



Frequency and risk factors for injury of the inferior alveolar nerve during surgical extraction of the impacted lower third molars

Učestalost i faktori rizika za povredu donjeg alveolarnog nerva u toku hirurške ekstrakcije impaktiranih donjih trećih molara

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Abstract

Background/Aim. The injury of inferior alveolar nerve during a surgical extraction of impacted lower third molars, followed by sensory disturbance, is, for the patient, an extremely unpleasant complication. The aim of this study was to determine the frequency of this complication after the third molar surgery and its frequency depending on a tooth position and tooth relation to the mandibular canal. **Methods.** In this study, 800 surgical extractions of the impacted lower third molar were performed. The position of the impacted tooth was recorded according to the Winter classification, as well as the ratio of their root tips to the mandibular canal using the Tanaka et al. and Rood and Shehab classifications. **Results.** The frequency of the recorded post extraction sensory disturbance was 2.25%, most frequently when teeth were in the mesioangular position. Concerning Tanaka and al. classification, the incidence of injuries was inversely proportional to the increase of distance between roots and mandibular canal with the statistical significance in cases where mandibular

canal overlaps more than a half of the root of the tooth ($p = 0.001$). Considering the radiological signs recommended by Rood and Shehab, a higher frequency of the inferior alveolar nerve injury was recorded when illumination in the area of the root tips was present and when the loss of linear overshadowing characterized by the “roof” and the “bottom” of the mandibular canal were observed, or diversion of the canal and root deflection, but without a statistical significance. **Conclusion.** The superposition of the mandibular canal with the lower third molar roots at the panoramic radiographies may increase a possibility of the inferior alveolar nerve injury. The angulations of the impacted lower third molar as well as the vicinity of the tips of its roots to the content of the mandibular canal, do not significantly affect the frequency of the nerve injury.

Key words:

molar, third; tooth, impacted; tooth extraction; mandibular nerve; oral surgical procedures; paresthesia.

Apstrakt

Uvod/Cilj. Povreda donjeg alveolarnog nerva prilikom hirurške ekstrakcije donjeg impaktiranog umnjaka, praćena poremećajem senzibiliteta, za pacijenta je izuzetno neprijatna komplikacija. Cilj ovog istraživanja je bio da se utvrdi učestalost ove komplikacije posle hirurškog vađenja impaktiranih donjih umnjaka, zavisno od položaja donjeg umnjaka i njegovog odnosa prema mandibularnom kanalu. **Metode.** U studiju je bilo uključeno ukupno 800 hirurški ekstrahovanih impaktiranih donjih umnjaka. Preoperativno je analizom digitalnog ortopantomografskog snimka evidentiran položaj impaktiranih umnjaka prema Winter-ovoj klasifikaciji, kao i odnos njihovih vrhova korenova prema mandibularnom kanalu primenom klasifikacije Tanaka-e i sarad-

nika, kao i Rooda-e i Shehaba-e. **Rezultati.** Učestalost poremećaja senzibiliteta iznosila je 2,25%, najčešće kada je umnjak bio u mezioangularnom položaju. Imajući u vidu klasifikaciju Tanaka-e i saradnika, uočen je značajno veći broj povreda u slučajevima kada mandibularni kanal superponira više od polovine korena impaktiranog umnjaka ($p = 0,001$). Praćenjem rendgenoloških znakova preporučenih od strane Rooda i Shehaba, veća učestalost povreda donjeg alveolarnog nerva zapažena je u slučajevima kada je postojalo rasvetljenje u predelu vrhova korenova i gubitak linijskog zasenčenja „krova” i „poda” mandibularnog kanala ili kada je zapaženo skretanje kanala ili defleksija korenova, ali bez statističke značajnosti. **Zaključak.** Superpozicija mandibularnog kanala sa korenovima donjeg trećeg molara na ortopantomografskom snimku može povećati mogućnost

povrede donjeg alveolarnog nerva. Angulacija impaktiranih donjih umnjaka, kao odnos vrhova njihovih korenova prema sadržaju mandibularnog kanala, ne utiču značajno na učestalost povrede nerva.

