

Original Article

Is 2 mm a safe distance from the inferior alveolar canal to avoid neurosensory complications in implant surgery?

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ABSTRACT

Aim: The aim of the present study was to compare the neurosensory complications related to implants inserted closer than 2 mm to the inferior alveolar canal (IAC) with those inserted further than 2 mm. **Materials and Methods:** A total of 474 implants in 314 patients placed posterior to mental foramen area were evaluated retrospectively on panoramic radiographs. Patients were divided into two groups regarding implant proximity to the IAC (Group 1, distance ≤ 2 mm, Group 2, distance > 2 mm). Postoperative neurosensory complications (pain and paresthesia) were recorded. Chi-square test was used for statistical comparison and $P \leq 0.05$ was considered significant. **Results:** One hundred and fifty-three implants (32.2%) were inserted closer than 2 mm to the IAC whereas 321 implants (67.8%) were inserted further than 2 mm. Three implants which had a distance of 0 mm to the IAC (0.63%) caused paresthesia after surgery. Implant distance to IAC did not show a significant difference regarding pain and paresthesia ($P = 0.06$ and $P = 0.08$, respectively). **Conclusion:** When 2 mm is considered as a safety distance, the distance of the implants to the IAC did not yield any statistical difference regarding postoperative neurosensory complications.

KEYWORDS: Dental implants, inferior alveolar nerve injury, neurosensory complication

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INTRODUCTION

Implants are used to reconstruct compromised occlusion and to improve patient's quality of life as well as diet. Implant dentistry has highly predictable results in most cases where there is horizontal and vertical adequate alveolar bone; however, this condition is not met in all cases because of several anatomical challenges.^[1,2] The most important anatomic limitation in the mandible is the inferior alveolar canal (IAC). Positioning of implants close to the IAC and traumatic anesthetic injections may result in damage to the inferior alveolar nerve (IAN), thus loss of sensation in the lower lip can occur.

It has been reported that IAN is the most commonly injured nerve (64.4%), followed by the lingual nerve (28.8%) during oral surgery procedures.^[3] The most common factors for IAN injury include third molar surgery, endodontic treatment, local anesthetic injection,

and implant surgery.^[2] Causes of such injuries include compression, stretch, transection, tearing, laceration, or needle penetration of the nerve.^[4-6] Nerve damage is one of the most unpleasant experiences for the patient, varying from mild paresthesia to complete anesthesia and/or pain. As a result, many daily activities such as speech, kissing, eating, drinking, and shaving are adversely affected.^[2,5]

Preoperative radiological planning can help to determine the location of the IAC and proposed implant sites,

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and may decrease neural complications during implant surgery. Panoramic radiographs are still the most commonly used radiographs in implant surgery since they are cheaper, widely available, and have less radiation dose than computed tomography (CT).^[6,7]

The aim of the present study was to compare the neurosensory complications of the implants inserted closer than 2 mm and those inserted further than 2 mm to the IAC using panoramic radiographs.

MATERIALS AND METHODS

Panoramic radiographs of the patients, who underwent dental implant placement in the posterior mandible at İstanbul Medipol University, School of Dentistry, Department of Oral and Maxillofacial Surgery between years 2011 and 2014, were retrospectively evaluated. Implant placement was achieved by local infiltration anesthesia (buccal infiltration and lingual mylohyoid anesthesia) in all the patients. The full thickness mucoperiosteal flap was raised from the alveolar crest and the width of bone was assessed. Implant bed was prepared with a physiodispenser device at a speed of 800 rpm and at a torque of 50 n/cm under copious sterile saline irrigation. Drilling sequence was followed concerning surgical kit of the implant company. All root shaped implants with sandblasted and acid-etched surface were inserted at least 6 months following tooth extraction (delayed placement) into D1 or D2 (Misch Classification) alveolar bone. All the patients were prescribed 875 mg amoxicillin +125 mg clavulanic acid combination, 500 mg paracetamol, and 0.2% chlorhexidine mouth rinse postoperatively.

The patients were divided into two groups regarding implants' proximity to the IAC (Group 1: Distance <2 mm, Group 2: Distance ≥2 mm). Systemic conditions were assessed from the patients' records. Those who have any neurological disorders, current orofacial sensory disturbance, or any systemic disease that may cause neurosensory disturbance were not included in the study. The panoramic views were obtained using the same machine (Planmeca Romexis®, P255 73KV 12 mA 10.78 s) in natural head position. All measurements were performed by the two authors (ST and ED) and an average of two measurements was accepted as a final distance. Postoperative neurosensory disturbances including pain and paresthesia on the 7th postoperative day were searched from patients' files. Pain was assessed using a four-point scale where 0: No pain, 1: Mild pain, 2: Moderate pain, and 3: Severe pain. Paresthesia was assessed by two-point discrimination and light touch neurosensory tests.

Vertical linear measurements were taken from the apex of the implant to the superior border of the IAC on

panoramic radiographs [Figure 1]. Calibration of the software was adjusted according to the actual implant sizes from the patient records. The study protocol was approved by the İstanbul Medipol University's Ethical Committee. Postoperative neurosensory complications were recorded. Chi-square test was used for statistical analysis and $P \leq 0.05$ was considered significant.

RESULTS

Panoramic radiographs of 314 patients (204 male and 110 female, age range, 19-78 years with a mean of 42.8 years) with a total of 474 dental implants were assessed [Table 1] and [Table 2]. Of these, 153 implants had a distance of <2 mm (32.2%) whereas 321 had a distance of ≥2 mm (67.8%) to the IAC. 3 patients (1 male and 2 female), who had an implant distance of 0 mm to the IAC, developed paresthesia after surgery. The implants were backed up and the numbness resolved gradually without any additional medical therapy. Implant distance to IAC did not show a significant difference in occurrence of paresthesia ($P = 0.08$). There was not a significant difference between the groups regarding pain scores (Group 1: 1 ± 08 , Group 2: 1 ± 02 , $P = 0.06$).

