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Cross-sectional Study

IS THERE ANY RELATIONSHIP BETWEEN THE INFERIOR ALVEOLAR NERVE INJURIES CAUSED BY IMPLANT SURGERY AND THE QUALIFICATION OF THE DENTIST?

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Abstract

Dental implant surgery has become a routine treatment in dentistry and is generally considered a safe surgical procedure with a high success rate. This breakthrough in oral rehabilitation is based on the concept of Osseo integration. Despite its high success rate, however, many complications have been encountered with its use. One of the most serious complications is the sensation alteration after implant placement in the posterior mandible.

The aim of this study was to evaluate the prevalence of neurosensory disturbances of the inferior alveolar nerve, and the relation between these complications and the qualification of the dental surgeons.

This cross-sectional study considered 1571 patients with 2432 dental implants who were treated in the period 2014-2016 in 67 privet clinics, Damascus, Syria. 36 of dentists were qualified as a maxillofacial surgeon or dental implantologist the rest of them were not.

By means of a prepared form, the patients' records and files were examined, information was retrieved, and radiographic images were analyzed. The patients were divided into three groups regarding implants' proximity to the inferior alveolar canal. 1571 patients with 2432 dental implants, the transient alterations in sensation, occurred in 348 patients with distance between the apex of the implants and the upper wall of Inferior Alveolar Canal ranged 0-0.99 mm, were done by 30 not qualified as maxillofacial surgeons or dental implantologist and one qualified dentist (p=0.008 significant difference).

There is a direct relationship between the qualification of surgeons and the altered sensation after the implant surgery due to the lack of experience in respecting the safe distant (≥2mm), which lead to deep insertion of the implant near to inferior alveolar canal.

Keywords: *altered sensation, inferior alveolar nerve canal, implant, dentists.*

Introduction

Dental implant surgery has become a routine treatment in dentistry and is generally considered a safe surgical procedure with a high success rate [*Su-Gwan K, 2011*]. Because of- its ability to restore esthetics and function, it has become the preferred option for replacing hopeless and missing natural teeth [*Alhassani A, Thafeed AlGhamdi A, 2010*].

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This breakthrough in oral rehabilitation is based on the concept of Osseo integration first described by the two research groups of Branemark [*Branemark P et al., 1977*] and Schroeder [*Schroeder A et al., 1981*].

Despite its high success rate, many complications have been encountered with its use [*Alhassani A, Thafeed AlGhamdi A, 2010*].

Sensory impairment of the skin and mucosa innervated by branches of the trigeminal nerve is a potential concern in association with dental implant surgery. The most common nerves traumatized in implant dentistry are the inferior alveolar nerve (IAN) and its mental branch.

Other nerves at risk include the lingual nerve, long buccal nerve and the infraorbital nerve because of the anatomic location of these structures [*Nazarian Y et al., 2003*].

Neurosensory impairment may occur during all phases of dental implant surgery, including anesthetic administration, incisions, soft tissue reflection, osteotomy preparation, bone augmentation, implant placement, suturing and/or soft tissue swelling after surgery [*Van Stenberghe D et al., 1990; Ellies L, Hawker P, 1993; Bartling R et al., 1999; Gregg MJ, 2000; Smith MH, Lung KE, 2006*].

One of the most serious complications is the alteration of sensation after implant placement in the posterior mandible. The prevalence of such a complication has been reported as high as 13% [*Ellies L, 1992; Bartling R et al., 1999*]. The nerve damage can result from the nerve being stretched, compressed, and partially or totally transected, and this may cause one of the following conditions: paresthesia (numb feeling), hypoesthesia (reduced feeling), hyperesthesia (increased sensitivity), dysesthesia (painful sensation), anesthesthesia (reduced feeling), or anesthesia (complete loss of feeling) of the teeth, the lower lip, or surrounding skin and mucosa [*Dannan A et al., 2013*].

