

Original papers

Analysis of complications after the removal of 339 third molars

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Abstract

Background. Extractions of third molars constitute about 90% of the scheduled surgical procedures performed by oral surgeons. Wisdom tooth surgery is associated with complications, such as the lingual and inferior alveolar nerve damage, bleeding, tooth/jaw fractures, tooth displacement into the adjacent anatomical spaces, trismus, infections, and other.

Objectives. The aim of the study was to analyze complications after wisdom tooth extraction in patients treated at the Department of Oral Surgery of Jagiellonian University Medical College in Kraków, Poland, in the years 2016–2018.

Material and methods. A retrospective analysis of the medical records of 339 patients treated in the outpatient setting was performed. The inclusion criterion comprised a single extraction of a third molar. The exclusion criteria were multiple extractions, comorbidities and pregnancy. No antibiotic prophylaxis was used. The incidence of post-extraction complications, such as oroantral communication, postoperative hematoma, acute inflammation of the surrounding tissues, trismus, and transient paresthesia in relation to patient gender and age, the developmental stage and location of the removed tooth as well as the type of surgery were studied.

Results. Perioperative complications occurred in 51 (15.0%) cases, and comprised the acute inflammation of the surrounding tissues in 31 patients, trismus after the removal of 13 lower third molars, oroantral communication after the extraction of 5 upper wisdom teeth, and hematoma as well as a transient sensory alteration of the lingual nerve in 1 case each. Complications were more common in patients who had a surgical extraction of a wisdom tooth with root separation and in cases of lower third molar extractions. No statistically significant correlation was found between the patients' age or gender, the developmental stage of the extracted tooth and the number of observed complications.

Conclusions. Lower third molars and the necessity of surgical extraction with root separation are risk factors for postoperative complications in patients who require wisdom tooth removal. Complications after the removal of third molars are most often inflammatory.

Key words: molar, third, tooth extraction, risk factors, postoperative complications

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Introduction

Extractions of third molars constitute about 90% of the scheduled surgical procedures performed by oral surgeons, and on average 37% of all procedures performed annually.¹ Among the indications for wisdom tooth removal, one can distinguish therapeutic indications, most often associated with problems with the eruption of impacted third molars, especially in the case of recurrent acute or chronic pericoronitis, orthodontic indications, mainly dental arch changes and anterior crowding, and also non-restorable caries lesions, periodontal diseases, neuralgic ailments, cysts, and tumors, when the tooth is removed along with a pathological lesion. It is often necessary to remove a mandibular wisdom tooth from the fracture line. This procedure, combined with the reduction and osteosynthesis of fractures, is performed under hospital conditions and general anesthesia. Prophylactic extractions of retained third molars are performed for example before prosthetic treatment in order to prevent these teeth from eruption under the denture plate.² The main local contraindication for the removal of lower third molars is acute inflammation, often combined with trismus, which prevents proper local anesthesia and extraction, usually surgical.

The location of wisdom teeth in the posterior part of the oral cavity as well as the variability of the anatomy and location of these teeth make the percentage of complications during and after their extraction higher than that observed after the removal of teeth from other groups. Complications associated with wisdom tooth extraction are estimated at about 3–30%.^{3–10} They are favored by the vicinity of important anatomical structures, such as the lingual and inferior alveolar nerves, facial and inferior alveolar arteries, masticatory muscles, and anatomical spaces, including pterygomandibular, parapharyngeal, retro- and submandibular spaces, and in the case of upper teeth – the maxillary sinus, and the pterygopalatine and infratemporal fossae. Intraoperative complications associated with the removal of third molars may include damage to the inferior alveolar nerve both during anesthesia and extraction.^{11,12} The fracture of a wisdom tooth or damage to the adjacent teeth as well as the fracture or luxation of the mandible or the fracture of maxillary tuberosity are usually associated with the use of excessive force by the surgeon. Injuries to the surrounding soft tissues and vascular damage, leading to bleeding during or after surgery, usually result from careless handling of instruments. Particularly unpleasant complications associated with the removal of third molars include the displacement of the entire tooth or its root into the maxillary sinus or the pterygopalatine fossa in the case of upper teeth, and into the mandibular canal or the soft tissues of the floor of the mouth in the case of lower teeth. The most serious, life-threatening complication during wisdom tooth extraction is tooth aspiration to the upper respiratory tract with the subsequent spasm of the laryngeal muscles.^{13–17}