Introduction

The injury of the inferior alveolar nerve during a surgical extraction of the impacted lower third molars is relatively rare complication, but for the patient an extremely unpleasant one. It can occur indirectly (infection in the post-extraction area, pressure of postoperative hematoma and/or oedema on the nerve), or directly (injuries due to intimate contact of the lower third molar roots and the nerve)¹. This injury manifests by a permanent or transient sensitivity disturbance in the area of nerve innervation of varying intensity. Clinically, sensory deficits are classified as: paraesthesia (neuropraxia and axonotmesis) and anaesthesia (neurotmesis)². Neuropraxia is the easiest degree of the sensitivity disturbance and presents the appearance of mild paraesthesia in the form of tingling, burning and numbness in the nervous distribution area³. It is usually due to ischemia or compression of the nerve, while its structure is still preserved⁴. Axonotmesis is a severe sensory disturbance that manifests itself as hyperalgesia (overstimulation on stimuli) or allodynia (pain caused by harmless stimuli)⁵. It occurs due to the interruption of certain axons in the structure of the nerve with consequent Wallerian degeneration, but still with the preserved myelin coating⁶. Neurotmesis is a permanent and complete absence of sensitivity caused by a complete breakdown of the morphological continuity of the nerve.

The degree of restoration of sensitivity depends on the extent of the damage. The outcome after neuropraxia is most often a complete recovery of sensitivity by the end of the fourth month at the latest⁷. Axonotmesis is usually accompanied by an incomplete recovery of sensitivity, especially if the disturbance lasts longer than six months⁴, while anaesthesia in neurotmesis, which lasts longer than a month, is usually permanent⁷. A higher degree of recovery can be expected in younger people, with a good general condition, with good vascularization of the tissue, without the presence of a foreign body and with a preserved epineural coat⁸.

The aim of this study was to determine the frequency of occurrence of sensory deficits in the innervation distribution of the lower alveolar nerve after surgical extraction of the impacted lower third molar, as well as the frequency of this complication, depending on a tooth position and its relation to the mandibular canal.

Methods

The research was conducted as a prospect clinical study in the period from 2009 to 2017 at the Department of Oral Surgery, Faculty of Medicine in Kosovska Mitrovica. The study included 687 people of both sexes from the northern part of Kosovo and Metohija, aged 17–60 years, who had

Ključne reči:

molar, treći; zub, impakcija; zub, ekstrakcija; n. mandibularis; hirurgija, oralna, procedure; paresteija.

800 surgical extractions of the impacted lower third molars. The study excluded people with a history of some neurological disease. The preoperative plan involved an analysis of digital panoramic radiographs of each patient. The position and angulation of impacted teeth were analysed according to the Winter classification. The study included the teeth in the most common positions - mesioangular, vertical, horizontal and distoangular⁹. Also, the relationship of the root tips of the impacted teeth and the mandibular canal was analysed using the classification by Tanaka et al.¹⁰ and Rood and Shehab¹¹ (Figures 1 and 2). The cases that were classified in the first three classes by Tanaka et al.¹⁰ were further analysed by the Rood and Shehab classification. According to this classification, seven X-ray signs or indications of a close contact between the tips of the roots of the lower third molar and the contents of the mandibular canal were proposed (Figure 2).

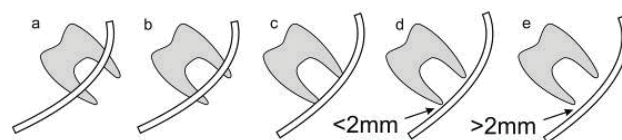


Fig. 1 – Classification by Tanaka et al.¹⁰: a) Class I – the canal overlaps more than a half of the root of the tooth; b) Class II – the canal overlaps less than a half of the root of the tooth; c) Class III – the root reaches to the upper limit of the mandibular canal; d) Class IV – the distance between the root and the top of the canal is less than 2 mm; e) Class V – the distance between the root and the upper edge of the canal is more than 2 mm.

