CASE REPORT

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Implant placement with inferior alveolar nerve repositioning in the posterior mandible

Doogyum Kim[1], Taeil Lim[1], Hyun-Woo Lee[2], Baek-Soo Lee[1], Byung-Joon Choi[1], Joo Young Ohe[1], Junho Jung[1]

[1]*Department of Oral and Maxillofacial Surgery, School of Dentistry, Kyung Hee University, Seoul,*
[2]*Department of Oral and Maxillofacial Surgery, Uijeongbu Eulji Medical Center, Eulji University, Uijeongbu, Korea*

Abstract (J Korean Assoc Oral Maxillofac Surg 2023;49:347-353)

This case report presents inferior alveolar nerve (IAN) repositioning as a viable approach for implant placement in the mandibular molar region, where challenges of severe alveolar bone width and height deficiencies can exist. Two patients requiring implant placement in the right mandibular molar region underwent nerve transposition and lateralization. In both cases, inadequate alveolar bone height above the IAN precluded the use of short implants. The first patient exhibited an overall low alveolar ridge from the anterior to posterior regions, with a complex relationship with adjacent implant bone level and the mental nerve, complicating vertical augmentation. In the second case, although vertical bone resorption was not severe, the high positioning of the IAN within the alveolar bone due to orthognathic surgery raised concerns regarding adequate height of the implant prosthesis. Therefore, instead of onlay bone grafting, nerve transposition and lateralization were employed for implant placement. In both cases, the follow-up results demonstrated successful osseointegration of all implants and complete recovery of postoperative numbness in the lower lip and mentum area. IAN repositioning is a valuable surgical technique that allows implant placement in severely compromised posterior mandibular regions, promoting patient comfort and successful implant placement without permanent IAN damage.

Key words: Inferior alveolar nerve repositioning, Nerve lateralization, Nerve transposition

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I. Introduction

Dental implant treatment has revolutionized the field of oral rehabilitation, providing an effective and predictable solution for patients with tooth loss and edentulism[1]. Implants offer numerous advantages such as enhanced esthetics, preservation of adjacent teeth, and prevention of bone resorption[1]. However, the success of implant placement depends on various factors involving careful consideration of anatomical structures and appropriate treatment planning[2].

One common challenge encountered in implant dentistry is inadequate alveolar bone height in the mandible. Various treatment modalities have been developed to address this deficiency including guided bone regeneration (GBR), block bone grafting, and use of short implants[3,4]. These techniques aim to augment the alveolar ridge and to create a favorable environment for implant placement. Nevertheless, in cases with a superiorly positioned inferior alveolar nerve (IAN), hinderance of adequate height of prosthetic crowns, or when vertical augmentation is not possible due to the presence of adjacent teeth and proximity of the mental nerve, the above-mentioned methods may have limitations[5].

In mandibular implant surgery, particular attention must be paid to the IAN, a vital neurosensory structure that runs through the mandibular canal[2,6]. Nerve damage during implant placement can result in significant complications such as altered sensation, paresthesia, or complete loss of nerve function[4]. Therefore, meticulous preoperative assessment and precise surgical techniques are necessary to ensure IAN integrity and to promote successful implant outcomes[6,7].

For individuals with extensive alveolar bone loss and limited treatment options, an alternative approach known as nerve repositioning (NR) with simultaneous implant placement has been proposed. This technique involves lateral repositioning

Junho Jung
Department of Oral and Maxillofacial Surgery, School of Dentistry, Kyung Hee University, 26 Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Korea
TEL: +82-2-958-9360
E-mail: ssa204@khu.ac.kr
ORCID: https://orcid.org/0000-0002-7007-0974

of the IAN followed by implant placement. Relocating the nerve creates space for optimal implant positioning while minimizing the risk of nerve injury. The NR method offers a potential solution for cases unsuitable for conventional bone-grafting procedures[8,9].

In this report, we present a clinical case in which implant treatment was performed using NR. By documenting this case, we aim to contribute to the existing literature, expand understanding of alternative approaches in implant dentistry, and guide clinicians in decision-making for similar cases.