In about 1% of patients, however, the mandibular canal bifurcates in the inferior superior or medial lateral planes. Thus, a bifurcated mandibular canal will manifest more than one mental foramen. This may or may not be seen on panoramic or per apical images. Accordingly, Dario suggested that clinicians should consider obtaining a preoperative tomogram to avoid nerve injuries prior to implant placement above the inferior alveolar canal [*Goodacre C et al., 1999; Goodacre C et al., 2003*].

The incidence of nerve injuries in the course of dental implantation is referred to in different figures by various authors. According to authors [*Bartling R et al., 1999*], only 8.5% of IAN injury cases occur during dental implantation; while Goodacre C. and co-authors (1999) claimed that on average 52. 4% of patients suffer from neuro-sensory troubles following dental implantation and this may occur from injury to the inferior alveolar nerve during dental implant osteotomy or placement due to its midway between the buccal and lingual cortical plates in the first molar region [*Tammisalo T et al., 1992; Hegedus F, Diecidue R, 2006*]. In some studies, the mean incidence of neurosensory disturbance after implant surgery was 6.1% to 7% [*Dario L, 2002; Greenstein G, Tarnow D, 2006*].

Data considering prevalence of neurosensory disturbances after dental implantation are contradicting. Adell R. and co-authors (1981) found no cases of persisting paresthesia or anesthesia of anatomic structures adjacent to the abutments after dental implantation. Other researchers have reported transient paresthesia in 3% to 14% of their study population, and persistent paresthesia (lasting more than 1 year after surgery) [*Van Steenberghe D et al., 1990; Johns R et al., 1992; Lekholm U et al., 1994; Higuchi K et al., 1995*].

In general, the prevalence of temporary altered sensations following implants placement in the mandible has been reported to vary between 0-36% and 43.5% [*Kiyak HA et al., 1990; Ellies LG, 1992; Ellies L, Hawker P, 1993*].

There is a dearth of published data or literature on the relationship between IAN injuries during dental implant surgery and qualification of the operating dentist.

The aim of this study was to evaluate the prevalence of neurosensory disturbances of the inferior alveolar nerve during dental implant surgery, and its relationship with the qualification of the dental surgeons.

MATERIAL AND METHODS

This cross-sectional study considered 1571 patients who were treated in the period from 2014 to 2016 in 67 private clinics in Damascus, Syria. 36 dentists were qualified maxillofacial surgeons or dental implantologists, while the rest of them were not. However, they took a course on implant surgery for one month.

Selected criteria for our research were:

1. Delay-loaded implants in the posterior mandible (molar and premolar areas).
2. Patients whose post-operative panoramic radiographs provided completely clear view of the mandibular canal.
3. No history of neurological disorders.
4. Absence of past bone augmentation surgeries in the mandible.

By means of a prepared form, the patients' records and files were examined, information was retrieved, considering the names and the qualification of the surgeons, the patient's name, age, gender, and any remarkable medical conditions, number of implants inserted, the zone of implant placement, date of surgery, and implant manufacture information were recorded. Radiographic images were also analyzed.

Only the patients who had a radiographic distance between the implant apical tip and the upper wall of the mandibular canal of 0-3 *mm* on the panoramic images were selected for the X-ray examination, considering (≥2 *mm*) as a "safe" distance. Panoramic radiographs were analyzed to obtain certain information concerning the real distance between the implant apical tip and the upper wall of the mandibular canal. For this purpose, the radiographs were examined under standard conditions on a viewing box.

The patients were divided into three groups regarding implant proximity to the IAC (Inferior Alveolar Canal) (group 1: distance ≤1 *mm*, group 2: distance 2>1 *mm*, group 3: distance ≥2 *mm* as a control group).

Information on postoperative neurosensory disturbances, including paresthesia on the 7th postoperative day were retrieved from patient's clinical files. Paresthesia was assessed by two-point discrimination and light touch neurosensory tests based on the clinical files.

