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K.P. Lokes, H.D. Avetikov, O.S. Ivanytska, D.V. Steblovskyi, M.G. Skikevych, I.O. Ivanytskyi, D.S. Avetikov
Poltava State Medical University, Poltava

ANALYSIS OF METHODS OF PREVENTION OF INTRA- AND POSTOPERATIVE COMPLICATIONS DURING TOOTH EXTRACTION

e-mail: k.lokes@pdmu.edu.ua

The literature data notes a compilation rate of 4.6–30.9 % after this surgical intervention, which can occur intraoperatively or develop during the postoperative period and can be general or local in nature. The purpose of the study was to conduct an analysis of methods of prevention of complications of tooth extraction surgery by analyzing domestic and foreign literary sources. The analysis of literary sources of domestic and foreign authors was carried out. In recent years, various methods have been proposed and used to minimize postoperative effects, such as the introduction of platelet-enriched fibrin, the use of lasers, cryotherapy, injections of various drugs, and the formation of various forms of muco-oxidative flaps. A wide range of techniques allows the dentist to minimize the risk of iatrogenic complications. But currently, the features of preventive measures that allow the dentist to create a physiological optimum for such a widespread surgical dental intervention as the extraction of the mandibular third molar are not sufficiently substantiated.

Key words: tooth extraction, complication, defect of bone tissue, wound repair, osteogenesis, prophylaxis.

К.П. Локес, Г.Д. Аветіков, О.С. Іваницька, Д.В. Стебловський, М.Г. Скікевич, І.О. Іваницький, Д.С. Аветіков

АНАЛІЗ МЕТОДІВ ПРОФІЛАКТИКИ ІНТРА- ТА ПІСЛЯОПЕРАЦІЙНИХ УСКЛАДНЕНЬ, ЯКІ ВИНИКАЮТЬ ПРИ ВИДАЛЕННІ ЗУБА

Літературні дані відзначають частоту накопичення 4,6–30,9 % після даного хірургічного втручання, яке може виникнути інтраопераційно або розвинутися в післяопераційному періоді і мати загальний або місцевий характер. Метою дослідження було провести аналіз методів профілактики ускладнень після видалення зубів шляхом аналізу вітчизняних та зарубіжних літературних джерел. Проведено аналіз літературних джерел вітчизняних та зарубіжних авторів. В останні роки були запропоновані та використані різні методи мінімізації післяопераційних ефектів, такі як введення збагаченого тромбоцитами фібрину, використання лазера, кріотерапії, ін'єкції різних препаратів, формування різних форм слизово-окислювальних клаптів. Широкий спектр методик дозволяє лікарю-стоматологу мінімізувати ризик ятрогених ускладнень. Але в даний час недостатньо обґрунтовані особливості профілактичних заходів, які дозволяють лікарю-стоматологу створити фізіологічний оптимум для такого поширеного хірургічного стоматологічного втручання, як видалення третього моляра нижньої щелепи.

Ключові слова: видалення зуба, ускладнення, дефект кісткової тканини, загоєння рани, остеогенез, профілактика.

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Despite the rapid development of dental science, tooth extraction remains the first among all surgical interventions. Indications for performing this operation are quite broad, in the vast majority – complications of carious lesions and orthodontic indications. After the removal of the tooth, dimensional changes occur in the alveolar bone, which leads to remodeling of the bone tissue and reduction of its volume in various directions. The vast majority of lost alveolar bone is cancellous. The formation of bone tissue occurs due to the deposition of osteoblasts on the alveolar bone, while osteoclastic activity leads to its destruction. Tooth extraction causes the development of horizontal and vertical atrophy of the alveolar process, which is caused by the lack of functional load characteristic of teeth and their supporting structures, which leads to further bone resorption [1, 14].

The literature data notes a compilation rate of 4.6–30.9 % after this surgical intervention [14], which can occur intraoperatively or develop during the postoperative period and can be general or local in nature [29]. Minimization of complications is best achieved before surgery. A comprehensive preoperative examination and treatment plan allows the stomatologist to predict intraoperative complications and prepare for procedures to obtain the best result [19].

The best way to deal with a surgical complication is its prevention. This can be achieved by careful assessment of all relevant risk factors, detailed patient examination, planning and clear execution of the

surgical procedure [6, 12, 34]. In recent years, various methods have been proposed and used to minimize postoperative consequences, such as the introduction of platelet-enriched fibrin, the use of laser, cryotherapy, injections of various drugs, and the formation of various forms of muco-gingival flaps, etc. [33].