II. Cases Report

1. Case 1

A 65-year-old male patient was referred to the Department of Oral and Maxillofacial Surgery at Kyung Hee University Medical Center for implant placement in the right mandibular area. Previous surgeries, attempted since 1998 for implant placement in the right mandibular premolar and molar regions, had been unsuccessful.(Fig. 1)

Cone-beam computed tomography (CBCT) revealed significant vertical and horizontal bone loss in the right mandibular premolar and molar areas, with only 3-5 mm of basal bone remaining over the IAN.(Fig. 2) Owing to the overall low alveolar ridge, as well as the complex relationship between adjacent implant bone levels and the mental nerve, vertical augmentation followed by implant placement was deemed unsuitable. Instead, implant placement with NR was proposed. A surgical guide was created to ensure precise implant placement and reduced surgical time.

Under general anesthesia, a crestal incision was created in the right mandibular premolar and molar regions, with a vertical incision on the mesial side of the right central incisor pontic. After elevating a full-thickness mucoperiosteal flap, the mental nerve was identified, and a rectangular osteotomy line encircling the mental foramen and extending posterior to the second molar region was marked to expose the IAN. A bony window was created using a piezoelectric device in the area of the mental foramen, and the bone was removed using a chisel and mallet. The mental nerve was moved buccally using a periosteal elevator and 3-0 Black Silk sutures.(Fig. 3) The next window was created along the distal osteotomy line, and the bone was removed to identify the IAN, which was mobilized buccally from the mandible. Using a digital guide, implants measuring 4.5 mm×8.5 mm (TS III; Osstem Implant Co. Ltd.) were placed in the first and second premolar positions and an implant measuring 5.0 mm×8.5 mm was placed in the first molar position.(Fig. 3) The integrity of the IAN was verified and a cover screw was placed. After repositioning of the bony window anterior to the IAN and on the buccal side of the implants, the window was secured to the mandible using two screws (Leibinger; Stryker) sized 2.0 mm×10.0 mm. A deproteinized bovine bone (0.5 g) (Bio-Oss; Geistlich Pharma AG) was grafted into the gap between the window and implants and covered with a collagen membrane (Bio-Gide; Geistlich Pharma AG). A mucoperiosteal-releasing incision and interrupted sutures were performed using 4-0 and 5-0 Nylon.(Fig. 4) The patient was administered methylcobalamin for 60 days. Two months after surgery, there was a notable improvement in paresthesia of the IAN, which resolved completely by the five-month mark. Five months after the initial surgery, a second surgery

Fig. 1. Preoperative panoramic X-ray.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

Fig. 2. Cone-beam computed tomography images showing the distance between the inferior alveolar nerve and crestal bone in the first premolar, second premolar, and first molar regions.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

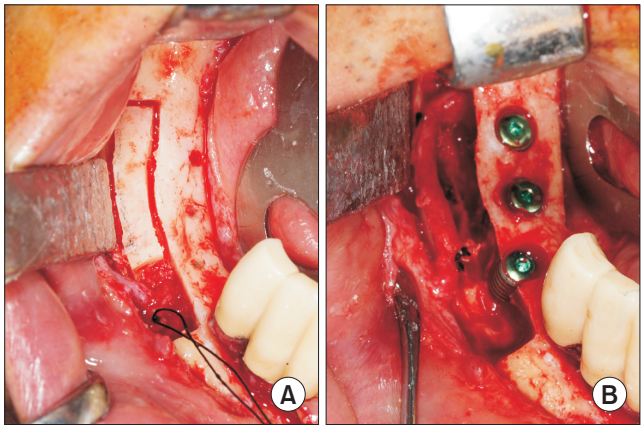

Fig. 3. A. Buccal movement of the mental nerve using 3-0 black silk and bony window formation to expose the inferior alveolar nerve. B. Implant placement following nerve transposition toward the buccal aspect.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

Fig. 4. Postoperative panoramic X-ray.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

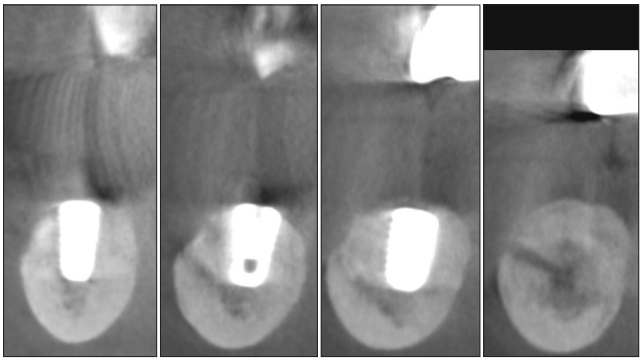

Fig. 5. Postoperative cone-beam computed tomography images of implants in the first premolar, second premolar, and first molar sites, as well as the repositioned inferior alveolar nerve in the second molar area.
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Fig. 6. Preoperative panoramic X-ray.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

was performed and successful osseointegration was confirmed through clinical and CBCT examinations.(Fig. 5)