In order to find out the actual distance (d) between the implant apical tip and the upper wall of the mandibular canal three measurements were taken: the first one was the actual length of the implant (manufacturer information) and referred to as (a), the second measurement was the length of the implant on the radiograph measured from the upper ridge of the implant to the apical tip and referred to as (b), and the third measurement was the radiographic distance between the implant apical tip and the upper wall of the mandibular canal taken by drawing a perpendicular line between the apical tip and the upper wall of the canal, referred to as (c). The measurements (b) and (c) were calculated by using a manual caliper to the nearest 0.1 *mm*. (Figure).

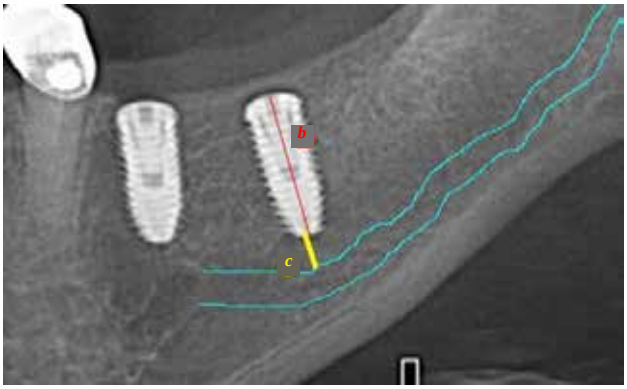

Figure. *Radiograph to measure not actual length of transplant (b), and the distance between the implant apical tip and the upper wall of the mandibular canal (c).*

To obtain the value (d), a simple equation was used

$$d = \frac{a \cdot c}{b}$$

Descriptive statistical analysis was used in this study to analyze the variables as frequencies and percentages. Microsoft Excel program/Office XP (Redmond, Washington, USA) was used.

This cross-sectional study followed the declaration of Helsinki on medical protocol and ethics, and the approval of the Ethic Committee of the Syrian Private University was firstly obtained.

Results

Panoramic radiographs of 1571 patients (1001 males and 570 females, with 2432 dental implants were examined. The age range was 19-58 years, mean-age was 48 years (Table 1).

Table 1

Distribution of dental implants according to specific tooth replaced

Teeth replaced	Number of dental implants placed	
	n	%
34	55	2.27
35	221	9.09
36	575	23.65
37	294	12.09
44	65	2.67
45	284	11.68
46	697	28.65
47	241	9.90
Total	2432	100

Of these, 560 implants had a distance of <1 *mm* (23.03%) and 490 implants had a distance of 2>1 *mm* (20.15%), whereas 1382 implants had distance of ≥2 *mm* (56. 82%) to the inferior alveolar canal. Twenty-one patients had an implant distance of 0 *mm* to the inferior alveolar canal. All information regarding the implants distance are presented in (Table 2).

Our study showed that transient sensation alterations occurred in 352 patients in group 1 (584 patients), in group 2 (4 patients), 22. 4% (p=0.031) which makes significant difference.

Transient alterations in sensation had resolved by one week in 143 patients, the distance between the apex of the implants and the upper wall of INC ranged 0.7-1.03 *mm*. One hundred and thirty-four patients reported that the symptoms had resolved from 4 weeks up to 12 months, the distance between the apex of the implants and the upper wall of INC ranged 0.46-0.99 *mm*, and 75 patients reported permanent altered sensation, the distance between the apex of the implants and the upper wall of INC ranged 0-0.45 *mm*.

The most commonly reported description of altered sensation was "numbness" (242 patients), followed by "frozen" in 110 patients.

Our study showed that transient alterations in sensation which occurred in 348 patients with distance between the apex of the implants and the upper wall of INC ranged 0-0.99 *mm* were done by 30 surgeons who are not qualified maxillofacial surgeons or dental implantologists p=0.0031 which makes a significant difference (Table 3).

Dental implants are becoming a more predictable tooth replacement option. Studies have demonstrated success rates ranging from 80-92% success for the maxilla of 5 to 10 years [*Branemark P et al., 1995; Jemt T, Lekholm U, 1995*] and 94% success for the mandible at 5 years [*Adell R et al., 1990*].