Understanding the anatomical features of the surrounding structures and the causes of extraction complications of the affected tooth is important for effective tooth extraction with minimal risk of complications. Extraction methods with the use of appropriate surgical protocols and the correct technical approach make it possible to effectively carry out these procedures and reduce the frequency of intraoperative and postoperative complications. Large proportions of complications are iatrogenic and negatively affect the course of reparative alveolar regeneration. All this determines the need for more careful planning of the operation to remove the lower third molar to prevent the occurrence of complications and more quickly restore the working capacity of such patients.

The purpose of the study was to perform an analysis of methods of prevention of complications of tooth extraction surgery by analyzing domestic and foreign literary sources.

Materials and methods. The analysis of literary sources of domestic and foreign authors was carried out. For this, the electronic database of medical and biological publications Pubmed and Web of Science was used. For data analysis, those literary sources that had a full text version were used. The search depth was 10 years.

This review included such types of studies as randomized controlled trials, observational studies, and we also used articles devoted to meta-analysis of post-extraction complications and methods of their prevention. After analysis, the references of the selected publications were also searched. The articles were selected by reviewing their titles and abstracts as well as from the bibliography of the selected articles.

Keywords used to search for relevant articles included “tooth extraction”, “complication”, “prevention of complications”, “mandibular canal”, “mandible”, “wisdom tooth”, “flap design”, “piezosurgery”. These terms were used individually and together to ensure an extensive literature search.

Articles that were clinical cases or did not have information on methods of prevention of intra- and postoperative complications of tooth extraction were excluded from the search. Articles such as editorials, letters, commentaries, and conference abstracts, as well as articles describing guidelines for how to read or interpret a systematic review, were also excluded. Studies not focused specifically on the selected topic were excluded of this article.

At first, the titles and abstracts of the articles were screened during the search using the inclusion criteria. After that, reviewers evaluated the full text of the screened articles that might be included in the review. Any differences between the reviewers were resolved by discussion with all authors of this article.

The full texts of all studies of relevance were then obtained for independent assessment by the reviewers, and any disagreement was resolved by discussion with all co-autors of this article.

Results of the study and their discussion. In recent years, various methods have been proposed and used to minimize postoperative effects, such as the introduction of platelet-enriched fibrin, the use of lasers, cryotherapy, injections of various drugs, and the formation of various forms of muco-oxidative flaps [31].

According to the conducted clinical studies, it was established that the use of intra-alveolar applications of 0.2 % chlorhexidine or 1 % hyaluronic acid in the form of bioadhesive gels after extraction of the mandibular third molars minimizes postoperative complications [23]. Although other researchers do not note statistically significant changes in the frequency of complications with the intra-alveolar use of sodium hyaluronate gel [16]. It has been established that the use of L-PRF, especially in combination with hyaluronic acid, can contribute to the minimization of postoperative edema after mandibular third molar removal [2].

For the prevention of complications after the extraction of the lower third molar, some authors recommend using bromelain, which is effective in controlling pain, swelling, and trismus after operations, but these results require further careful research [11].

The choice method for the prevention of postoperative complications is the use of low-frequency laser therapy, which, even with a single intraoral application, is more effective than the extraoral method in reducing postoperative pain [3].

The form of incision and mucosa-periostal flap has a significant impact on the risk of developing postoperative complications. This is justified by the fact that the correct operative tactics aim to reduce surgical trauma as much as possible in order to limit immediate and delayed complications of surgical intervention. However, lengthening the healing time also leads to an increase in the likelihood of postoperative complications and deterioration in the quality of life of patients [29].

There are different styles of flap designs used for the removal of impacted mandibular third molars, mainly represented by bordering, triangular, and envelope flaps. Many studies have found that using a less stretched flap tends to reduce patient complaints. However, some studies failed to find differences in

postoperative symptoms and signs when different flaps were used. A triangular flap, as opposed to a simple flap without a relaxing incision, generally provides a better and wider view during surgery. But at the same time, it can contribute to the emergence of inflammatory complications [17].

Regardless of the variations in flap design, the basic principle of adequate blood supply to the flap, which promotes wound healing, should be followed. The studies conducted revealed a significant loss of attachment for various flap designs and showed that the initial height of the alveolar bone, distal to the second molar, was not significant for the loss of attachment. Some researchers found a significant periodontal pocket depth of more than 7 mm distal to the second molar, which directly affected plaque formation within two years after intervention [37].

Comparison of paramarginal and marginal flaps revealed better wound healing due to primary tension in the first case. However, other parametric abnormalities such as pain, mouth opening and swelling were not found to be significant. According to Glera-Suárez P, a modified flap design that follows the contour of the crown of the tooth being removed is more effective; while the standard distal and vertical incisions are performed with a variable length that requires sufficient exposure compared to other models, does not reflect the lingual flap, and protects against damage to the lingual nerve. It was proposed a triangular laterally turned flap, which showed a significant positive effect on the periodontal status of the second molar [15].