2. Case 2

A 27-year-old female patient was referred from the Department of Orthodontics at Kyung Hee University Dental Hospital for placement of right mandibular implants.(Fig. 6) Four years prior, the patient had undergone orthognathic surgery for mandibular prognathism and facial asymmetry and was returning for implant placement.

Upon CBCT examination, distances from the mental foramen to the alveolar crest and from the alveolar crest to the opposing teeth were measured as 5.09 mm and 6.29 mm, respectively, in the second premolar area. In the first molar region, these distances were 5.99 mm and 4.19 mm, respectively.(Fig. 7) Consequently, placing a short implant was expected to be challenging. Moreover, performing vertical augmentation would have resulted in limited space for the prosthesis, potentially leading to a poor emergence profile.

After administering general anesthesia, crestal and vertical incisions were created, followed by full-thickness flap elevation. The mental nerve was identified, and a fissure bur was used to create a bony window from the posterior aspect of the mental foramen to the distal aspect of the second molar. The cortical and outer cancellous bones of the mandibular canal were removed to expose the IAN. The implant sites of the first premolar and first molar were marked, and the IAN below these sites was gently detached and repositioned buccally.

Implants measuring 4.0 mm×10 mm (CMI IS-II; Neobiotech, Co.) (Fig. 8) were placed in the right mandibular second premolar and first molar sites. A mixture of xenograft (1 mL, Cerabone; Botiss Biomaterials GmbH) and demineralized freeze-dried bone matrix (1 mL, Accell Connexus; IsoTis Or-

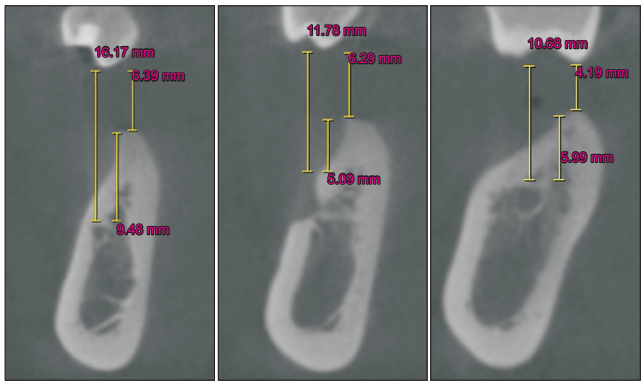

Fig. 7. Cone-beam computed tomography images illustrating the distance from the mental nerve and inferior alveolar nerve to the alveolar crest, as well as the distance from the alveolar crest to the opposing teeth.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

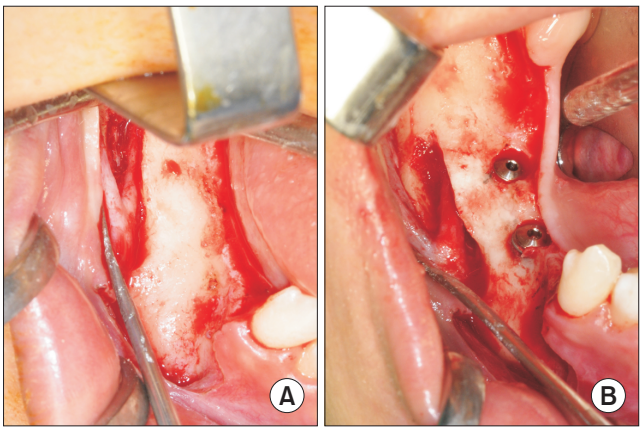

Fig. 8. A. Buccal movement of the inferior alveolar nerve using a periosteal elevator. B. Implant placement following nerve lateralization toward the buccal aspect.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

thoBiologics) was applied to the bony defects. The graft was then covered with a collagen membrane (Jason membrane; Botiss Biomaterials GmbH). Subsequently, a mucoperiosteal-releasing incision was created, and the surgical site was sutured using interrupted sutures with 4-0 Nylon.(Fig. 9)

After 3 months, numbness in the right lower lip and mentum had improved, and there were no complaints of sensory disturbances. After 6 years of follow-up, the patient had successfully utilized the implants without any complications.