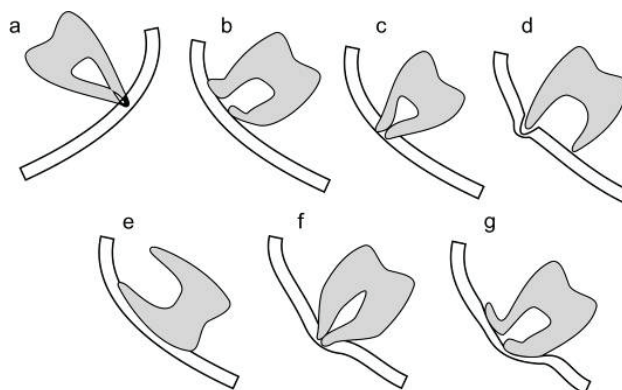


Fig. 2 – Classification by Rood and Shehab¹¹: a) X-ray illumination of tooth root; b) deflection of tooth root; c) narrowing of the root; d) lightness and bifid root apex; e) interruption of the “white” line, i.e., X-rays of linear shadow, which delineates “roof” or “bottom” of the mandibular canal (interruption of white line of the canal); f) diversion of the canal; g) narrowing of the canal.

In all patients included in this study, the surgical extractions of the impacted third molars were performed in local block anaesthesia for the inferior alveolar nerve (HCR 4% + Epinephrine 1:100.000, 1.7 mL), with the use of standard triangular flap and buccal approach to the impacted lower third molar. Osteotomy and, if necessary, a separation of crown and/or roots of the impacted teeth was performed using the round and fissure carbide drills with a minimal trauma to the surrounding jawbone and mandatory cooling with saline to prevent or reduce the surgical trauma of the mandibular canal. After the extraction, antibiotic and/or analgesic therapy was prescribed when needed.

The post-operative follow-ups were performed on the first and the seventh post-operative day. To the patients with the sensitivity disturbances registered in the innervated area of the lower alveolar nerve, the complex of vitamin B (Beviplex N, Galenika A.D. Serbia) was administered in the next four weeks, in a dose of one coated tablet daily, and, in the same period of time, infrared therapy was applied locally (Infrared lamp, Medisana IRL), three times a week, lasting 15 minutes, from a distance of 40 cm. The patients with persistent paraesthesia after this period were called for screening twice a month until the total absence of symptoms. Anamnesis and three types of clinical tests were used to determine the existence of the sensory deficiency:

Pin-prick test was performed with a dental probe placed on the surface of the skin or mucous membrane, and then used for a light prick of the tissue, with the simultaneous assessment of painful perception of the patient. Each area was examined three times consecutively, bilaterally, and the patient was asked to point to any difference in sensation between the two sides. The test was performed in the skin area of the corners of the mouth and mucous membranes from the vestibular side in the area of the canines¹².

The light touch test was performed by a tactile stimulation of the patient's skin. A ball of cotton wool was used to gently touch the skin at the corners of the lips, concentrically, gradually spreading towards the periphery until the patient felt touch, which made it possible to map the area with a loss of sensation¹²;

The two-point discrimination test – this test was performed using a ten-millimetre scale divider. The tips of the divider at a distance of 2 mm were placed on the skin at the corners of the mouth with continuous pressure, and the patient was asked whether he felt pressure in one or two points. Whenever the patient gave an incorrect response, the distance of the divider peaks for the next test would increase and whenever the patient gave the correct answer the distance of the divider peaks for the next test would be reduced

until the smallest distance in which the patient could feel the pressure in two spots was defined. The distance obtained was compared with the reference values. With the preserved sensitivity in the corner of the lips, the pressure in two spots could be different at their distance from 2 mm to 4 mm and in the lower edge of the mandible at the distance of 8 mm to 10 mm¹³. The minimum distance of two spots where the pressure might vary was usually greater on the side of the damage¹⁴.

