Factors Affecting for the Injury of Lingual and Inferior Alveolar Nerve During Third Lower Molar Surgery in the Mandible

Czynniki predysponujące do uszkodzenia nerwu językowego i zębodołowego dolnego podczas usuwania trzecich zębów trzonowych w żuchwie

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article

Abstract

One of the most often performed surgical procedures in the oral cavity is the extraction of teeth, including the extraction of third molars in the mandible. This surgical procedure is conducted as a result of both preventive and health recommendations. In each case, surgeons must take into account the possibilities of different complications. One of the complications can be the dysfunction of the lingual or inferior alveolar nerves, which are sensory branches of trigeminal nerves. Such damages can result in the limitation or total deprivation of sensation, paresthesia, and in extreme cases, even neuralgia within the inferior lip or within the tongue. The factors that have an impact on the damage of the lingual and inferior alveolar nerves may be: the experience of the surgeon, the spatial location of the tooth in the mandible, the type of applied anesthesia (general or local), the surgical access chosen by the surgeon and individual distinctiveness in the anatomy of the third inferior molars. The diversity of branches that route the lingual and inferior alveolar nerves is also of great significance in order to perform the surgery without complications. This paper presents a review of recent literature discussing damages of lingual and inferior alveolar nerves resulting from the extraction of third molars in the mandible (Dent. Med. Probl. 2014, 51, 2, 225–230).

Key words: complications after tooth extraction, extractions of third molars in the mandible, nerve injury after dental procedures.

Streszczenie

Najczęściej wykonywanym zabiegiem z zakresu chirurgii jamy ustnej jest ekstrakcja zębów, w tym chirurgiczna ekstrakcja zębów ósmych w żuchwie. Jest to zabieg wykonywany zarówno ze wskazań profilaktycznych, jak i zdrowotnych. W każdym przypadku usuwania trzecich zębów trzonowych w żuchwie operator musi liczyć się z możliwością powikłań. Do tych powikłań należą m.in.: zaburzenie czynności nerwu zębodołowego dolnego oraz językowego, które są czuciowymi gałęziami nerwu trójdzielnego. Uszkodzenia te mogą skutkować ograniczeniem lub całkowitym zniesieniem czucia,parestezją, a w skrajnych przypadkach nawet neuralgią w obrębie anatomicznej strefy zębów ósmych dolnych. Do przeprowadzenia zabiegu bez powikłań jest ważna także różnorodność przebiegu gałęzi nerwu językowego i zębodołowego dolnego mającą doświadczenie operatora, przestrzenne położenie zęba ósmego w żuchwie, rodzaj zastosowanego znieczulenia (ogólne, miejscowe), dostęp chirurgiczny wybrany przez operatora oraz osobista zmienność w budowie anatomicznej zębów ósmych dolnych. Do przeprowadzenia zabiegu bez powikłań jest ważna także różnorodność przebiegu gałęzi nerwu językowego i zębodołowego dolnego. W pracy przedstawiono przegląd aktualnego piśmiennictwa na temat uszkodzeń nerwu językowego i zębodołowego dolnego, będących następczem ekstrakcji zębów ósmych w żuchwie (Dent. Med. Probl. 2014, 51, 2, 225–230).

Słowa kluczowe: powikłania po ekstrakcji zębów, ekstrakcja trzecich trzonowców w żuchwie, uszkodzenia nerwów po zabiegach chirurgicznych.
The extraction of impacted third inferior molars is a surgical procedure that is most often performed in the oral cavity [1]. One of the complications of extraction concerns the injury of terminal nerves in the third branch of trigeminal nerves – the inferior alveolar nerve and the lingual nerve. IAN – inferior alveolar nerve is the sensory nerve which provides sensation to the inferior of the lip and the angle of the mouth, mucous membranes of the buccal cavity, bone core, the angle of the mandible, and also teeth and periodontal membranes which are located there. The nerve before entering the mandibular canal relays the motor branch (mylohyoid nerve) to the mylohyoid muscle and to anterior belly of digastric muscle. The inferior alveolar nerve leaves the mandibular canal through the mental foramen as a mental nerve in the area of the premolars. LN – lingual nerve belongs to the rear branch of the mandibular nerve and provides sensation in two-thirds of anterior part of the tongue at the same side. Apart from that, by anastomosis with chorda tympani, it guides taste and secretory fibers to two-thirds of the tongue on the same side. The lingual nerve, after being separated from the mandibular nerve in infratemporal fossa, runs under the inferior edge of the lateral pterygoid muscle, where it enters the pterygomandibular space. It runs further between the branch of the mandible and internal pterygoid muscle. Finally, it comes down to the floor of mouth in the area of the third molar [2].

