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Evaluation of postoperative paresthesia following oral surgery in documented cases at forensic medicine

Diş hekimliğinde cerrahi operasyonlar sonrası parestezi gelişen adli vakaların geriye dönük incelenmesi

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ABSTRACT

Objective: Surgical procedures applied in dentistry are open to different complications and one of the most important of these complications is nerve damage. Paresthesia occurs at varying rates according to the degree of damage to the affected nerve. The aim of this study is to compare the surgical procedures applied in cases where paresthesia has occurred.

Methods: The study was designed retrospectively on cases referred to the Department of Dentistry of the 7th Specialization Board of the Council of Forensic Medicine between April 2019 and May 2023, with complaints of paresthesia following oral, dental and maxillofacial surgery operations. A total of 387 surgical procedures were divided into 3 groups as impacted mandibular wisdom tooth surgery, orthognathic surgery and dental implant surgery and the groups were compared with each other. The groups were also evaluated in terms of the technique, patient age and gender, and local factor variables applied within themselves.

Results: Of the cases, 58.9% were female (229 people) and 41.1% (159 people) were male ($p<0.05$) and the mean age was 35.99 ± 10.24. In terms of complication distribution rates, 32.3% (125 people) underwent impacted mandibular wisdom tooth surgery, 18.9% (73 people) underwent orthognathic surgery and 48.8% (189 people) underwent dental implant surgery ($p<0.05$). The amount of tooth eruption in impacted mandibular wisdom tooth surgery, the type of technique applied in orthognathic surgery, and residual bone height/implant length in dental implant surgery were determined as parameters that made a significant difference in the formation of paresthesia ($p<0.01$).

Conclusion: Within the limits of this study, nerve damage and paresthesia most often occur after dental implant surgery and in women. However, it should not be forgotten that there is a risk of paresthesia in all oral surgical procedures, and all kinds of precautions should be taken meticulously in order to prevent this situation.

Keywords: *Paresthesia, dental implant, impacted mandibular wisdom tooth, orthognathic surgery*

ÖZET

Amaç: Diş hekimliğinde cerrahi müdahaleler çeşitli başarısızlıklar içermektedir, bunlardan en önemlilerinden biri de sinir hasarlarıdır. Sinire verilen hasarın derecesine göre değişen oranlarda paresteziler görülebilmektedir. Bu çalışmanın amacı parestezi görülen vakalarda uygulanan oral cerrahi uygulamaların karşılaştırılmasıdır.

Yöntem: Adli Tıp Kurumu 7. İhtisas Kurulu diş hekimliği bölümüne Nisan 2019- Mayıs 2023 arasında intikal etmiş oral, dental ve maksillofasiyel cerrahi operasyonları sonucu parestezi görülen vakalar retrospektif olarak incelenmiştir. Toplam 387 adet vaka gömük mandibular yirmi yaş cerrahisi, ortognatik cerrahi ve dental implant cerrahisi olarak 3 gruba ayrılmış, gruplar birbiriyle karşılaştırılmış aynı zamanda uygulanan teknik, hastaların demografik özellikleri ve lokal faktörler de incelenmiştir.

Bulgular: Vakaların %58,9'u kadın (229 vaka), %41,1'i erkek (159 vaka) ortalama yaş ise 35.99 ± 10.24 olarak gözlenmiştir ($p<0.05$). Başarısızlıkların %32,3'ü gömük mandibular yirmi yaş cerrahisi (125 vaka), %18,9'u ortognatik cerrahi (73 vaka) ve %48,8'i dental implant cerrahisidir (189 vaka) ($p<0.05$). Gömük mandibular yirmi yaş cerrahisinde dişin sürme miktarı, ortognatik cerrahide uygulanan tekniğin tipi, dental implant cerrahisinde ise rezidüel kemik yüksekliği/implantın boyu parestezi meydana gelmesinde istatistiksel olarak anlamlı fark yaratan parametrelerdir ($p<0.05$).

Sonuç: Bu çalışmanın sınırları içerisinde parestezi dental implant cerrahisi neticesinde ve kadın hastalarda daha fazla meydana gelmektedir. Tüm oral cerrahi işlemlerin parestezi meydana gelmesi noktasında risk içerdiği ve bu durumundan sakınmak için tüm tedbirlerin titizlikle alınması gerektiği akıldan çıkartılmamalıdır.

Anahtar Kelimeler: *Parestezi, dental implant, gömük mandibular yirmi yaş dişi, ortognatik cerrahi*

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INTRODUCTION

Surgical procedures in dentistry can lead to disruptions in normal sensory functions. These sensory abnormalities, generally referred to as paresthesia, can range from partial and temporary sensory loss to a more extensive area and even permanent sensory loss, depending on the affected nerve and the severity of the nerve damage. Changes in sensory perception in the orofacial region can lead to difficulties in speech, chewing, and social interactions. Even minor sensory damage can significantly impact a patient's quality of life. In Steadman's Medical Dictionary, paresthesia is defined as an abnormality in sensory functions, such as burning, tingling, tickling, or numbness. Paresthesias are one of the largest groups within neuropathies. Subgroups of paresthesias include complete loss of sensory sensation (anesthesia), burning or tingling sensation (dysesthesia), painful response to normal stimuli (allodynia), or a significantly painful response to all stimuli (hyperesthesia) (1, 2).