Oroantral communication found after the extraction of upper third molars may result from anatomical reasons; it is important to diagnose and treat it according to the indications.¹⁸ Bleeding from the injured bones or soft tissues can be observed in the early postoperative period, with less frequent bleeding from the inferior alveolar artery. The formation of hematomas in the postoperative period is related to damage to the pterygoid venous plexus after the removal of third upper molars and a tight suture of the wound after the surgical extraction of third lower molars. Hemorrhagic complications often result from the general condition of the patient (arterial hypertension, diabetes) and the medications taken, which affect the condition of the haemostatic system.^{8,19} After wisdom tooth surgery, inflammatory complications often develop, e.g., dry socket and inflammation of the submandibular lymph nodes with the subsequent formation of a submandibular abscess. The inflammatory process spreading to the surrounding anatomical spaces may include the parapharyngeal space, the skull base and the mediastinum. In immunocompromised patients, phlegmon or bacterial osteomyelitis may develop. The postoperative course after the removal of third molars is often complicated by transient trismus and reversible sensory alterations of the lingual and inferior alveolar nerves.^{12,20–22}

Objectives

The aim of the study was to analyze the complications after wisdom tooth extraction in patients treated at the Department of Oral Surgery of Jagiellonian University Medical College in Kraków, Poland, in the years 2016–2018.

Material and methods

A retrospective analysis of the medical records of patients treated in the outpatient setting within 2 years was performed. The inclusion criterion comprised a single extraction of an upper or lower third molar in a patient, regardless of the stage of tooth development. The exclusion criteria were multiple extractions, general comorbidities and pregnancy in women. The type of procedure included simple extractions, surgical extractions with root separation and surgical extractions with flap formation (with an angular incision). No antibiotic prophylaxis was used. In 339 patients, the incidence of post-extraction complications, such as oroantral communication, postoperative hematoma, acute inflammation of the surrounding tissues, trismus, and transient paresthesia in relation to patient gender and age, the developmental stage and location of the removed tooth as well as the method of extraction were studied.

The statistical analysis was performed using the statistics package PQStat, v. 1.8.0.392 (PQStat Software,

Poznań/Plewiska, Poland). Associations between categorical variables were analyzed with the χ^2 test or Fisher's exact test for small samples. The rank correlation coefficient between age and the number of complications was calculated with Kendall's τ test and the χ^2 test (for trend assessment). Results were statistically significant for p -values below 0.05.

Results

Extraction of third molars was performed in 178 (52.5%) women and 161 (47.5%) men aged 15–69 years. The average age of patients was 32 years. People under 18 years of age constituted 16.5% of the respondents. Wisdom tooth extraction was most commonly performed in patients aged 18–38 years. Demographic data is presented in Table 1.

Table 1. Demographic data of the patients

Age [years]	Women <i>n</i>	Men <i>n</i>	Total <i>n</i>
15–17	21	35	56
18–38	85	83	168
39–69	72	43	115
Total <i>n</i> (%)	178 (52.5)	161 (47.5)	339 (100.0)

In the studied group of patients, the main indication for third molar surgery was recurrent pericoronitis. The following were qualified for extraction: 134 (39.5%) completely erupted teeth; 115 (33.9%) completely impacted teeth; 59 (17.4%) partially impacted teeth; and 31 (9.2%) eighth tooth buds. The lower teeth were removed more often; in own material, it was 178 (52.5%) third molars. Detailed data on the developmental stage and position of the removed third molars is presented in Table 2.

Table 2. Developmental stage and location of the extracted third molars

Stage of development	Upper third molars <i>n</i>	Lower third molars <i>n</i>	Total <i>n</i> (%)
Tooth buds	12	19	31 (9.2)
Partially impacted teeth	21	38	59 (17.4)
Completely impacted teeth	41	74	115 (33.9)
Completely erupted teeth	87	47	134 (39.5)
Total <i>n</i> (%)	161 (47.5)	178 (52.5)	339 (100.0)

The method of extraction in 339 patients was analyzed. In 205 (60.5%) cases, surgical extractions with flap formation by means of an angular incision were performed. This procedure was done while removing 131 lower and 74 upper third molars. Root separation was performed

during the extraction of 42 lower third molars. Germetomy was performed in 9 girls and 22 boys under 18 years of age, slightly more often removing lower tooth buds. In other cases, simple extractions were performed. The type of procedure depending on the stage of development of the removed third molars is presented in Table 3.