III. Discussion

Implant placement surgeries utilizing NR have been reported to exhibit a survival rate greater than 90%[8,10-12]. A study

Fig. 9. Postoperative panoramic X-ray.
Doogyum Kim et al: Implant placement with inferior alveolar nerve repositioning in the posterior mandible. J Korean Assoc Oral Maxillofac Surg 2023

on the survival and success rates of implants placed with IAN lateralization reported that 129 implants in 40 patients demonstrated a cumulative survival rate of 98.44% after 5 years of loading[11]. Compared with short implants, the techniques exhibited similarly high survival rates[8,10-13]. Therefore, implant placement with NR represents a favorable treatment option in severely resorbed mandibles where short implants cannot be used.

NR is primarily performed to prevent IAN injury in the posterior mandible in cases with inadequate bone height as well as anatomical and prosthetic constraints, hindering conventional bone grafting procedures. Repositioning can be classified into two techniques: lateralization and transposition. Nerve lateralization (NL) involves shifting the IAN laterally to the implant site posterior to the mental foramen without a corticotomy around the mental foramen or lateral movement of the mental nerve. This process does not involve retraction of the incisive nerve. In contrast, nerve transposition (NT) involves a corticotomy around the mental foramen and lateral movement of the mental nerve. This technique results in slight posterior displacement of the mental nerve, which may lead to retraction of the incisive nerve[8]. According to a systematic review[8], NT was performed slightly more frequently compared with NL, at 107 cases (51.44%) and 101 cases (48.56%), respectively, and the number of implants placed after NT (211 implants) was more than twice as that placed after NL (95 implants). When performing lateralization up to the mental nerve, NT has the advantage over NL of allowing placement of implants even in the mental foramen area with insufficient bone height. In a study comparing NL and NT, the NT group exhibited a higher incidence of negative tooth vitality in the anterior region of the mental foramen compared to the NL group. However, no significant differ-

ences were observed in the occurrence of numbness in the lower lip and chin between the two groups[14]. In the present case reports, Case 1 utilized NT, while Case 2 employed NL. In Case 1, the patient presented with a completely resorbed alveolar ridge, where only the basal bone remained, along with planned implant placement near the right mandibular first premolar region close to the mental foramen. Therefore, NT was selected as the treatment approach. In Case 2, the patient's nerve was positioned in the superior region of the alveolar bone as a result of the setback and upward movement of the distal segment of the mandible during orthognathic surgery. This led to an increase in overbite and a decrease in the distance from the mandibular posterior alveolar bone to the opposing teeth. Therefore, the treatment plan included placement of implants in the second and first molar areas with a cantilever pontic at the first premolar site, along with the decision to perform NL.

NR during implant placement offers several noteworthy advantages in oral implantology. First, implants can be placed at a greater depth, enabling an appropriate emergence profile and the desired form of prosthesis. Moreover, the ability to strategically position multiple implants through NR allows improved load distribution, mitigating the potential for overload and optimizing the longevity of the prosthetic restorations. Finally, implant placement with NR eliminates the need for sequential surgical procedures, minimizing treatment duration and patient inconvenience compared with procedures such as bone grafting, which may require a longer healing period[8].

Short implants, measuring ≤8 mm in length, are used as an alternative to more invasive and costly surgical interventions such as bone grafting procedures, especially in cases of posterior mandibular atrophy[13]. Studies have revealed that short implants have comparable survival rates to standard implants (8-10 mm)[13]. Additionally, they provide a suitable option for patients unable to undergo complex surgeries, such as bone grafting or sinus grafting, due to systemic conditions or socioeconomic constraints[15]. However, their use may be limited in cases of severe bone resorption, where the residual bone height above the superior aspect of the mandibular canal is lower than the length of a short implant. Additionally, when alveolar bone height is significantly reduced compared with adjacent implants, the use of short implants can result in a poor emergence profile, which may have unfavorable prosthetic implications. In such circumstances, longer implants should be placed through NR rather than using short implants[8,9,16]. In Case 1, the patient presented with severe bone loss, resulting in residual bone heights of 3.86 mm, 4.87 mm, and 5.05 mm at the first premolar, second premolar, and first molar sites, respectively, hindering placement of short implants. In Case 2, the patient exhibited a condition where the IAN was positioned superiorly, accompanied by significant resorption of the alveolar bone at the sites of the second premolar and first molar. In this scenario, the placement of short implants posed a risk of nerve damage.