The mandibular nerve is the largest branch of the trigeminal nerve and is most likely to be damaged during oral surgical procedures. It is responsible for the sensory perception of the lower lip, chin, lower jaw soft tissues, teeth, and the sense of touch in the mandibular region. When compared to the infraorbital nerve, the inferior alveolar nerve (IAN) and lingual nerve (LN) are more likely to be damaged in the branches of the mandibular nerve. Additionally, the mandibular nerve supports chewing muscles with its motor fibers. These motor fibers do not get damaged during oral surgeries because they separate from the mandibular nerve at the exit of the oval foramen. Sensory fibers for the lingual region enter within the mandibular nerve. Damage to the mandibular nerve during implant surgery can occur anywhere along its course from where it enters the lingula to its exit through the mental foramen (3-5).

The classification by nerve injuries was first defined by Sudden in three categories in 1943 and then modified by Sunderland into five subcategories in 1951 (6, 7). This classification is based on the severity of axonal damage. Neuropraxia represents the mildest form of nerve injury, where there is no visible damage to the axon or epineurium, and nerve conduction is not interrupted. Axonotmesis describes axonal damage that may result in degeneration or regeneration, while neurotmesis is the most severe injury involving damage to the nerve sheath and the nerve itself. In some cases, partial recovery may occur, but complete recovery is not always possible.

There are several local and host-related factors that influence the neurological response to nerve injuries. The type and severity of the injury are the most important local factors. In general, injuries occurring in the proximal part of a peripheral nerve (e. g. , ramus) are more significant than those occurring in the distal part (e. g. , mental foramen). Proximal nerve injuries carry a higher risk of trigeminal ganglion cell damage and, therefore, a greater potential for retrograde differentiation in the central nervous system. Among host factors associated with nerve injuries, the greatest risk is often related to the patient's age and gender. Numerous studies have reported a higher incidence of nerve damage in older individuals and in females (8, 9).

Impacted mandibular wisdom teeth surgery (IMWTS), teeth may be necessary for various reasons such as recurrent acute or chronic pericoronitis, orthodontic indications, crowding of anterior teeth, untreated caries, cysts or tumors, and periodontal diseases. Following IMWTS, complications may include pain, swelling, trismus, infection, tooth or jaw fractures, and displacement of the tooth into adjacent anatomical structures. Temporary and permanent sensory losses can also occur as a result of IAN or LN injury. Factors influencing the incidence of paresthesia include the experience of the performing surgeon, surgical technique employed, anatomical variations, duration of the procedure, position of the impacted tooth, and retraction of the lingual flap (10-13).

Orthognathic surgery (OS) is performed to correct congenital or acquired facial deformities. Bilateral Sagittal Split Osteotomy (BSSO) is one of the most commonly used techniques for the rehabilitation of various jaw deformations. In many cases, Le Fort 1 osteotomy is indicated in conjunction with BSSO (14). However, like all oral surgeries, orthognathic surgery carries certain risk factors for complications. In sagittal split osteotomies, damage to the nerve can occur directly with a saw or burr, or indirectly due to postoperative edema and/or hematoma. The risk of nerve injury increases in Le Fort 1 and genioplasty procedures. In genioplasty surgery, bilateral mental foramina are fully exposed, increasing the incidence of sensory dysfunction due to potential damage to the cranial nerves (15).

Dental implant surgery (DIS) is considered a standard option for prosthetic rehabilitation in cases of posterior tooth loss. Proper preoperative planning is essential to ensure the appropriate implant position, diameter, and length, and to avoid damage to anatomical structures such as the maxillary sinus or mandibular canal (16). Incorrect implant placement can lead to varying degrees of temporary or permanent damage to the nerve structure, potentially causing complications such as paresthesia or dysesthesia due to compression on the nerve following implant loading. To prevent such complications, the position of the mandibular canal and the appropriate implant length should be carefully analyzed before surgery (17).

The aim of this retrospective study was to evaluate potential risk factors before procedures that have resulted in paresthesia in patients referred to the Forensic Medicine Institute 7th Specialization Board Dentistry Department. The study also aimed to examine nerve injuries observed at varying rates depending on the technique used in the relevant procedure and provide guidance to healthcare professionals on how to avoid potential complications.