Table 3. Type of surgery depending on the stage of development of the extracted third molars

Stage of development	Type of surgery <i>n</i> (%)	
	flap operation	root separation
Tooth buds	31 (15.1)	0 (0.0)
Partially impacted teeth	48 (23.4)	41 (97.6)
Completely impacted teeth	115 (56.1)	0 (0.0)
Completely erupted teeth	11 (5.4)	1 (2.4)
Total <i>n</i> (%)	205 (100.0)	42 (100.0)

Perioperative complications were found in 51 (15.0%) cases. The most frequently observed complication after the extraction of third molars was the acute inflammation of the surrounding tissues, which occurred in 31 patients. In these cases, antibiotic therapy was used. Trismus was found after the removal of 13 lower third molars, oro-antral communication was diagnosed after the extraction of 5 upper wisdom teeth and hematoma after the extraction of a lower tooth. A transient sensory alteration in the range of innervation by the lingual nerve was observed in 1 case. Detailed data on the frequency of complications depending on the location of the extracted third molars is presented in Table 4. Fisher's exact test gave a p -value of 0.0001, indicating a statistically significant correlation between the location of the wisdom tooth in the mandible and an increased number of postoperative complications.

Table 4. Location of the tooth and the types of postoperative complications in the study group

Complications	Upper third molars <i>n</i>	Lower third molars <i>n</i>	Total <i>n</i> (%)	p -value
Infection	13	18	31 (60.8)	0.0001*
Trismus	0	13	13 (25.5)	
Oroantral communication	5	0	5 (9.8)	
Hematoma	0	1	1 (1.95)	
Transient paresthesia	0	1	1 (1.95)	
Total <i>n</i> (%)	18 (35.3)	33 (64.7)	339 (100.0)	

* statistically significant.

Dependence between the age of the patients treated and the occurrence of complications is presented in Table 5. Kendall's τ rank correlation coefficient did not reveal a significant association between the age of the patients

and the number of complications ($r = 0.3333$; $p = 0.6015$). Also the trend assessment did not show any significant correlation ($\chi^2 = 0.4027$; $p = 0.5257$).

Table 5. Relationship between patient age and complications in the study group

Age [years]	Complications <i>n</i> (%)	<i>p</i> -value
15–17	5 (9.8)	0.6015
18–38	35 (68.6)	
39–69	11 (21.6)	
Total <i>n</i> (%)	51 (100.0)	

The relationship between the gender of the patients treated and the incidence of postoperative complications was assessed. However, Fisher's exact test did not reveal any statistically significant association ($p = 0.2450$). The results are presented in Table 6.

The influence of the developmental stage of the extracted tooth on the types of postoperative complications was statistically insignificant, as presented in Table 7.

Table 6. Relationship between patient gender and the types of postoperative complications

Gender	Infection <i>n</i>	Trismus <i>n</i>	Oroantral communication <i>n</i>	Hematoma <i>n</i>	Transient paresthesia <i>n</i>	Total <i>n</i>	<i>p</i> -value
Women	17	11	4	1	1	34	0.2450
Men	14	2	1	0	0	17	
Total <i>n</i> (%)	31 (60.8)	13 (25.5)	5 (9.8)	1 (1.95)	1 (1.95)	51 (100.0)	

Table 7. Relationship between the developmental stage of the extracted tooth and the types of postoperative complications

Stage of development	Infection <i>n</i>	Trismus <i>n</i>	Oroantral communication <i>n</i>	Hematoma <i>n</i>	Transient paresthesia <i>n</i>	Total <i>n</i>	<i>p</i> -value
Tooth buds	0	1	0	0	0	1	0.3724
Partially impacted teeth	8	4	3	0	0	15	
Completely impacted teeth	4	0	1	0	0	5	
Completely erupted teeth	19	8	1	1	1	30	
Total <i>n</i> (%)	31 (60.8)	13 (25.5)	5 (9.8)	1 (1.95)	1 (1.95)	51 (100.0)	

Table 8. Method of extraction and complications in the study group

Method of extraction	Number of complications <i>n</i>	Percentage of complications [%]	<i>p</i> -value
Surgical extraction with flap formation	205	3.9	<0.0013*
Surgical extraction with root separation	42	40.5	
Simple extraction	92	28.3	
Total	339 (100.0) <i>n</i> (%)	15.0	

* statistically significant.

