When asked about the degree of abnormality, these patients said that they were not aware of it except when they tested and compared the affected area with other areas on the face. Each also stated that the abnormality was not bothersome and that it did not interfere with daily activities.

According to objective testing all sites were normal (i.e., had the same sensibility as control sites), including those that were subjectively reported as abnormal.

All implants had been placed with a 2-stage technique. All 30 of the implants that had been placed had successfully integrated. There were no infections, wound dehiscences, fractures or other major complications. One patient who underwent bilateral procedures experienced painful unilateral dysesthesia that lasted 3 months and required carbamazepine and then narcotics for pain control. The pain eventually subsided, and although detailed objective testing for this patient revealed normal sensation, she reported altered but not bothersome sensation.

No patients reported any interference with daily activities. All patients said that, all things considered, they would undergo the procedure again.

Discussion

No patients who underwent this procedure during the specified period were overlooked. The list of potential study participants included the first patient for whom the surgeon had performed this procedure. Of the 3 patients who were excluded from the study because of inability to return for testing, all reported an absence of sensory disturbances.

Although some might consider the need for general anesthesia a disadvantage of this technique, it does make placement of the implants easier with optimal control of patient-related factors, such as access, tongue movement and patient compliance.

Our experience indicates that implants are best placed at the same time as nerve transposition or lateralization. There is direct visualization of the nerve as the fixture location is prepared and the fixture placed through the IAN canal and inferior cortex. There is no advantage to performing nerve transposition or lateralization and implant placement during separate procedures; rather, such an approach would represent a disservice to the patient by incurring an unnecessary second surgery.

Conclusions

IAN transposition is a useful adjunct for managing the atrophic posterior mandible with dental implants. The risk of permanent dysfunction of the mental nerve appears small. ◆

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