METHODS

The study was designed retrospectively on cases referred to the Department of Dentistry of the 7th Specialization Board of the Council of Forensic Medicine between April 2019 and May 2023 and approved by Committee of Education and Scientific Research, Council of Forensic Medicine, 21589509/2023/906, with complaints of paresthesia following oral, dental and maxillofacial surgery operations. After the operations were grouped under 3 main headings: IMWTS, OS and DIS, each group was divided into subgroups and evaluated according to the applied technique and local factors.

Classification of each group within itself: Classification of subgroups in IMWTS; number of the tooth (number 38, lower left wisdom teeth, number 48, lower right wisdom teeth), position of the tooth (distoangular, horizontal or mesioangular), amount of eruption of the tooth (with mucosa or bone retention), buccolingual angulation of the tooth (buccal/lingual inclination or non-inclination) and localization of paresthesia (tongue, lip or tongue + lip), subgroups in OS; depending on the surgical technique applied: Bilateral Sagittal Split Osteotomy (BSSO), BSSO + Genioplasty or BSSO + Le Fort 1 Osteotomy, and subgroups in DIS; the length of the implant (≤ 8 mm or ≥8mm), residual bone height (≤10mm or ≥10mm) and position of the implant (premolar region as anterior, molar region as posterior).

The data was analyzed through the Statistical Package for the Social Sciences (SPSS) 26. 0 Statistics package program. Categorical data of the cases are given as numbers and percentages, and numerical data are given as mean, standard deviation, median, minimum and maximum. The suitability of the age variable of the cases to normal distribution was determined by looking at the skewness and kurtosis values. It was observed that the age values of the cases followed the rules of normal distribution. The reference value taken in normal distribution is between ±1. 96.

Chi-Square Concordance Test was used to determine the difference between the distribution rates of various variables of the cases. Chi-Square test was used to compare complication rates according to gender and age. One-Factor ANOVA test was used to examine the differences between ages according to complication status. Post Hoc tests were used to determine the differences between different groups. In the entire study, significance levels were determined by taking into account the values of 0. 05 and 0. 01.

RESULTS

A total of 387 patients with paresthesia following oral, dental, and maxillofacial surgery operations participated in the study. The demographic characteristics of the patients are shown in Table 1.

Significant differences were observed in the gender distribution of the cases (p<0.05). 58.9% of the cases were female (229 people), and 41.1% were male (159 people). When examining the age distribution, significant differences were observed among the groups (p<0.05). 50.6% of the cases were aged 18-34 (196 people), 32% were aged 35-44 (124 people), and 17.3% (67 people) were 45 years and above. According to these results, the incidence rates of cases between the ages of 18-34 were higher compared to the rates in the ages of 35-44 and 45 and above groups. As age increased, the incidence rates decreased. The youngest age was 18, and the oldest age was 67. The average age of the cases was 35. 99 ± 10. 24 years.

Significant differences were observed among the groups in the formation of paresthesia (p<0.05). 32.3% of the cases (125 people) underwent IMWTS, 18.9% (73 people) underwent OS, and 48.8% (189 people) underwent DIS. The distribution of complications is shown in Figure 1.

In cases undergoing IMWTS, there were no significant differences in tooth number, tooth

Table 1. Descriptive analysis of patients with paresthesia following oral surgical procedures

		n	%	p
Gender	Female	228	58,9	**0,000****
	Male	159	41,1	
Age	18-34	196	50,6	**0,000****
	35-44	124	32,0	
	45+	67	17,3	
Complications	Impacted Mandibular Wisdom Teeth Surgery	125	32,3	**0,000****
	Orthognathic Surgery	73	18,9	
	Dental Implant Surgery	189	48,8	
		Ave.±S.D Med. (Min.-Max.)		
Age		35,99±10,24 34 (18-67)		