Sensory nerve damage during extraction can be direct or indirect. Direct damage constitutes the damage of nerve fiber by surgical tools or rotary instruments with total or partial disruption of its continuity. Indirect damage can be caused by pressure that is the result of growing hematoma and parts of tissues (moveable bone lamella, parts of teeth) as well as from thermal overheating of bones during extraction. Also it has to be taken into account that anatomical run-through of the lingual and inferior alveolar nerves has an influence on the character of the injury and the extent of its regeneration in the specified unit of time. The inferior alveolar nerve runs through the mandibular canal, which does not change its location or volume. Moreover, it constitutes specific protection from direct injuries of the neurovascular bundle. From the other point of view, the mandibular canal is a place of hindered drainage of hematoma or growing edema as a result of closed space. The inferior alveolar nerve does not change its location because of the damage that conduces regeneration and disturbance of functions usually recedes after 6 months [3]. After the lingual nerve is injured, the soft tissues are surrounded by a scar, which makes it vulnerable to its ends being pulled, which decreases its ability for healing and regeneration [3, 4].

In order to describe the clinically iatrogenic damages of peripheral nerves the five-step Seddon scale in Sunderland modification was created. First degree damage is specified as neuropraxis and constitutes segmental myelinolysis of nerve fibers. It is a completely reversible dysfunction and regeneration takes place very quickly. Most usually, it is caused by short-term compression of nerves. The next degree is known as axonotmesis, which occurs because of damage to the axon without disruption of nerve continuity. Regeneration is possible, but it proceeds very slowly. A twelve-month period constitutes a limit of regeneration time. From a clinical point of view, first and second degrees of damage manifest with sensory disturbances, paresthesia, and pain. These ailments disappear idiopathically. The third degree determines the damage of the endoneurium with retention of the perineurium. The recovery of nerve function is possible, but prognoses are doubtful. Patients can be exposed to exceptionally unpleasant pain caused by stimuli. Fourth degree describes an injury that encompasses all sheaths of nerve fibers excluding the epineurium. The idiopathic regeneration is not possible in that case of damage. From a clinical point of view, there are symptoms of bathyhyposensitivity and unpleasant painful reactions caused by a stimulus. The last fifth degree, is defined as neurorrhaphy, which is unambiguous with total disruption of nerve continuity. Its idiopathic regeneration is not possible. Patients complain about bathyhyposthesia or symptoms of damaged nerve neuralgia [5, 6].

The aim of this paper is to present the standpoints of several authors of recent literature. Authors discuss the main factors affecting the iatrogenic damages of inferior alveolar and lingual nerves during the third molars surgery in the mandible and present short characteristics of these factors based on the collected literature.

The following scientific databases were analyzed: PubMed, Medline, ScienceDirect, Ebsco and Elseviri. The search criteria contained key words such as: complications after tooth extractions, extraction of third molars in the mandible and damages of nerves after dental procedures. Authors have chosen 18 positions. The additional sources were books with special attention paid to the surgical anatomy of the head and neck area and dental procedures in the oral cavity with special attention paid to the third molar surgery in the mandible.