The other opinion is that the flap design does not affect the depth of the dentogingival pocket or the level of attachment on the distal surface of the mandibular second molar after surgery on the mandibular third molar. A conventional incision with an oblique direction from the mesial side provided better access and ease of surgical intervention. However, there was no statistical significance between different flap designs regarding postoperative wound healing [32].

The number of stitches has a significant impact on the occurrence of postoperative complications. A large number of sutures can lead to the accumulation of food residues, causing the development of infectious complications and halitosis. There are no concrete data on the correlation between the number of sutures and their effect on wound healing; however, barbed suture (knotless) is considered a safe and effective alternative to conventional sutures for fixation of free flaps to local tissue. Thus, it can be assumed that the use of fewer knots leads to better wound healing and a corresponding reduction in the frequency of complications [28].

Operative time and postoperative complications have a direct correlation, where increased operative time is associated with greater postoperative morbidity, and operative duration affects acute postoperative symptoms and signs after mandibular third molar extraction. The alveolar preservation technique is considered an effective procedure for preserving alveolar bone from post-extractive physiological resorption. However, like any other surgical intervention, it can be affected by the same complications that can lead to graft rejection (graft exposure, infectious complications, resorption) [10].

Different types of grafts can be used for volume: synthetic grafts, xenografts (from other species), allografts (from human donors) and autografts (from the patient himself). Obviously, it is not necessary to preserve the alveolus for each removed third molar; however, it may be beneficial in cases where a large amount of bone tissue may be lost during extraction, which may lead to periodontal tissue damage that may lead to mobility or hypersensitivity of the second molar [9].

In order to prevent the occurrence of a fracture of the mandibular angle, some authors recommend fixing miniplates before or after the extraction of the lower third molar. Such patients should also follow a liquid and bland diet and expect to return to their regular physical activities four weeks after the procedure [13].

Information on the spatial relationship between the third molars and the topography of the inferior alveolar nerve is critical for preoperative procedures. The study of panoramic images is important for evaluation before extraction [27].

However, because an orthopantomogram is two-dimensional, the image can be distorted or overlapped, which can cause clinicians to misinterpret results or make incorrect judgments. Therefore, in order to minimize postoperative complications and improve the planning of operative handing, computed tomography (CT) is performed to assess the spatial relationship between the third molar and the mandibular canal [22].

Based on the concept of the Cartesian coordinate system, it was reported that the probability of mandibular canals relative to the third molar is more buccal, lingual, and lower, and between the roots of the third molar, which are 51 %, 26 %, 19 %, and 4 %, respectively [25]. Yang Y with a similar research method, reported its localization on the buccal (17 %), lingual side (49 %), below the third molar (19 %) and between the roots (15 %) [35].

In addition, conflicting data have been reported by different researchers, including trends in the probability of tooth placement. This is primarily due to differences in measurement positions among

different races. It could also be a consequence of differences in the morphological and anatomical structure of the mandible and lower third molar, which may cause approximate and imprecise classification, leading to misinterpretation of study data and different extraction results [20].

To reduce the risk of injuring the inferior alveolar nerve during the extraction of mandibular third molars, it is necessary to use appropriate instruments. Therefore, the use of CT images to accurately identify the relationship between the molars and the mandibular canal in the buccolingual region is crucial [25, 20].

The advantage of using a cylindrical coordinate system to assess the location of the mandibular canal is that it simplifies the classification of the relationship between the third molars and the inferior alveolar nerve. Two parameters identified by this system, namely the relative angle and the smallest distance between the mandibular canal and the third molars, provide quantitative data and detailed understanding for further investigation. Angle data not only reveal the distribution between the inferior alveolar nerve and the lower third molar, but can also prevent misunderstanding among practicing clinical investigators. In addition, the shortest distance between the lower third molar and the mandibular canal provides additional information that is not available when using the Cartesian coordinate system. The shorter the distance between these two structures makes the greater the chance of damage to the nerve trunk during the removal of the lower third molar. Therefore, the determination of this distance is crucial [35].

Alternative options for preventing injury to the inferior alveolar nerve are orthodontic interventions to slowly move the tooth away from the mandibular canal and thus reduce the potential for traumatic injury during extraction. A stepwise approach, which includes the removal of the mesial part of the crown, creating space for the mesial migration of teeth; and coronectomy, which involve removing the crown of the tooth, leaving the root intact [18].

The option of choice is coronectomy, which is safer to perform than full extraction in situations where the third molar is in close proximity to the mandibular canal. As a rule, root migration has an asymptomatic course, but in the case when the patient undergoes a second surgical intervention, the risk of neurological damage is reduced [18].

During extraction, it is always desirable to minimize ostectomy, thereby reducing mandibular fragility and fracture incidence. It is described in the literature that the use of a piezoelectric tip for osteotomy helps to reduce excessive mechanical forces during tooth extraction and minimize injury to nerve structures and, accordingly, the occurrence of paresthesia [36].