The relationship between the method of extraction and the incidence of complications was analyzed. Complications were significantly more frequent in the patients who underwent a surgical extraction of a wisdom tooth with root separation ($\chi^2 = 53.74$; $p = 0.0013$). The results are shown in Table 8.

Discussion

According to the literature, the frequency of complications associated with the removal of third molars ranges from 3.7% to 30.9%, with the majority of authors analyzing mainly postoperative complications regarding surgical extractions, whereas, in everyday practice, the non-surgical removal of wisdom teeth is a more common procedure.^{3–10,21} The percentage of complications observed in our material, 15% (51/339), is within the limits given in other studies.^{5,8,15} In the analyzed group of patients, simple extractions were also included.

In our study group, complications occurred mainly after the extraction of lower third molars (64.7%), which is consistent with the observations of other authors.

According to Sukegawa et al.,⁴ the percentage was 1.94%, while in Sayed et al.'s research, it reaches 80.6%.³ A high rate of postoperative complications after mandibular wisdom tooth removal is connected with the vicinity of large blood vessels and nerves. Moreover, the density of bone as well as the limited visibility in the distally placed operating field should be taken into consideration.^{3,4,16,18}

In several reports, patient age exceeding 30 years, female gender, and surgical extraction with significant bone damage and root separation are defined as risk factors for complications after wisdom tooth extraction.^{3,9,22–25} Although in the analyzed group, the influence of the age and gender of the patients treated as well as the developmental stage of the tooth on the incidence of complications was not proven, the method of extraction, especially surgical extraction with root separation, was considered to be a risk factor. In extractions with flap formation, the surgical field was wider, and it was possible to either cut off the crown of the tooth or perform a complete extraction after the cautious removal of the surrounding bone. Careful handling of tissues and instruments prevented our patients from such complications as fracture or luxation of the mandible, fracture of maxillary tuberosity or displacement of the extracted tooth into the adjacent tissues.^{13,14,16,17}

The most common complications associated with the removal of third molars include inflammatory reactions, estimated at 0.3–26%.^{4,25–27} In our material, this percentage was 9.1% (31/339) for all extractions and 60.8% (31/51) for all complications. According to the literature, the risk of wound infection and the development of alveolar osteitis depends on pre- and postoperative oral hygiene, the type of wound closure and previous pericoronal infection.^{4,5,7}

The issue of antibiotic prophylaxis in third molar surgery is widely addressed in the literature. Currently, the opinion that patients requiring wisdom tooth surgery do not benefit from routine antibiotic prescription, as expressed by Menon et al.,²⁶ predominates. However, there are also some studies showing a slight reduction in the incidence of inflammatory complications in patients who were given antibiotics in the perioperative period.²⁷ In our material, antibiotics were prescribed only in cases of acute inflammatory complications.

Damage to the lingual or inferior alveolar nerve after the removal of lower wisdom teeth is found in about 5.6% of cases^{3,11,12,20,28}; in our study, transient lingual nerve dysfunction was observed in 1 case (1.95%). Despite progress in imaging techniques and the availability of cone-beam computed tomography (CBCT), it is not possible to completely prevent nerve damage in wisdom tooth surgery. According to Pourmand et al., such factors as position of the third molar in relation to the mandibular canal, access to piezo surgery as well as influence of the local anesthetic on the degree of sensation disorders should be also taken into consideration.²⁹

Complications occur less frequently after the extraction of upper third molars than lower wisdom teeth.^{18,29} Oroantral communication is the most common adverse effect.¹⁶ The incidence of oroantral communication varies from 3.8% to 18.7%.^{3,4,16,18,29} In this study, oroantral communication was diagnosed in 3.1% (5/161) of all extracted maxillary third molars and constituted 9.8% of all postoperative complications. The prediction of oroantral communication before surgery is essential both for the patient and the surgeon. According to the literature, the superimposition of the wisdom tooth roots on the maxillary sinus floor, shown on orthopantomogram or CBCT, is one of the most important risk factors.^{18,29} Retained upper molars, especially with the distal and mesial inclination of the axis, root fractures and the displacement of the tooth present a higher risk of oroantral communication.^{3,4,16}