Sequel to the increase in the number of practitioners performing implant surgeries, 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 of the IAC by the drill and the 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 [*Juodzbalys G et al., 2013; Lin M et al., 2014*].

When such injury occurs, complete healing is difficult if the injury is a major and extensive one, but when a minor injury occurs, the results would be temporary numbness, paresthesia or pain [*Juodzbalys G et al., 2011; Kütük N et al., 2014*].

The current study utilized panoramic radiographs because they have sufficient accuracy to measure the vertical dimension when a patient is correctly positioned [*Branemark P et al., 1995*]. The results showed that 1571 patients with 2432 implants generally had a radiographic distance ranging from 0 *mm* to 3 *mm* (implant apical tip-upper wall of the canal). It is supposed that 0 *mm* in this case means that the implant was either inserted deep into the mandibular canal or that it was very near to it. However, the real relationship between the implant and the nerve might be only possible to detect on CT and/or 3D imaging.

It is surprising to note that our study observed a very high percentage of subjective postoperative complaints. From 1571 patients 348 had transient or persistent altered sensation after implant surgery 22.4% p=0.031 i.e. there are significant differences. The percentage of patients with altered sensation in our study is in agreement with others studies [*Ellies L, 1992; Ellies L, Hawker P, 1993; Goodacre C et al., 1999; Goodacre C et al., 2003; Kubilius R et al., 2004*].

Our study showed that the distance between the apex of the implant and the upper wall of IAC must be 2≤ as a safe distance (894 patients with 1382 implants without any complications).

TABLE 2

Distribution of implants regarding distance to Inferior Alveolar Canal

Distance to Inferior Alveolar Canal	Number of implants	
	n	%
0-0.99 *mm*	560	23.03
1-1.99 *mm*	490	20.15
2 *mm* and above	1382	56.82
Total	2432	100

Table 3

Distribution of sensory complications regarding implants distance to IAC

Distance to IAC	Number of patients	Number of implants	Number of patients with altered sensation	Duration	patients	implants	Distance *mm*	Description of altered sensation	Qualification of the DDS	
									Number of qualified	Number not qualified
0-0.99 *mm*	361	560	348 § (96, 39%) p=0.008	Permanent:	75	121	0-0.45	Numbness 242	1	30
				Transient (6-12months):	134	216	0.46-0.99			
				Transient (Lessthan1 week):	139	223	0.76-1	Frozen 106		
1-1.99 *mm*	316	490	4					Frozen 4	36	28
				Transient (Lessthan1 week):	4	5				
2 and over *mm*	894	1382	-						36	31
Total	1571	2432	352 § p=0.031	Permanent	75	121	0-0.45		-	-
				Transient (4 weeks-12 moths)	134	216	0.46-0.75			
				Transient (Less than 1 week)	143	339	0.76-1.03			

Note: **§** - There are significant differences

All cases of altered sensation after implant surgery occurred when the distance between implant apical tip and upper wall of the canal was between 0 *mm* to 1.5 *mm* p=0.014 with significant differences and that matches the results of many previous studies [*Al-Juboori M et al., 2016; Tufekcioglu S et al., 2017*].

Our study is the first to show that there is a direct relation between the altered sensation after implant surgery and the qualification of the surgeon.

Transient alterations in sensation in 348 patients, the distance between implant apical tip -upper wall of the canal ranged 0-1 *mm* which were done by 34 not qualified maxillofacial surgeons or dental implantologists p=0.0031 (significant difference) because of the lack of experience in the correct planning of the surgery.

Conclusion

There is a direct relationship between the qualification of dental surgeons and the altered sensation after the implant surgery. All dentists who don't have enough surgical qualification, due to the lack of experience did not respect the safe distant of ≥2 *mm*, which lead to deep insertion of the implant near to IAC.

Suggestions and indications

The safe distance between the implant and alveolar nerve canal should be minimum 2 *mm*.

Only the right planning and qualified dentists can stay away from Transient alterations in sensation complications.

Treatment efficacy of these complications should be studied.

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