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Research Article

TECHNIQUES OF INFERIOR ALVEOLAR NERVE TRANSPOSITIONING FOR IMPLANT PLACEMENT- A REVIEW OF LITERATURE

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ABSTRACT

Currently, dental implants are the most recommended treatment plan for edentulous ridges. Edentulous ridges tend to pose anatomical limitations owing to residual ridge resorption and adjacent anatomical structures, making the treatment plan challenging and costly for patients. Residual ridge resorption in the edentulous posterior mandible can result in a higher position of the inferior alveolar canal and its contents, posing a challenge for the installation of dental implants in the region. Various treatment plans have been suggested, such as bone grafting, the use of short dental implants, distraction osteogenesis, and repositioning of the inferior alveolar nerve. This article aimed to provide a comprehensive view of the use of inferior alveolar nerve repositioning, the surgical anatomy of the inferior alveolar nerve, current surgical techniques, and anticipated postoperative complications. It was concluded that all techniques used for inferior alveolar nerve repositioning have high success rates when precise treatment planning and surgical procedures are applied.

INTRODUCTION

Early loss of teeth in the posterior region of the jaw, accompanied by a failure to replace the lost teeth, along with systemic factors, has led to rapid alveolar ridge resorption in the mandibular region. Currently, treatment modalities to compensate for bone loss include bone grafting and implants. The major anatomical limitation is the inferior alveolar nerve, and reconstruction of the ridge is challenging. Various treatment options are available for the restoration of the residual alveolar ridge of the posterior mandible, including removable or fixed prosthetics and reconstruction of the dentoalveolar system with dental implants. Implant-based surgical plans have various advantages such as bone preservation and improved functionality. However, certain prerequisites must be met to successfully place an implant. The most important criteria are the quality and quantity of the bone. The level of the inferior alveolar nerve, amount of residual ridge resorption, and bone density limit implant placement. Reconstruction and rehabilitation of the dentoalveolar system in alveolar ridge atrophy is a challenge for oral surgeons and prosthodontists [1]. Techniques have been utilized for bone augmentation such as the use of bone grafts [2], cartilage [3], or hydroxyapatite [4], vestibuloplasty [5], and several osteotomy techniques [6] that have been suggested in the literature. Each of these techniques poses challenges, along with their respective advantages and disadvantages. This review explains the anatomy of the inferior alveolar nerve, the technique utilized for inferior alveolar nerve transpositioning, its advantages and disadvantages, and the adverse effects of this technique on the neurovascular bundle.

HISTORY

The first case of inferior alveolar nerve repositioning was reported by Alling in 1977 to rehabilitate patients with severe atrophy for dental prostheses[7] Jenson and Nock 1987 performed IAN transposition for the placement of dental implants in the posterior mandible [8]. in 1992, Rosenquist et al. performed the first case series study on 10 patients with 26 implants. They reported an implant survival rate of 96% for this procedure [9]. Therefore, this technique has become widely accepted for the reconstruction of the dentoalveolar system in the posterior mandible.

Anatomy of the Inferior Alveolar Nerve

The inferior alveolar nerve is the largest branch of the posterior division of the mandibular nerve. It runs down the medial side of the ramus mandibularis. From The medial side of the ramus enters the mandibular foramen in the pterygomandibular space. In the inferior alveolar canal, it gives off branches to the mandibular teeth as apical fibres that enter the apical foramina of the lower teeth to supply the dental pulp. When the inferior alveolar nerve reaches the mental foramen, it splits into two terminal branches. The mental nerve exits the body of the mandible through the mental foramen to transmit sensory fibres to the skin of the chin, lower lip and mucosa of the lower lip. A branch of the sensory fibres of the mylohyoid nerve enters the mandible in

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the area of the chin to help provide sensory supply to the mandibular incisors [10]. In some cases, the IAN canal is unilaterally or bilaterally bifid [11,12], so it is necessary to pay close attention to radiographic and computer topographic examinations to reduce the associated risks.

Inferior Alveolar Nerve Canal in Edentulous Patients

On panoramic radiographs of edentulous patients, the IAN canal in the mandibular body is not very clearly visible, so its path through the ramus and the opaque lines above and below the canal may not be visible. Moreover, the closer we get to the mental foramen, the less visible the canal is [13, 14] in their studies, Cesar et.al offered 2 types of classification for IAN canals in edentulous patients. In the vertical direction, the canal was located in the upper or lower half of the mandible. In 73.7% of men and 70% of women, the nerve is located in the lower half of the mandible (therefore, the presence of the canal in the lower half of the mandible is the most common occurrence). [15]