Extractions of third molars are generally more difficult than those of other molars and require certain surgical skills. Delicate handling of soft tissues and bones, maintaining aseptic conditions of the procedure, proper surgical technique and choice of equipment (instruments, light, suction), and the duration of surgery are related to the experience of the surgeon and should diminish the incidence of peri- and postoperative complications. It is noteworthy that while some authors claim a direct correlation between the level of training and the likelihood of complications,^{10,17,25,29} others indicate that the experience of the surgeon has no influence on the incidence of adverse effects.²¹


It should be emphasized that the complications in the analyzed material were mild and transient.


Conclusions


Lower third molars and the necessity of surgical extraction with root separation are risk factors for postoperative complications in patients who require wisdom tooth removal. Complications after the removal of third molars are most often inflammatory.

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References

1. Szubert P, Sokalski J, Czechowska E. Removal of third molars performed in Oral Surgery Clinic of Poznan Medical University in 1982–1988 and 2004–2007 [in Polish]. *Dent Med Probl.* 2007;44(4):456–462.
2. Shoshani-Dror D, Shilo D, Ginini JG, Emodi O, Rachmiel A. Controversy regarding the need for prophylactic removal of impacted third molars: An overview. *Quintessence Int.* 2018;49(8):653–662. doi:10.3290/j.qi.a40784
3. Sayed N, Bakathir A, Pasha M, Al-Sudairy S. Complications of third molar extraction: A retrospective study from a tertiary healthcare centre in Oman. *Sultan Qaboos Univ Med J.* 2019;19(3):e230–e235. doi:10.18295/squmj.2019.19.03.009