The results were presented in percentages and ratios. A binomial test was used to analyse the frequency of events of interest. For the multiple variables testing, Bonferroni correction was applied. All *p* values less than 0.05 were considered significant. All analyses were performed in the R programming language and environment (R Core Team, 2014).

Results

Of the total number of surgically extracted the impacted lower third molars, the occurrence of sensory disturbances was recorded at 18/800 or 2.25%. In all patients, in the observed period of 6 months, full recovery of sensitivity occurred.

Of all recorded cases with the injuries of the lower alveolar nerve, the largest number occurred after the surgical extraction of the impacted lower third molars in the mesioangular position, and the least was registered at distoangular position (Table 1). The statistical analysis of the obtained results showed no statistically significant difference in the incidence of lower alveolar nerve injuries compared to the position of the impacted third molar.

By monitoring a percentage of the sensitivity outbreak in the innervated zone of the inferior alveolar nerve, depending on the relationship of the molar roots and the mandibular canal, the highest percentage of sensitivity disturbance was registered in Class I, then in Class II and the smallest in Class III, according to the Tanaka et al. classification¹⁰ (Table 2). The statistically significant difference was observed in Class I, in the cases where mandibular canal overlapped more than a half of the root of the tooth (*p* = 0.001).

After additional analysis of all registered cases of sensitivity outbreaks in the innervated zone of the inferior alveolar nerve in different classes (Tanaka et al.¹⁰), to which the classification by Rood and Shehab¹¹ was applied, it was concluded that the nerve injuries were more frequently met when the „white” line of the root canal and canal diversion was interrupted and when the root deflection and narrowing of the canal were previously radiographically observed (Table 3), but without a statistical significance.

Table 1

Nerve injury in regard to the angulation of the impacted lower third molar (Winter⁹ classification)

Position of impacted lower third molar	n	Sensitivity disturbance, n (%)		<i>p</i> – value
		with	without	
Mesioangular	336	11 (3.3)	325 (96.7)	0.196
Vertical	242	4 (1.7)	238 (98.3)	0.826
Horizontal	118	2 (1.7)	116 (98.3)	1.000
Distoangular	104	1 (1.0)	103 (99.0)	0.734
Total	800	18 (2.3)	782 (97.7)	

p – values were calculated by comparing each ratio with the ratio 18:782.

Table 2
Nerve injury in regard to the relationship of the molar roots and the mandibular canal (Tanaka et al.¹⁰ classification)

Class*	n	Sensitivity disturbance, n (%)		p – value
		with	without	
I	264	13 (4.9)	251 (95.1)	0.001†
II	157	4 (2.6)	153 (97.4)	0.783
III	188	1 (0.5)	187 (99.5)	0.138
IV	106	0	106 (100)	0.181
V	85	0	85 (100)	0.270
Total	800	18 (2.3)	782 (97.7)	

* – Description of particular class see under Fig. 1.

p – values were calculated by comparing each ratio with the ratio 18:782; † – statistically significant.

Table 3
Nerve injury in regard to the relationship of the molar roots and the mandibular canal (Rood and Shehab¹¹ classification)

Parameters	n	Sensitivity disturbance, n (%)		p – value
		with	without	
Illumination of root	172	7 (4.1)	165 (95.9)	0.362
Deflection of root	174	3 (1.7)	171 (98.3)	0.498
Narrowing of root	0	0	0	-
Lightness and bifid root apex	12	0	12 (100)	1.000
Interruption of white line of canal	140	5 (3.6)	135 (96.4)	0.612
Diversion of canal	67	2 (3.0)	65 (97.0)	1.000
Narrowing of canal	44	1 (2.3)	43 (97.7)	1.000
Total	609	18(3.0)	591 (97.0)	

p – values were calculated by comparing each ratio with the ratio 18:591.