*p<0,05, **p<0,01, $\chi 2$: Chi-Square Concordance Test

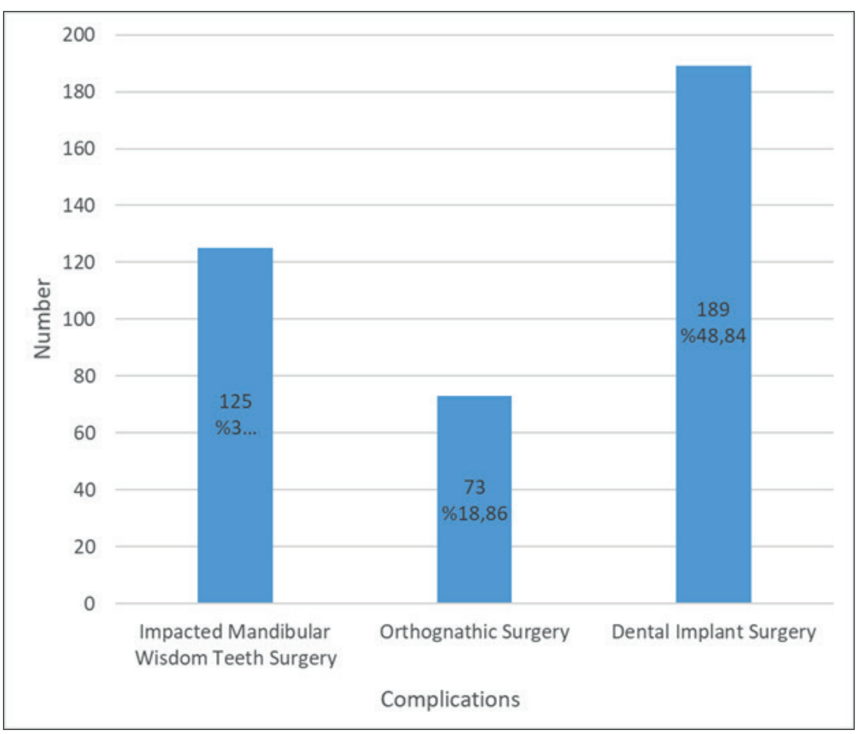

Figure 1. The distribution of complications in oral surgical procedures

position, buccolingual angulation, and paresthesia localization parameters (p>0.05), but there was a significant difference in tooth eruption amount (p<0.05). 28% of the cases had mucosal retention (35 people), and 72% had bone retention (90 people). Significant differences were observed among the surgical techniques used in OS (p<0.05). 24.7% of the cases underwent BSSO (18 people), 53.4% underwent BSSO+Genioplasty (39 people), and 21.9% underwent BSSO + Le Fort 1 surgical technique (16 people). In the DIS group, there was no significant difference in implant position (p>0.05), but significant differences were observed in implant length and residual bone height distribution rates (p<0.05). 31.7% of the cases had implant lengths ≤8mm, and 68.3% had implant lengths ≥8mm. 61.9% of the cases had residual bone heights ≤10mm, and 38.1% had residual bone heights ≥10mm. According to these results, the incidence rates of cases with implant lengths above 8mm and residual bone heights below 10mm were higher compared to those with implant lengths below 8mm and residual bone heights above 10mm (Table 2).

The comparison of complication rates according to the gender and age of the groups is shown in Table 3. While there were no significant differences in gender distribution based on complication status

Table 2. The distribution rate of various variables in oral surgical procedures

Surgical Procedure	Variable		n	%	p
Impacted Mandibular Wisdom Teeth Surgery (n:125)	Number of tooth	38	72	57,6	0,089
		48	53	42,4	
	Position of tooth	Distoangular	47	37,6	0,185
		Horizontal	46	36,8	
		Mesioangular	32	25,6	
	Amount of eruption	Mucosal retention	35	28,0	**0,000****
		Bone retention	90	72,0	
	Buccolingual inclination	Buccal inclination	39	31,2	0,483
		Lingual inclination	48	38,4	
		Non-inclination	38	30,4	
	Localization of paresthesia	Tongue	51	40,8	0,142
		Lip	33	26,4	
		Tongue+Lip	41	32,8	
Orthognathic Surgery (n:73)	Surgical technique	BSSO	18	24,7	**0,001****
		BSSO + Genioplasty	39	53,4	
		BSSO + Le Fort 1	16	21,9	
Implant Surgery (n:189)	Length of implant	≤ 8mm	60	31,7	**0,000****
		≥ 8mm	129	68,3	
	Height of residual bone	≤ 10mm	117	61,9	**0,001****
		≥ 10mm	72	38,1	
	Position of implant	Anterior	101	53,4	0,344
		Posterior	88	46,6	

*p<0,05, **p<0,01, $\chi 2$: Chi-Square Concordance Test

Table 3. The comparison of complication rate according to the gender and age

		Impacted Mandibular Wisdom Teeth Surgery (n:125)		Orthognathic Surgery (n:73)		Dental Implant Surgery (n: 189)		
N		%	n	%	n	%	p	
Gender	Female	72	57,6	48	65,8	108	57,1	0,418
	Male	53	42,4	25	34,2	81	42,9	
Age	18-34	49	39,2	63	86,3	84	44,4	**0,000****
	35-44	54	43,2	9	12,3	61	32,3	
	45+	22	17,6	1	1,4	44	23,3	
		Ave.±S.D Med. (Min.-Max.)		Ave.±S.D Med. (Min.-Max.)		Ave.±S.D Med. (Min.-Max.)		p
AgeF		36,85±9,00 39 (19-56)		27,93±6,40 26 (18-46)		38,54±10,67 38 (20-67)		**0,000****

*p<0,05, **p<0,01, $\chi 2$: Chi-Square Concordance Test (Categoric Variables), F: One Way ANOVA