Block bone grafting can be utilized in cases of severe bone loss in the posterior mandibular region[17]. According to a retrospective study comparing short implants and vertical augmentation with block bone, both techniques demonstrated favorable clinical outcomes at 5-year follow-up[18]. However, limitations may arise in performing block bone grafting when considering the superior positioning of the mental foramen due to mandibular bone resorption or the relationship with bone levels of adjacent neighboring teeth. Instead of block bone grafting, NR with simultaneous implant placement was performed in both cases, followed by additional GBR. GBR primarily served the purpose of gap filling around the repositioned bony window rather than extensive bone augmentation. In both cases, xenograft materials were utilized, and successful osseointegration of all implants exhibited no discernible difference in prognosis. Xenograft materials are known for their lower resorption rate compared to allografts, resulting in better volume maintenance capacity. Therefore, when performing GBR for gap-filling purposes after NR, xenografts appear to be more advantageous since there is no concern about osteoconductivity.

Neurosensory problems such as paresthesia and hypoesthesia of the lower lip and chin are the most common postoperative complications after NR and can be transient or permanent[19]. In a systematic review of neurosensory complications after NR, 376 of 378 patients (99.47%) exhibited temporary neurosensory disturbances, while permanent nerve disturbances were observed in 2 patients (0.53%)[5]. Another study reported 7 of 139 sites undergoing NL (5.04%) exhibiting any nerve-related symptoms, while the remaining 132 sites demonstrated complete recovery[19]. Neurosensory issues arise from different etiologies such as nerve trauma, edema, or hematoma following surgery[19]. However, the primary cause of these problems is disruption of microvascular circulation within the nerve fibers due to mechanical trauma, leading to impaired metabolic supply[20]. Such trauma can occur during all stages of surgery including flap design, osteotomy, moving the nerve lateral to the canal, and maintaining distance from the surgical site[20]. To prevent this, efforts should be

made to minimize the application of excessive pressure on the nerve[20]. Both patients experienced numbness in the right lower lip and chin immediately after surgery. The second patient who underwent NL exhibited a complete recovery of numbness 4 months post-surgery, while the first patient experienced sensory disturbances for up to 2 months after surgery but achieved complete resolution of numbness in the follow-up at 5 months. Although the follow-up timing differed for each patient, hindering comparison of numbness recovery over time, both patients achieved full recovery from the neurosensory issues. However, as NT involves a corticotomy around the mental foramen and lateral movement of the mental nerve, a more cautious approach is necessary compared to NL.

In conclusion, IAN repositioning is a valuable surgical technique that enables implant placement in severely compromised posterior mandibular regions, promoting patient comfort. This allows successful implant placement without permanent damage to the IAN, even when vertical augmentation through bone grafting is not possible. Although temporary sensory disturbances may occur following surgery, both NT and NL techniques offer the advantage of successful implant osseointegration without compromising IAN integrity. This technique ensures patient satisfaction and facilitates successful implantation under challenging anatomical conditions.

ORCID

Doogyum Kim, *https://orcid.org/0009-0009-5398-5628*
Taeil Lim, *https://orcid.org/0009-0000-4133-8436*
Hyun-Woo Lee, *https://orcid.org/0000-0002-8144-3633*
Baek-Soo Lee, *https://orcid.org/0000-0002-9145-8062*
Byung-Joon Choi, *https://orcid.org/0000-0002-6644-7994*
Joo Young Ohe, *https://orcid.org/0000-0002-4411-7871*
Junho Jung, *https://orcid.org/0000-0002-7007-0974*

Authors' Contributions

D.K. participated in data collection and wrote the manuscript. T.L., H.W.L., B.S.L., B.J.C., and J.Y.O. participated in the study design, and reviewed the manuscript. J.J. conceptualized the study, and participated in the surgery and study design, and revised the manuscript. All authors read and approved the final manuscript.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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