Discussion

Surgical extraction of impacted lower third molars is a common therapeutic procedure in everyday oral surgery. Indications for it are numerous, although it might be followed by several possible complications with the injury of the inferior alveolar nerve being one of the most serious and unpleasant. According to relevant literature, the frequency of this complication ranges from 0.5%^{15,16} to 8%^{17,18}. In our study, the recorded frequency was 2.25%, which is roughly the registered value reported by Rood and Shehab¹¹. Some authors state that the frequency of permanent sensory deficit is between 0.35%¹⁹ and 1.1%²⁰, but there are also those ones who do not record it^{16,21}, which is in correlation with the results of this study.

Some authors considered the possible risk factors that could predict a possibility of occurrence of this complication. In this respect, the incidence of injuries of the inferior alveolar nerve was monitored in relation to a number of factors, such as: gender and age of respondents, experience of a surgeon and a degree of tooth impaction. However, as the most commonly cited factors are angulation of the impacted third molar and the relationship of its roots to the mandibular canal.

According to our results, the favourable position for the injury of the lower alveolar nerve was the mesioangular position of the tooth, but it was not significant. The lowest frequency of the occurrence of this complication was recorded with lower third molars in the distoangular position. Selvi et al.²², Hasegawa et al.²³ and Nguyen et al.²⁴ recorded similar results to ours. However, there are authors who reported different results.

Thus, Jerjes et al.²⁰, showed that the most risky situation for the emergence of a nerve injury is a vertical position and the least risky is horizontal position. The results of our study, however, indicate the importance of careful preoperative planning as well as using an adequate surgical approach in order to prevent the development of this complication.

The relationship between the tips of the roots of the impacted lower third molars and the content of the mandibular canal was also analysed according to their mutual distance, on the panoramic radiographs, using the X-ray classification by Tanaka et al.¹⁰ and the classification by Rood and Shehab¹¹. The results showed that the incidence of injuries was inversely proportional to the increase of a distance between the tip of the tooth roots and the canal. Such results suggest that the presence of a superimposition of roots with a mandibular canal on standard radiographs requires the additional three-dimensional imaging techniques in order to perceive more accurately the relationship of the root tips of the impacted lower third molar to the content of the mandibular canal. Observation of the radiological signs in this study, recommended by Rood and Shehab¹¹, showed a higher possibility of the inferior alveolar nerve injury during the extraction if the illumination in the area of the root tips was present, or the loss of linear overshadowing characterized by the “roof”, i.e., “bottom” of the mandibular canal, as well as when the canal diversion, root deflection and narrowing of the canal were present, which is in accordance with the results of Rood and Shehab¹¹. Valmaseda-Castellón et al.¹⁹ state that only the canal diversion can predict a possible injury of the nerve, while Blaeser et al.²⁵ point out the illumi-

nation of the roots, the loss of the “white” line and the canal diversion as the most risky x-rays indicators. However, in contrast to these studies, in our research, in spite of the greater interrelation of these radiographic signs with the frequency of the occurrence of sensory disturbances, no statistical significance was recorded with any of the mentioned parameters.

It should be noted that in this study articaine was used as local anaesthetic. Some authors state that articaine can induce paraesthesia after the inferior alveolar nerve block. The reason for that, as they state, is the higher concentration of anaesthetic (4%) compared to lidocaine (2%) and, eventually, a greater potential to cause neurotoxicity. However, it is the lingual nerve that is more often affected with this complication (about 89% of all cases)²⁶.

Conclusion

The incidence of the inferior alveolar nerve injury during a surgical extraction of impacted lower molars is approximately 2.25%. The superimposition of the mandibular canal with the lower third molar roots at the panoramic radiography significantly increases a possibility of nerve injury. The angulation of the impacted tooth does not significantly affect the incidence of nerve injury after the surgical extraction, nor does the relationship of the tips of tooth roots to the content of the mandibular canal.

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