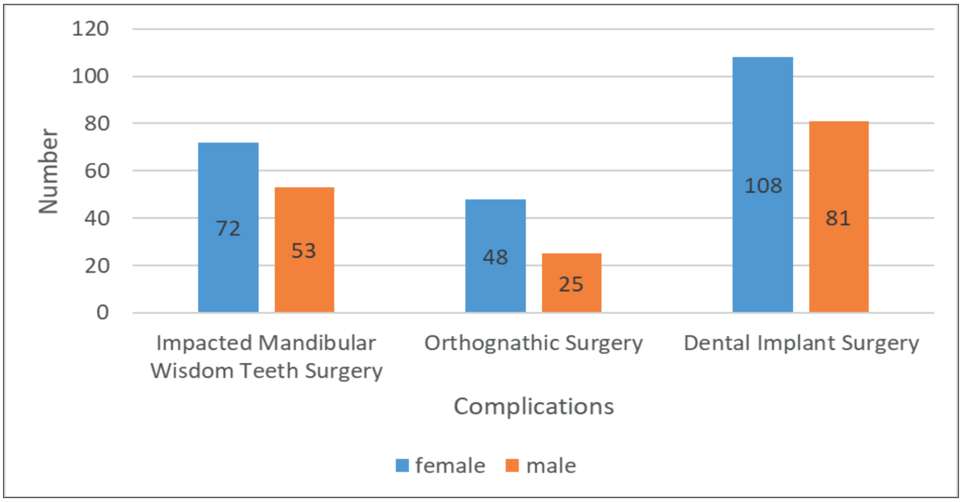

Figure 2. Gender distribution based on complication status

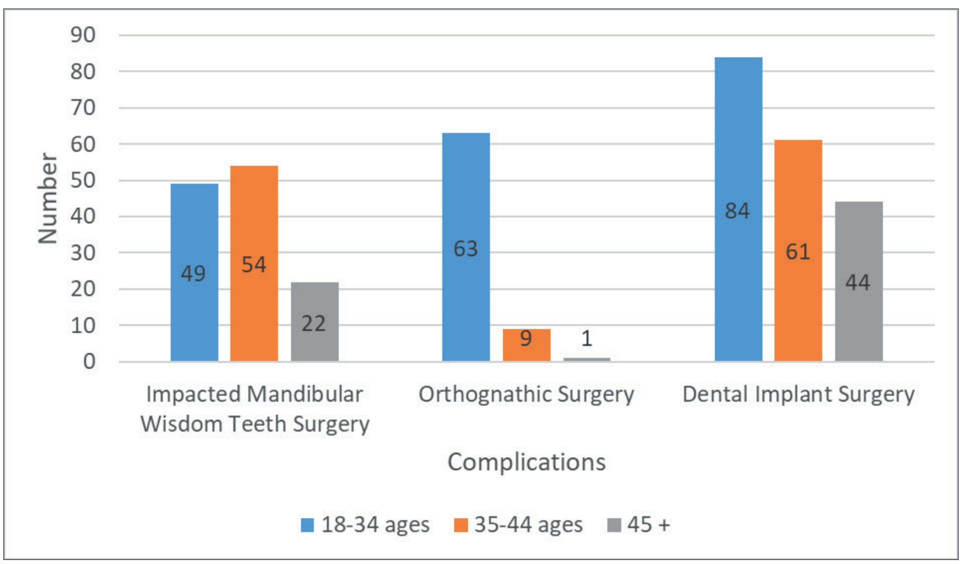

Figure 3. Age distribution based on complication status

(p>0.05), (Figure 2), significant differences were observed in age distribution based on complication status (p<0.05). The number and percentages of complications observed in the 18-34 age group were 86.3% orthognathic surgery, while the majority of cases in the 35-44 and 45 and above age groups underwent impacted third molar and implant surgery (Figure 3).

There were significant differences in the average age based on complication status among the groups (p<0.05). The average age of cases undergoing IMWTS was 36. 85, cases undergoing OS was 27. 93, and cases undergoing DIS was 38. 54. According to these results, the average age of cases undergoing impacted third molar surgery was lower than the average age of cases undergoing orthognathic and implant surgery (Figure 4). The comparison of parameters related to IMWTS, OS, and DIS according to the gender of the cases is shown in Table 4. There were no significant differences were observed in the specified parameters (p>0.05).