4. Sukegawa S, Yokota K, Kanno T, et al. What are the risk factors for postoperative infections of third molar extraction surgery: A retrospective clinical study? *Med Oral Patol Oral Cir Bucal*. 2019;24(1):e123–e129. doi:10.4317/medoral.22556
5. Barbosa-Rebellato NL, Thomé AC, Costa-Maciel C, Oliveira J, Scariot R. Factors associated with complications of removal of third molars: A transversal study. *Med Oral Patol Oral Cir Bucal*. 2011;16(3):376–380. doi:10.4317/medoral.16.e376
6. Candotto V, Oberti L, Gabrione F, Scarano A, Rossi D, Romano M. Complication in third molar extractions. *J Biol Regul Homeost Agents*. 2019;33(3 Suppl 1):169–172.
7. Malkawi Z, Al-Omiri MK, Khraisat A. Risk indicators of postoperative complications following surgical extraction of lower third molars. *Med Princ Pract*. 2011;20(4):321–325. doi:10.1159/000324550
8. Agrawal A, Yadav A, Chandel S, Singh N, Singhal A. Wisdom tooth – complications in extraction. *J Contemp Dent Pract*. 2014;15(1):34–36. doi:10.5005/jp-journals-10024-1484
9. Miclotte I, Agbaje JO, Spaey Y, Legrand P, Politis C. Incidence and treatment of complications in patients who had third molars or other teeth extracted. *Br J Oral Maxillofac Surg*. 2018;56(5):388–393. doi:10.1016/j.bjoms.2018.02.001
10. Szczepkowska A, Lipczyńska M, Osica P, Janas-Naze A. The most common complications after surgical extraction of mandibular third molars in the material of the Department of Oral Surgery, Medical University of Lodz. *J Educ Health Sport*. 2016;6(5):412–423. doi: 10.5281/zenodo.53181
11. Kazubowska K, Hadzik J, Dominiak M. Iatrogenic damage to inferior alveolar nerve and lingual nerve – prevention and non surgical treatment on the basis of the literature and personal observations [in Polish]. *Magazyn Stomatol*. 2016;26(12):36–41.
12. Shintani Y, Nakanishi T, Ueda M, Mizobata N, Tojyo I, Fujita S. Comparison of subjective and objective assessments of neurosensory function after lingual nerve repair. *Med Princ Pract*. 2019;28(3):231–235. doi:10.1159/000497610
13. Shetty V, Hegde P, Jain S. Management of iatrogenic dislodgment of a mandibular third molar into the pterygomandibular space. *Gen Dent*. 2019;67(3):e1–e4.
14. Lutz JC, Cazzato RL, Le Roux MK, Bornert F. Retrieving a displaced third molar from the infratemporal fossa: Case report of a minimally invasive procedure. *BMC Oral Health*. 2019;19(1):149. doi:10.1186/s12903-019-0852-z
15. North L, Sulman C. Subcutaneous emphysema and vocal fold paresis as a complication of a dental procedure. *Int J Pediatr Otorhinolaryngol*. 2019;124:76–78. doi:10.1016/j.ijporl.2019.05.033
16. Nienartowicz J, Komorski J, Woytoń-Górawska H. Displacement of maxillary and mandibular third molar buds to maxillary sinus – a rare case of germectomy complication [in Polish]. *e-Dentico*. 2016;5(63):66–70.
17. Ambicki M, Lewandowski B. Iatrogenic dislocation of the lower wisdom tooth to the perimandibular space – a case report. *J Stoma*. 2019;72(3):142–146. doi:10.5114/jos.2019.87535
18. Lewusz-Butkiewicz K, Kaczor K, Nowicka A. Risk factors in oroantral communication while extracting the upper third molar: Systematic review. *Dent Med Probl*. 2018;55(1):69–74. doi:10.17219/dmp/80944
19. Zabojszcz M, Malinowski KP, Janion-Sadowska A, et al. Safety of dental extractions in patients on dual antiplatelet therapy – a meta-analysis. *Adv Interv Cardiol*. 2019;15(1):68–73. doi:10.5114/aic.2019.83773
20. Tojyo I, Nakanishi T, Shintani Y, Okamoto K, Hiraishi Y, Fujita S. Risk of lingual nerve injuries in removal of mandibular third molars: A retrospective case–control study. *Maxillofac Plast Reconstr Surg*. 2019;41(1):40. doi:10.1186/s40902-019-0222-4
21. Azenha MR, Kato RB, Lima Bueno RB, Oliveira Neto PJ, Ribeiro MC. Accidents and complications associated to third molar surgeries performed by dentistry students. *Oral Maxillofac Surg*. 2014;18(4):459–464. doi:10.1007/s10006-013-0439-9
22. Nguyen E, Grubor D, Chandu A. Risk factors for permanent injury of inferior alveolar and lingual nerves during third molar surgery. *J Oral Maxillofac Surg*. 2014;72(12):2394–2401. doi:10.1016/j.joms.2014.06.451
23. Adeyemo WL, Ogunlewe MO, Ladeinde AL, Hassan OO, Taiwo OA. A comparative study of surgical morbidity associated with mandibular third-molar surgery in young and aging populations. *J Contemp Dent Pract*. 2010;11(4):E001–E008.
24. Badenoch-Jones EK, David M, Lincoln T. Piezoelectric compared with conventional rotary osteotomy for the prevention of postoperative sequelae and complications after surgical extraction of mandibular third molars: A systematic review and meta-analysis. *Br J Oral Maxillofac Surg*. 2016;54(10):1066–1079. doi:10.1016/j.bjoms.2016.07.020
25. Momin M, Albright T, Leikin J, Miloro M, Markiewicz MR. Patient morbidity among residents extracting third molars: Does experience matter? *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2018;125(5):415–422. doi:10.1016/j.oooo.2017.12.006
26. Menon RK, Yan LK, Gopinath D, Botelho MG. Is there a need for post-operative antibiotics after third molar surgery? A 5-year retrospective study. *J Investig Clin Dent*. 2019;10(4):e12460. doi:10.1111/jicd.12460
27. Al Harbi MJ, Alomaym MAA, Aldohan MFM, Alkurdi IF. Necessity of antibiotics to reduce inflammatory complications after third molar extractions: A prospective study. *J Pharm Bioallied Sci*. 2019;11(Suppl 1):S13–S17. doi:10.4103/jpbs.JPBS_232_18
28. Dalewski B, Kamińska A, Trybek G, Frączak B. Neuropathic pain after a third molar extraction. A case report [in Polish]. *Pomeranian J Life Sci*. 2018;64(2):83–86. doi:10.21164/pomjlifesci.410
29. Pourmand PP, Sigrón GR, Mache B, Stadlinger B, Locher MC. The most common complications after wisdom-tooth removal: Part 2: A retrospective study of 1,562 cases in the maxilla. *Swiss Dent J*. 2014;124(10):1047–1051,1057–1061.