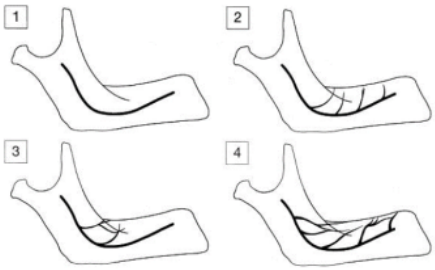

Figure 1variations of inferior alveolar nerve types in an edentulous mandible image in Textbook of Advanced Oral and Maxillofacial Surgery [1]

Mental Nerve

The mental nerve supplies sensory innervation to the anterior region of the buccal mucosa, the lower lip and the skin of the chin ventral to its foramen. Once the mental foramen is exited, it usually splits into three branches below the depressor anguli oris muscle. One of them descends towards the chin and supplies sensory innervation to the skin of the anterior chin. [16,17] The sensory innervation of the mental nerve may overlap slightly with that of the contralateral mental nerve. It also has some connection with the facial nerve [18]

Inferior Alveolar Nerve Injury

Injury to the inferior alveolar nerve can have several causes, such as injection with a needle, compression of the nerve due to bleeding around the nerve, or trauma to the jaw. The main cause of nerve injury is any surgical procedure that results in injury to the neurovascular bundle. The nerve boot consists of four layers of connective tissue. These membranes include, from the outside in, the mesoneurium, epineurium, perineurium and endoneurium. The mesoneurium holds the nerve trunk within the soft tissue and contains vessels. The epineurium is a dense, irregular connective tissue that protects the nerves from mechanical stress. The larger the epineurium (which usually accounts for 22%-88% of the nerve diameter), the greater the resistance of the nerve to compressive forces compared to tensile forces. [19,20-22]

Clinical Examination of Sensory Impairement Post Inferior Alveolar Nerve Injury

According to Sharawy et al [23], nerve damage can result from stretching, compression and partial or complete severing of the nerve. Paraesthesia (numb sensation), hypoesthesia (decreased sensation), hyperaesthesia (increased sensitivity), dysthesia (painful sensation) or anaesthesia (complete loss of sensation) of the teeth, lower lip or surrounding skin and mucosa may occur with osteotomy [24].

Neurosensory deficit can be diagnosed by the following tests:

1. Two-point discrimination test
2. Thermal discrimination test
3. Pin pressure nociception test
4. Static light touch test
5. Brush directional discrimination test.

Indications and Contraindications of Mental Nerve Transpositioning

Babbush mentioned several indications for nerve transpositioning, namely, placement of removable prosthetics, stabilization of the remaining anterior teeth, stabilization of the temporomandibular joint, and establishment of muscular balance following reconstruction of the dentoalveolar system [25].

In their study on nerve transpositioning, Resenquise et al. mentioned the following indications and contraindications for this operation:

Indications

1. Less than 10-11 mm bone height above the canal when the quality of the spongy bone does not provide sufficient stability for implant placement.
2. In certain orthognathic surgeries such as total mandibular subapical osteotomies.
3. In severely atrophic mandibles requiring implant therapy, the residual bone above the mandibular canal vary between 0.5 & 1.5 mm.
4. When the bone height above the mandibular canal is less than 10 – 11 mm, spongy bone quality does not support sufficient stability for implant placement.
5. Class V or VI of Cawood and Howell classification in the presence of interforaminal teeth.
6. Class V or VI of Cawood and Howell, if the patient desires fast implant-prosthetic rehabilitation with predictable outcomes. [26-29]

Contraindications

1. The height of the bone over the canal was < 3 mm
2. Severe advanced resorption of the mandibular alveolar process.
3. Poor general health, with the presence of systemic diseases that interfere with the patient's health condition following inferior alveolar nerve repositioning.
4. Presence of Surgical Access Limitations.
5. Susceptibility to infection and bleeding.
6. Presence of thick cortical bone buccally and thin neurovascular bundles.
7. Patients' unwillingness to tolerate numbness of the lower lip or surgery in general. [30-32]

Surgical Technique

Both techniques aim to reposition the inferior alveolar nerve during implant placement without requiring any type of bone augmentation.

Following are the steps for nerve lateralization/distalization:-

1. The procedure should be discussed with the patient to explore all the possible postoperative neurosensory disturbances. And to allow the patient to sense the real feeling of anesthesia, an IAN block anesthesia using long-acting local anesthesia (8 – 16 hours), such as Marcaine, can be performed [33]
2. Nerve transpositioning can be performed under local anesthesia, local anesthesia along with conscious sedation, and general anesthesia, depending on factors such as patient cooperation, financial status, any medical condition that the patient might be suffering from, and the skills of the operating surgeon.
3. An incision was made on the alveolar crest starting from the anterior border of the ramus. At the mesial surface of the mandibular canine, a releasing incision is made anteriorly and towards the vestibular sulcus to avoid injuring the mental nerve branches [34-38]