The comparison of parameters related to IMWTS, OS and DIS according to the age of the cases is shown in Table 5. In the group undergoing impacted wisdom teeth surgery, there were no significant differences in tooth number, tooth position, buccolingual

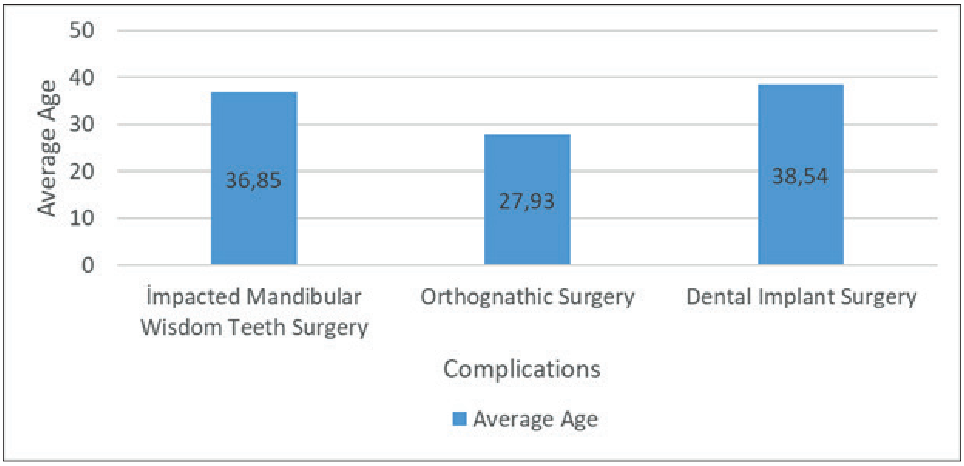

Figure 4. Average age based on complication status

Table 4. The comparison of parameters according to the gender of the cases

Surgical Procedure	Variable n		Female		Male		
			%	n	%	p	
Impacted Mandibular Wisdom Teeth Surgery (n:125)	Number of tooth	38	44	61,1	28	52,8	0,458
		48	28	38,9	25	47,2	
	Position of tooth	Distoangular	24	33,3	23	43,4	0,158
		Horizontal	25	34,7	21	39,6	
		Mesiongular	23	31,9	9	17,0	
	Amount of eruption	Mucosal retention	24	33,3	11	20,8	0,178
		Bone retention	48	66,7	42	79,2	
	Buccolingual angulation	Buccal inclination	24	33,3	15	28,3	0,309
		Lingual inclination	30	41,7	18	34,0	
		Non-inclination	18	25,0	20	37,7	
	Localisation of paresthesia	Tongue	33	45,8	18	34,0	0,307
		Lip	19	26,4	14	26,4	
		Tongue and lip	20	27,8	21	39,6	
Orthognathic Surgery (n:73)	Surgical technique	BSSO	9	18,8	9	36,0	0,188
		BSSO + Genioplasty	29	60,4	10	40,0	
		BSSO + Le Fort 1	10	20,8	6	24,0	
Dental Implant Surgery (n:189)	Length of implant	≤ 8mm	33	30,6	27	33,3	0,804
		≥ 8mm	75	69,4	54	66,7	
	Height of residual bone	≤ 10mm	73	67,6	44	54,3	0,088
		≥ 10mm	35	32,4	37	45,7	
	Position of implant	Anterior	59	54,6	42	51,9	0,817
		Posterior	49	45,4	39	48,1	

*p<0,05, **p<0,01, $\chi 2$: Chi-Square Concordance Test

Table 5. The comparison of parameters according to the age of the cases

Surgical Procedure	Variable n		18-34		35-44		45+		
			%	n	%	n	%	p	
Impacted Mandibular Wisdom Teeth Surgery (n:125)	Number of tooth	38	25	51,0	32	59,3	15	68,2	0,379
		48	24	49,0	22	40,7	7	31,8	
	Position of tooth	Distoangular	21	42,9	15	27,8	11	50,0	0,180
		Horizontal	14	28,6	26	48,1	6	27,3	
		Mesiongular	14	28,6	13	24,1	5	22,7	
	Amount of eruption	Mucosal retention	17	34,7	9	16,7	9	40,9	**0,042***
		Bone retention	32	65,3	45	83,3	13	59,1	
	Buccolingual angulation	Buccal inclination	19	38,8	15	27,8	5	22,7	0,152
		Lingual inclination	20	40,8	17	31,5	11	50,0	
		Non-inclination	10	20,4	22	40,7	6	27,3	
	Localisation of paresthesia	Tongue	18	36,7	22	40,7	11	50,0	0,676
		Lip	15	30,6	12	22,2	6	27,3	
		Tongue and lip	16	32,7	20	37,0	5	22,7	
Orthognathic Surgery (n:73)	Surgical Technique	BSSO	15	23,8	2	22,2	1	100,0	0,680
		BSSO + Genioplasty	34	54,0	5	55,6	0	0,0	
		BSSO + Le Fort 1	14	22,2	2	22,2	0	0,0	
Dental Implant Surgery (n:189)	Length of implant	≤ 8mm	31	36,9	19	31,1	10	22,7	0,260
		≥ 8mm	53	63,1	42	68,9	34	77,3	
	Height of residual bone	≤ 10mm	50	59,5	39	63,9	28	63,6	0,833
		≥ 10mm	34	40,5	22	36,1	16	36,4	
	Position of implant	Anterior	47	56,0	33	54,1	21	47,7	0,670
		Posterior	37	44,0	28	45,9	23	52,3	

*p<0,05, **p<0,01, $\chi 2$: Chi-Square Concordance Test

angulation, and paresthesia localization among the age groups (p>0.05), but there was a significant difference in tooth eruption amounts (p<0.05). The rate of bone retention in cases aged 35-44 was higher than in cases aged 18-34 and 45 and above. In the group undergoing orthognathic surgery, there were no significant differences in surgical techniques among the age groups (p>0.05). In the group undergoing implant surgery, there were no significant differences in implant length, residual bone height, and implant position distribution among the age groups (p>0.05).