The injuries of the inferior alveolar and lingual nerves after the extractions of impacted third inferior molars are troublesome complications. They can result in temporary disfunction lasting up to 6 months or permanent disfunction – lasting more than 6 months [5]. In the analyzed literature, the number of complications connected with inferior al-
Anatomic Distinctions

One of the factors causing injury to the lingual nerves was anatomic distinction along the nerve in the retromolar region near the inferior molars. The first research to address this problem was published in 1983 by Kiesselbach and Chamberlain [8], who described detailed routes of lingual nerves in relation to the medial edge of mandible's alveolar process. They proved that lingual nerves run beneath the edge of the alveolar process with an average distance of 2.28 mm under the edge of the mandible and with an average distance from the body of the mandible in transverse axis of 0.58 mm. According to Kiesselbach and Chamberlain [8], in as many as 17.6% cases, lingual nerves were either located at the apex of the alveolar process or above it. These results corresponded with the results of Pogrel's [9] research who by presenting a detailed position of lingual nerves in the region of wisdom teeth in 1995 informed that in 15% of cases lingual nerves were located above or at the edge of the mandible's alveolar process. Pogrel and Renault [9] made measurements in relation to the inner slanted line in the area of the change of direction from horizontal to vertical. With respect to that point, he measured the lengths of the segments of lingual nerves in adherence to the alveolar process and its distance from the lingual lamella of the mandible body in rabdoidal and vertical dimensions. The results of his research disclosed that the average distance of lingual nerves in contact with the mandible's lingual lamella amounted to 27 mm, the average distance of lingual nerves from lingual lamella measured in rabdoidal direction amounted to 3.45 mm in contrast to vertical direction i.e. 8.32 mm [8]. In 1997 Miloro et al. [7] presented the results of his studies about the location of lingual nerves in the region of the third molar. They were conducted amidst 10 volunteers within the age range of 25–35 by means of high-resolution magnetic resonance imaging (HR-MRI). The results showed that lingual nerves run on average 2.75 mm under the edge of the alveolar process and is remote from it in the rabdoidal direction on average by 2.53 mm. Among the volunteers in 10% of cases, lingual nerves were located above the edge of alveolar process and in 25% of the cases, it had direct contact with the alveolar bone [10]. The results of studies show that the lingual nerve is in close contact with the alveolar process at the distance of 3 cm [8]. The lingual nerves run infrequently in the submucosal tissue being in touch with desmodontium and covering mesial or the lingual wall of third molar pocket. It is more likely to happen if the mandible's branch is very near or entirely at the apex of the tooth [4, 8].

Age

The analyzed scientific works made evident the raised risk of neurological complications after the extractions of impacted inferior third molars in patients above the age of 35 [1]. The research proved that the damages only concern the inferior alveolar nerve [11, 12]. The increased density of bones, the termination of root development and decreased ability of the healing of the after extraction cuts are considered to be the reason for the inferior alveolar nerve damage [3]. The studies of other authors have proven that sensory disorders occur more often in people below the age of 20 [4]. However, in the majority of works analyzed by authors, there was no correlation between the age of patients and damages to lingual and alveolar nerves [3, 11–14].
take into account the lingual angulation of teeth in their studies have the opinion that lingual nerve injury is most often caused by mesioangulation and injury of the alveolar nerve occurs as a result of vertical angulation [7, 15].

Grade of Impaction and the Distance from the Mandibular Canal

In most papers analyzed by the authors the grade of impaction and the distance of root from canal of the inferior alveolar nerve constituted a significant factor of risk complications connected with nerve injuries in the course of the extraction of the impacted inferior third molars [3, 4, 7, 14, 15]. The classification of Pell and Gregory was used for the evaluation of impaction grade and the distance of the eighth tooth in the mandible in relation to the mandibular canal. This division distinguishes three grades specifying the position in relation to the anterior edge of the mandible’s branch. First grade describes a lack of bone tissue in the dental crown of the inferior eighth tooth in the mandible’s branch, while third grade is completely surrounded with bone tissue. Apart from that, the aforementioned classification determines the location of the eighth tooth dental crown with respect to the plane of the nearby tooth occlusion in the mandible. Letter A describes the eighth tooth located on the level of the patient’s occlusion plane and letter C describes the tooth situated beneath the occlusion plane. Also the simplified classification that divides teeth into totally and partially impacted is very common [3]. It is regarded that the totally impacted teeth located deeply in the body of the mandible corresponds to class C of Pell and Gregory’s classification and demonstrates the highest frequency of complications in the form of damage of inferior alveolar nerve [3, 4, 7, 13, 15]. In the literature there are different description criteria of roots of impacted tooth positions in relation to the mandibular canal. It was a hindrance for authors to make explicit evaluations of this factor. Jerjes defined the radiological distance between the roots and canals of the inferior alveolar nerve in the following manner: lower than 2 mm as close, above 2 mm as far [3]. Other authors defined this relationship when the roots are above the nerve canal, reaching it, exceeding it, and situated in other positions. The majority of authors proved that complications are most often in close location to inferior alveolar nerves in relation to the mandibular canal [3, 15]. Jerjes [3] holds the opinion that roots exceeding the nerve canal cause most of complications.