One of the most important techniques is the use of osteotomy techniques to minimize the trauma and heat generation associated with bone cutting or osteotomy during the surgical removal of mandibular third molars.

Rotary systems are the most often used tool for removing an affected tooth. However, with this method, uneven surfaces of bone tissue remain and marginal osteonecrosis is formed. Healing is also impaired due to overheating of bones and damage to adjacent tissues. Experimentally, the best alveolar bone healing was obtained when the osteotomy was performed with a chisel, followed by an ultrasonic instrument, and finally a rotary instrument. Piezoelectric surgery is a new osteotomy technique that uses micro-vibrations of scalpels at an ultrasonic frequency. Piezoelectric surgery has been proposed as an alternative to third molar removal using conventional rotary instruments [21].

Piezosurgery generates very small oscillations with an amplitude of 60–200 μm horizontally and 20–60 μm vertically, which is comparatively very small compared to oscillating micropiles; thus, it provides precise and safe osteotomy cuts. Compared to rotary tips, there is no need to use additional force to resist rotation or oscillation of the device. In addition, piezosurgery has an additional advantage because its ultrasonic vibrations break up the irrigation fluid into very small particles (cavitation phenomenon - the implosion of gas bubbles in the vessel during bone cutting, which produces a hemostatic effect and reduces blood loss), which are washed out of the operative field, which ultimately provides a clear, unobstructed view of the operating field [26].

There is a direct effect of duration of surgery on postoperative pain, trismus, and edema. However, it was reported that postoperative outcomes were independent of the time required for the surgical procedure. Other studies report that despite a longer time (mean time = 54.63 min) spent with the piezosurgery unit compared to the micromotor (mean time = 37.90 min), there was a statistically significant reduction in postoperative pain, trismus, and swelling; these findings are also supported by a study conducted by Shetty which can be explained by less damage to soft tissues by piezosurgery, since its surgical action is terminated when it comes into contact with non-mineralized tissue [30].

Analysis of the data confirms that there is a significant correlation between postoperative edema and bone removal by piezoelectric surgery in all postoperative periods, since piezoelectric surgery reduces the traumatism of bone structures, potentially reducing the risk of inflammatory complications [7].

In contrast, other studies have found significantly less facial edema in cases of bony osteotomy combined with tooth sectioning, a risk factor for edema. This result may be due to less initial bone tissue damage compared to the rotary system. Minimal surface area affects the use of piezoelectric surgery; this factor may contribute to the statistically significant results showing a greater reduction in edema and trismus in high-risk cases such as distoangular, vertical type of tooth position, and an increase in the degree of difficulty of surgical extraction compared to horizontal, mesioangular type of position and simple cases. Similar cases treated with rotary systems have been shown to be associated with a higher degree of edema and trismus on all postoperative days [4].

Research results have shown that the disadvantages of conventional rotor systems are reduced when using piezoelectric technology, especially in relation to paresthesia of the inferior alveolar nerve, which is a serious complication. The use of a piezoelectric tip is very beneficial in minimizing soft tissue damage. In comparison, thermal injury and accidental mechanical injuries, such as soft tissue damage, can occur with a high-speed drilling device [30].

Other side of complications of tooth extraction is emotional reaction of patients. Fear and anxiety about dental treatment occur in 40-50% of the general population, and in the vast majority of patients these conditions are more pronounced precisely during the operation of removing the lower third molars. Moreover, patients who underwent surgical dental treatment showed higher levels of anxiety compared to those who underwent other types of operations, such as gastrointestinal disorders [8].

The emotional and psychological states of the patient can affect the treatment, impair the absorption of anesthetics or even cause unwanted physiological changes. Thus, fears, phobias, stressful situations, and depression can often change the physiological functions of the body, lower the excitability threshold, change the immune response, and negatively affect the intra- and postoperative periods [5].

Anxiety can be controlled with both pharmacological and non-pharmacological methods. For this, the most used method is the verbalization method, where the dentist must be able to understand, guide and reassure the patient about the procedures to be performed. When this is not enough, some pharmacological methods, such as anxiolytics, are used to reduce anxiety and to prevent stress reaction [24].

Conclusion

Thus, a significant number of literary sources are devoted to the issue of prevention of general and local complications, and interest in this issue is constantly growing. The prevention of intra- and postoperative complications of extraction of teeth, including the lower third molar has a significant impact on the course of reparative processes. A wide range of techniques allows the dentist to minimize the risk of iatrogenic complications. But currently, the features of preventive measures that allow the dentist to create a physiological optimum for such a widespread surgical dental intervention as the extraction of the mandibular third molar are not sufficiently substantiated.

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