DISCUSSION AND CONCLUSION

After oral, dental, and jaw surgery operations, many complications can occur. Factors such as the surgical technique performed, host factors, and the experience of the surgeon can affect the incidence of complications (18). Paresthesias resulting from nerve damage are one of the most commonly encountered complications. Temporary or permanent paresthesias that occur after oral surgical procedures not only reduce the patients' quality of life but also can lead to legal issues between the surgeon and the patient (19). Especially in recent years, the increased use of dental implants and orthognathic surgical procedures, along with the inherent risk of nerve damage and paresthesia associated with impacted mandibular wisdom teeth surgery, has led to a significant increase in legal cases. Detailed preoperative history and necessary radiological assessments, careful evaluation of potential risk factors and anatomical variations, informing patients about risks, and obtaining informed consent are of great importance in this regard (20).

In this study, which retrospectively examined cases received by the Institute of Forensic Medicine 7th Specialization Board between April 2019 and May 2023, oral surgical procedures were divided into three groups: impacted mandibular wisdom teeth surgery, orthognathic surgery, and dental implant surgery. Among the cases examined, it was observed that dental implant surgery was the procedure most commonly associated with the formation of paresthesia, followed by impacted mandibular wisdom teeth surgery and orthognathic surgery.

Pogrel and Tamby reported in their study of 163 patients that inferior alveolar or lingual nerve injuries were significantly more common in women than in men, and the surgical procedures most frequently causing nerve damage were, in order, third molar extraction, implant surgery, and orthognathic surgery (21). Tay and colleagues, in their study of 59 patients, found that the most common etiology of trigeminal nerve injuries was lower third molar surgery (52.1%), followed by orthognathic surgery (12.3%) and implant surgery (11%). They also reported that the inferior alveolar nerve was more frequently injured (64.4%) compared to the lingual nerve (28.8%) (22).

In our study, the number of female patients was significantly higher than male patients, and there are many studies in the literature reporting that paresthesia is more common in female patients after oral surgical procedures. While publications have indicated advancing age as a risk factor for nerve damage and paresthesia formation after oral surgical procedures, our study showed that as age increases, paresthesia cases decrease (23-25).

The most important risk factor for implant-related nerve damage and paresthesia formation is the reduction in residual bone height due to alveolar bone resorption. Detailed examinations should be conducted through panoramic radiography and dental volumetric tomographies taken before the procedure. In recent years, access to dental volumetric tomographies has become easier, and they are often preferred due to their low radiation dose. With the help of dental volumetric tomographies taken from patients before the procedure, distances to the mandibular canal and mental foramen can be seen with millimetric precision in cross-sectional views, thus preventing nerve damage through appropriate implant selection. In cases where resorption has increased and bone height has decreased, dental volumetric tomography should definitely be obtained before implant surgery (26, 27).

Placement of the implant inside the mental foramen or in close proximity to the inferior alveolar nerve can result in paresthesia due to early inflammation or compression on the nerve. In one study, sensory dysfunction was reported in the range of 0-13% after implant placement in atrophic mandibles (28), while another study indicated temporary paresthesia in the range of 3-14% and permanent paresthesia in 4% of cases (29). There are studies in the literature that recommend leaving a distance between the apex of the implant and the inferior alveolar nerve. Bartling and colleagues (30) recommended leaving a safe area of 2 mm based on panoramic radiography and 1 mm based on tomographic images between the implant apex and the nerve.

In a study conducted by G. Sammartino et al. (31) on mandibular models prepared in a laboratory setting, they assessed the pressure on the inferior alveolar nerve by applying force to implants placed at different proximities to the mandibular canal. Their study recommended leaving a minimum distance of 1. 5 mm between the implant apex and the mandibular canal. Additionally, they noted that as bone density decreases, the potential compression effect on the nerve would increase. Therefore, they recommended increasing the safety distance in low-density residual bone.

Choi et al (32) stated that direct contact between the implant and the nerve was necessary for nerve damage, observed in their study that 10.1% of patients with sensory dysfunction had contact between the implant and the nerve.

Padmanabhan et al. (33) reported in their review that there is a higher risk of nerve damage in implants placed in the anterior region (premolar area) of the mandible compared to the posterior region (molar area). This contradicts the theory that implants are more apically placed than planned and the potential pressure exerted by the implant on the nerve would more easily affect the nerve due to the thinner cortical layer and denser trabecular bone in the posterior mandible.