Type of Anesthesia (General/Local)

In the reviewed works the patients were subject to both local and general anesthesia. The dental procedures performed under general anesthetic were connected with a higher number of complications [1, 3, 4, 13, 15, 16]. The injuries to nerves after the procedures under general anesthetic occurred 5 times more often than when performed under local anesthetic [4, 15, 16]. The reason given for performing procedures under general anesthesia was the higher difficulty of cases qualified for dental procedures [1, 4]. Nevertheless, according to Brann et al. [16], general and local anesthesia were applied regardless of the predicted difficulty of the case. Despite that, the quantity of complications in patients under general anesthesia considerably exceeded the quantity of complications in patients under local anesthesia. The author suspects that it can be associated with the lying position of the patient, preparation of more extensive muco-periosteal flaps, removal of bone tissue in greater scope, and the application of greater forces by extraction movements. These conclusions are solely the assumptions of the author, which are not confirmed by any studies [13, 16]. There is no influence of the type of anesthetic applied under local anesthesia on the frequency of nerve damages during the extraction of the inferior wisdom teeth. That was proved by Valmaseda-Castellon et al. [14], who was using solutions of articaine, mepivacaine, prilocaine, lidocaine, and bupivacaine in his research.

Experience of the Surgeon

In the majority of reviewed works, experience of the surgeon was the most significant factor influencing the frequency of lingual and inferior alveolar nerve damages during the extractions of impacted inferior eighth teeth [1, 3, 4, 16]. Damage can be caused by uncontrolled application of force, lack of ability to handle surgical instruments, and, above all, lesser experience of young surgeons [3]. Authors found only one work that mentioned that the lack of surgical experience did not influence the frequency of complications [13].

Preparation of Lingual Flap and Ostectomy

Preparation of the lingual flap was applied to make the lingual nerve visible in order to avoid direct injury during extraction, requiring the application of rotary tools [4]. Retraction of this cusp increased the number of temporary sensory disorders in the innervation area of lingual nerves. That was associated with the extension of nerves and result-
Discussion

Degree of damage to the inferior alveolar and lingual nerves after the extractions of the impacted mandible's molars and the subsequent regeneration depends on the injury degree of the given nerve fiber. Sensory disorders lasting less than 6 months are treated as temporary ones in contrast to disorders lasting more than 6 months, which are deemed as permanent ones [1, 16]. Surgeons should take into consideration that lingual nerves can run above the edge of the alveolar process which qualifies its damage during extraction of the third impacted molar. The result of the research shows that lingual nerves are situated closely to the alveolar process at the distance of 3 cm [8]. Often lingual nerves run through submucosal tissue which have contact with periodontal fiber and cover the mesial or lingual pocket wall of a third molar [4]. The frequency of this complication increases when the mandible's branch is located very close or at the apex of the tooth during the extraction of third inferior molars [8].