Technique for distalization of the inferior alveolar nerve: Here, the mental foramen will be included in the osteotomy. Drilling was initiated using a round drill approximately 5 mm anterior to the foramen orifice to preserve the mental nerve over its anterior loop, and a posterior window was then performed through the external cortical layer along the intrabony trajectory of the IAN. When the drilling was closer to the mandibular canal, the round drill was replaced with a diamond drill to reduce the risk of nerve damage. Another choice is the use of piezo surgery to minimize nerve damage. [1,39,40]

1. The bone surrounding the nerve was removed using a 700 or 701 burr, along with a straight handpiece with adequate amounts of irrigation.
2. To release the inferior, the incisive nerve must be severed, after which complete visualization of the nerve is possible.
3. Following the above step, the nerve can be relocated with the help of an elastic band (10 mm) or gauze cord
4. At this stage, the dental implants can be placed under direct vision.
5. A graft material is inserted between the bone surface and the implant to improve the contact between the boneand the implant. The graft material can be autogenous or allogenous
6. An absorbable collagen membrane is placed between the mucoperiosteal flap and the exposed area to securely fix the graft material and further stabilise the nerve
7. The nerve can also be passively left outside the mandibular canal
8. The surgical site was then sutured back into its original position, preserving the papilla of the adjacent tooth structure.

Figure 2 The mental nerve is identified(courtesy- Inferior alveolar nerve lateral transpositionBruno Ramos Chrcanovic& Antônio Luís Neto Custódio)[41]

Figure 3 curette put between the bone and the nerve. Courtesy- Bruno Ramos et al. [41]

Figure 4 inferior alveolar neurovascular plexus being removed out of the mandible (courtesy- Bruno Ramos Et al) [41]

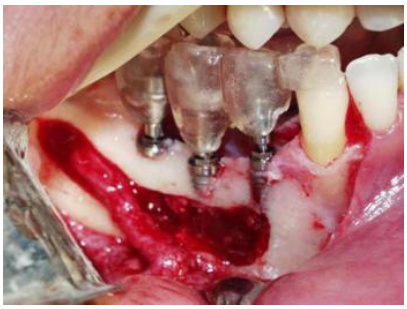

Figure 5 insertion of implant according to the surgical guide (courtesy- Bruno Ramos Et al) [41]

Figure 6 excised bone replaced around the implant (courtesy- Bruno Ramos Et al) [41]

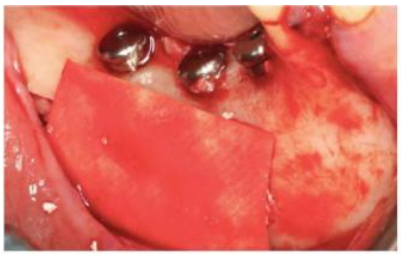

Figure 7 placement of resorbable collagen membrane (courtesy of Pimentel AC et al.) [40]

Technique for lateralisation of the inferior alveolar nerve - In this technique, the incisive branches of the nerve are not cut

1. A 700 or 701 round burr on a straight handpiece was used to prepare a window just posterior to the mental foramen to remove all the cortical bone
2. A curettage was performed to remove all spongy bone along with the cortical layer over the mandibular canal
3. All debris and sharp bone needles were removed to avoid damage to the neurovascular bundle
4. Once the nerve was visible, a 10 mm elastic band or thin band gauze was wrapped around the nerve to move it laterally. Wide gauze or elasticity prevents is chaemic trauma that can be caused by the procedure
5. Dental implants were placed under direct visual control
6. Bone grafts, i.e. allogenic or autogenic bone grafts, are inserted together with the resorbable membrane 7. The surgical area was closed with sutures.

Figure 8 detachment of flap and mental nerve bundle (courtesy- Leandro Lécio de Lima Sousa., et al.) [42]

Figure 9 Horizontal superior osteotomy (courtesy- Leandro Lécio de Lima Sousa., et al.) [42]

Figure 10 Completed osteotomy(courtesy- Leandro Lécio de Lima Sousa., et al.)[42]

Figure 11 inferior alveolar nerve retraction (courtesy- Leandro Lécio de Lima Sousa., et al.)[42]

DISCUSSION

Some studies [43,44,45,46] have shown the advantages of nerve repositioning procedures, such as the use of longer implants, a greater number of implants and implants in ridges where the nerve has a close approach to the ridge. Greater primary stability has been achieved. However, there are also some disadvantages, such as neurosensory changes, muscle weakness and fractures in the extremely resorbed ridges.

CONCLUSION

The presence of an inferior alveolar nerve near the alveolar ridge has always posed problems in the prosthetic rehabilitation of atrophic ridges, and techniques such as this one gives us the opportunity to develop alternative treatment plans. Although this procedure presents some complications, such as neurosensory deficits, postoperative infections, pathological fractures and osteomyelitis, these techniques can be used for successful implant placement in the posterior mandibular region with high residual resorption of the ridge.

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