In our study, it was found that nerve damage and paresthesia occurred more frequently in cases with low residual bone height and longer implants, which was in line with other studies in the literature (34-36). While there was no significant difference in the occurrence of paresthesia in implants placed in the premolar or molar area in the cases we examined, risk factors such as perforation of the mandibular canal during implant socket preparation or implant placement deeper than intended should not be overlooked, especially due to decreasing bone density in the posterior region. Additionally, the possible superior course of the mental foramen in the anterior region is another risk factor to consider.

Patients' conditions should be monitored following risky implant surgeries with regards to nerve damage. Six hours after the procedure, the full effect of local anesthesia is expected to wear off. If the patient still reports complete numbness, the physician should suspect that something has gone wrong and potential nerve damage. Additionally, the presence of complaints such as tingling, tickling, or burning should raise suspicion of possible nerve damage. If there is arterial or venous bleeding during implant socket preparation, the implant should not be placed. The dentist has responsibility after implantation and should follow up the process to avoid legal problems.

The extraction of impacted or partially impacted wisdom teeth is one of the most common dentoalveolar surgical procedures. Wisdom teeth are in close proximity to important anatomical structures such as the IAN and LN. The main risk factor for IAN injury is the proximity of the tooth to the nerve. In some cases, the tooth is so close to the nerve that nerve damage is inevitable, and this situation can lead to legal problems between the physician and the patient (37). It is essential to inform the patient before operation about anatomical condition and potential risks.

In the literature, it is reported that IAN injuries following impacted wisdom tooth surgery are temporary in 1-20% of cases and permanent in 0-2% of cases, and risk factors for complications following wisdom tooth surgery include being 30 years or older, being a female patient, increased impaction degree of the tooth, and the need for root separation (38, 39). In our study, there was no significant difference in terms of tooth number, position, bucco-lingual angulation, and paresthesia localization in the impacted wisdom tooth surgery group. However, there was a significant difference in the impaction degree of the tooth parameter, where the risk of paresthesia increases as the degree of impaction of the tooth increases.

There are studies in the literature reporting sensory damage after orthognathic surgical procedures ranging from 0% to 72% (40). In a systematic review published by Collela and colleagues, reported that one week after the BSSO procedure, sensory loss was 63.3% based on objective criteria and 83% based on subjective criteria (41). Philips et al (42) stated that six months after orthognathic surgery, the most common complaints among patients were sensory loss, followed by burning and throbbing sensations. Walter and Gregg (43) observed immediate mental numbness in all patients after BSSO, and six months post-operation, this rate was 84.4%, with permanent numbness in patients over 40 years of age. Zaytoun et al (44) reported that simultaneous genioplasty with BSSO is an important risk factor for nerve damage.

Factors affecting the development of sensory damage after the BSSO procedure include advanced patient age, direction and amount of mandibular movement, undesired osteotomy, manipulation of the mandibular nerve, excessive bleeding during the procedure, simultaneous genioplasty or third molar extraction, the use of rigid or intermaxillary fixation, local anesthesia, and the surgeon's experience. In our study, the group that underwent genioplasty along with BSSO had significantly higher paresthesia, which is consistent with the literature. We believe that the most significant risk factor for paresthesia development in the genioplasty procedure is the exposure of bilateral mental foramina.

The assessment of trigeminal nerve injuries includes the date of the incident, clinical evaluation, and objective sensory tests. In many studies, sensory tests have been proven to be successful in diagnosing, prognosing, and evaluating treatment options for trigeminal nerve injuries (45-47). In some cases, iatrogenic nerve damage is accompanied by neuropathic pain, which requires thorough examination. A significant portion of iatrogenic nerve injuries can be prevented with appropriate indications, correct surgical techniques, experience, and proper management of complications. When complications arise, immediate measures should be taken, and treatment should begin because the first few months determine the degree of nerve recovery.

Regarding the limitations of our study, the most important point is that only cases referred to the Institute of Forensic Medicine were evaluated, and the follow-up process of patients after their files were concluded was not tracked. In the management of paresthesia, while no action was taken by the physician in some cases, in others, medication and microsurgical consultations were conducted. However, because the protocols at every stage were not thoroughly communicated to us, the potential for recovery could not be fully assessed. Another limitation is the lack of standardization in radiographs, and some data were missing in post-operative records in some cases.

In conclusion, oral surgical procedures are inherently prone to various complications, and it is the responsibility of the surgeon to prevent these complications through detailed medical history, informed consent, appropriate indications, correct techniques, and managing the resulting complications. To prevent legal issues, medical records related to all procedures performed on the patient should be kept, necessary radiographs should be taken and stored. Taking steps to address the shortcomings of dental practitioners in this regard is crucial in preventing increasing legal issues.

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