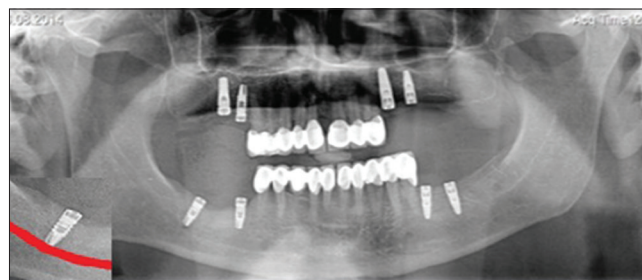


Figure 1: Panoramic radiograph of an implant that caused paresthesia

Table 1: Distribution of implants regarding tooth number

Tooth number	Number of implants	Percentage
34	10	2.10
35	45	9.49
36	119	25.10
37	70	14.76
44	6	1.26
45	44	9.28
46	120	25.31
47	60	12.65

Table 2: Distribution of implants regarding distance to IAC

Distance to IAC (mm)	Number of implants	Percentage
0.00-0.49	57	37.25
0.50-0.99	37	24.18
1.00-1.49	25	16.33
1.50-1.99	34	22.22

IAC=Inferior alveolar canal

DISCUSSION

Parallel to increase in the number of practitioners performing implant surgery, problems and complications are expected to increase as well. The damage of the IAN is the most encountered complication related with implant surgery. Over penetration by the drill may result in close insertion of the implant to IAC. This may cause hemorrhage into the canal or contamination of drilling debris, which are major factors for compression and damage of the IAN. It is stated that the incidence of lingual nerve injury has remained stable over the last 30 years, but the incidence of IAN injury has increased due to implant surgery and endodontic treatment.^[5,8] When such injury occurs, a complete healing is difficult if the extent of the injury is not minor. A minor injury only results in temporary numbness, paresthesia, or pain.^[1,6,8] Interference of IAN may affect patient's quality of life and psychology. If such complication occurs, the dentist should immediately provide appropriate care and treatment for the patient. In our cases, the penetration through the IAN with either drill or implants did not occur. The paresthesia could possibly result from the heat generated by the drills.

Thermal stimuli can result in bone necrosis and IAN damage. Nerve tissue is more sensitive to thermal changes than the bone; hence, IAN injury is inevitable. The excessive high speed of the drills may increase temperature resulting in necrosis, fibrosis, osteolytic degeneration, and increased osteoclastic activity.^[1,8,9] Khawaja and Renton^[10] emphasized that damage to IAN can arise from cracking of the superior border of the IAC while preparing the implant bed. This may result in hemorrhage into the canal or deposition of debris which causes compression and ischemia of the nerve. Implant itself may also cause nerve injury by direct and indirect trauma. When the implant is intruded through the canal, compression of the nerve may initiate degeneration and ischemia of the neurovascular bundle. Efforts to achieve good primary stability during implant insertion can cause undesired sinking of the implant and nerve damage.^[1,5,8] In our study, implants were inserted following preoperative evaluation with panoramic radiographs, since cone-beam computed tomography (CBCT) brings extra financial burden for the patient.

One suggested way to prevent IAN injury during implant surgery is to determine safety distance from implant apex to superior border of IAC. Little evidence exists regarding the minimum distance to protect the nerve during bone drilling or implant placement.^[1,5,6,8] As a result of a biomechanical study, Sammartino *et al.*^[11] suggested a distance of 1.5 mm to prevent IAN when biomechanical loading is to be considered. Froum *et al.*^[12] reported that if this distance is closer than 6 mm, the risk

for IAN may increase during immediate implant placement; on the contrary, Lin *et al.*^[8] stated that even if the distance is closer than 6 mm, the risk for IAN injury did not increase since alveolar housing for implant placement was still available. To determine the exact alveolar bone height, bone density, and length of the proposed implant, thorough radiographic evaluation with CT or CBCT is highly recommended. CBCT provides low radiation dose and high-resolution three-dimensional imaging which enables surgeons to plan implant surgery in critical sites.^[6,7,13] Basa and Dilek^[14] stated that average density and thickness of the bone around the IAC is not resistant enough to withstand drill force. They suggested to assess the bone mass around the canal and to avoid applying excessive force with drills when approaching the canal.

Another suggestion may be the use of local infiltration anesthesia to insert implants in the posterior mandible. Infiltration anesthesia has been shown to be a safe technique to prevent IAN injury and to decrease IAN anesthesia complications as well as to provide sufficient anesthesia in the posterior mandible to insert implants. Repeated IAN anesthesia should be avoided.^[15,16] Surgeon's experience and skill are other important factors to decrease surgical complications. If IAN injury is diagnosed, the implant should be removed or backed-up as soon as possible. Removal after osseointegration is not effective on resolving nerve damage.^[4,13]

We suggest that, if one can avoid thermal, pressure, and traumatic damage to the IAN, then implants can be placed closer than 2 mm to the IAC.

Anatomical limitations indicated for oral surgical procedures are becoming more tolerated as the studies declare successful results compelling these limitations. There are not conclusive safety distances to avoid damage to anatomical structures during oral surgical procedures. Further clinical and experimental studies are needed to determine consensus on safety limits.

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Conflicts of interest

There are no conflicts of interest.

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