In the anticipation of damage to the inferior alveolar nerve, the evaluation of the mandibular canal run-through is of utmost importance. If the roots of the impacted tooth are situated in a distance less than 2 mm from mandibular canal or if they exceed it, then the risk of complications is higher than for roots distances by a minimum of 2 mm. The most precise evaluation of root position distance in relation to the mandible is performed on the basis of computer-assisted tomography, the best being cone beam computed tomography (CBCT) [1, 3]. The reviewed test is a pantomographic X-ray picture, which does not equip surgeons with all of the information about the structure and location of the impacted tooth, because it is only two-dimensional. Rood's criteria are very helpful in the analysis of the inferior alveolar nerve damage risk on pantomographic X-ray photos. Moreover, it must be kept in mind that one of the rear alveolar branches can depart from the inferior alveolar nerve, but before it enters the mandibular canal it can be localized in the retromolar region [17].

Papers analyzed by authors proved that the inferior alveolar nerve is most often vulnerable to injuries at the horizontal position of the tooth which do not correlate with the degree of difficulty of extraction which according to Peterson is the highest at distoangulation [1, 3, 4, 7, 15, 18]. On the other hand, the injuries of lingual nerves occur most frequently in the lingual angulation, which seems to be the result of nerve course anatomy. Authors who did not analyze lingual angulation proved that this complication is most often a case in mesioangulation [3, 4, 15, 18]. Complications in the form of sensory disorders increase together with the degree of tooth impaction [19]. The majority of post-extraction complications are the results of the removal of totally impacted teeth, which are completely surrounded by bone tissue [1, 3, 4, 7, 11, 14, 15]. This may be related to the greater range of dental procedures; the necessity of ostectomy and application of drill bits and closer vicinity of the tooth with the mandibular canal.

The importance of the age of patients and correlation with post-extraction injuries in the inferior alveolar and lingual nerves is differentiated in literature. Authors, whose research proved a higher number of inferior alveolar nerve injuries in elderly patients (after the age of 35), have the opinion that it is related to physiological changes that occur in the human body as a consequence of aging [1]. Nevertheless, the majority of research does not disclose any relationship between age and number of inferior alveolars and lingual nerve injuries [1, 3, 4, 13, 16, 18].

An interesting issue discovered by authors is the problem of complications dependent on the type of applied anesthesia either general anesthesia or local anesthesia. In the majority of analyzed works, the nerves were injured 5 times more often during general anesthesia than during the local one [4, 13, 15, 16]. The dental procedures in Great Britain are performed very often under general anesthesia because of the preferences of both patients and surgeons. However, the results of the conducted studies that report the prevalence of complications after dental procedures under general anesthesia induced considerable reduction of the amount of procedures performed under general anesthetics [16, 19].

Similarly, the preparation of the lingual flap and the intraoperative removal of bones are connected with higher amounts of lingual nerve damages [1, 3, 4, 13, 20, 21]. During the procedure of lingual flap creation, lingual nerves are vulnerable to temporary injury, which can be of a kind neuropraxia. In contrast, ostectomy, which is very often connected with the application of drill bits, is more often the cause of direct nerve injury, and then regeneration is less probable [1, 3, 4, 13, 16, 20]. Many authors also raise the issue of the influence of retractor usage (drawing lingual flap away) on injuries of the lingual nerve [1, 4, 13, 21]. On one hand, the retractor protects against injury inflicted by surgi-
cal tools but is a cause of blunt trauma [1, 4]. Therefore, it is recommended to avoid both the preparations of lingual flap and the application of the retractor [1, 3, 4, 16, 21].

According to many authors, dental procedures performed by experienced surgeons are associated with a lower number of complications which is probably a result of their ability to handle surgical tools. They can also control the force during extraction [1, 3, 4, 16]. Consequently, it would seem that in order to avoid post-operative sensory disorders solely experienced surgeons should perform the extraction of impacted third molars. However, this would not give the opportunity to train young surgeons, who need practice to acquire the required abilities. Thus, this can be connected with a higher amount of complications in the cases of less experienced surgeons amounts to 1.3% and 1.2% proportionately for the lingual and inferior alveolar nerves [4].

This data certainly should not be a cause for limiting young surgeons to have the opportunity to perform extractions of impacted third molars.

References

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Conflict of interest: None declared
Received: 17.02.2014
Revised: 12.03.2014
Accepted: 28.04.2014

Praca wpłynęła do Redakcji: 17.02.2014 r.
Po recenzji: 12.03.2014 r.