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ABSTRACT

On the dissertation of Madina Amanzholovna Mugalbaeva, entitled «Optimization of Surgical Treatment for Atypical Lower Third Molar Extraction», submitted for the degree of Doctor of Dental Sciences (PhD) in the specialty 8D10103 – «Medicine»

Scientific consultants:
Doctor of Medical Sciences,
Acting Professor of the Department
of Surgical Dentistry
Mirzakulova U.R.

Foreign scientific consultant:
DDM, MPH, PhD,
Professor of the Department
of Public Health in Dentistry
Katrova L.G.

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ABSTRACT

On the dissertation of Madina Amanzholovna Mugalbaeva, entitled «Optimization of Surgical Treatment for Atypical Lower Third Molar Extraction», submitted for the degree of Doctor of Dental Sciences (PhD) in the specialty 8D10103 – «Medicine»

Relevance of the problem

At the present stage of development in surgical dentistry and maxillofacial surgery, the management of difficult eruption of the lower third molar remains highly relevant due to its high prevalence (35–76%), with peak incidence observed in the 20–30-year age group.

Complications associated with difficult eruption of the lower third molars include periostitis (18–32%), osteomyelitis (10–17%), lymphadenitis (10–28%), abscess formation (5–12%), and phlegmon (3–9%). The most severe complications - sepsis and mediastinitis - occur in 0.5–2% of cases in the absence of timely treatment.

Extraction of the lower third molar presents significant challenges, since it requires removal of a considerable amount of surrounding bone tissue. Following this procedure, a substantial bone defect is formed. Healing of the extraction site is often complicated by alveolitis, and in some cases by osteomyelitis of the jaw, abscesses, or phlegmons of the maxillofacial region.

Given the high incidence of complications (23.7–40.6%), the development of methods aimed at optimizing socket healing and preventing inflammatory complications after atypical extraction of the lower third molars remains an urgent issue.

Various surgical and conservative approaches have been proposed to optimize healing after extraction of the lower third molar. For example, Kunkel M. (2018) suggested filling the socket with an autograft of bone fragments obtained from adjacent anatomical areas to accelerate regenerative processes. Schmidlin P.R. et al. (2019) reported on the use of biopolymers based on alginates and chitosan, which are biocompatible, stimulate osseointegration, and improve healing of the bone defect. Pilloni A. et al. (2020) proposed matrices containing hyaluronic acid, which promote accelerated soft tissue regeneration and exert a pronounced anti-inflammatory effect.

One of the major achievements in medicine, and in dentistry in particular, has been the use of growth factors to accelerate regenerative processes in wounds. The most accessible source of autologous growth factors is platelets. Platelet-rich plasma (PRP) is a medium containing a high concentration of platelets, as well as leukocytes, which provide a local antibacterial effect.

Numerous studies have confirmed the positive effects of PRP in the treatment of various diseases and during recovery after surgical interventions, including tooth

extraction. PRP promotes accelerated tissue regeneration, reduces inflammation, and improves healing through the release of growth factors contained in platelets. When autologous PRP is applied, socket healing occurs significantly faster compared with conventional treatment methods.

Dohan Ehrenfest D.M. et al. (2006) advanced the technique for obtaining platelet-rich fibrin (PRF), which possesses improved rheological and regenerative properties. PRF facilitates faster restoration of bone tissue, particularly in cases of alveolar atrophy, periodontitis, and postoperative bone defects of the jaws.

The studies of Menchisheva Yu.A. (2020), Menzhanova D.D., and Azhibekov A.S. (2024) focused on the use of PRP to optimize wound healing in the maxillofacial region, as well as in complex dental implant therapy. The authors demonstrated that PRP enhances the regeneration of both soft and hard tissues, reduces the risk of inflammatory complications, and improves implant osseointegration, making this approach a promising direction in modern surgical dentistry.

In recent years, plasmogel has been introduced—an autologous filler derived from thermally processed platelet-rich plasma. Plasmogel functions as a “fibrin glue” enriched with growth factors, albumin, and amino acids. It exhibits high plasticity and modeling capacity, as well as a multifactorial biological effect. There are only limited studies on its application in maxillofacial surgery and implantology. However, no studies have been identified in the available literature regarding the use of plasmogel to enhance healing of post-extraction sockets.

To optimize healing after traumatic tooth extraction, various synthetic bone graft materials are also employed. One widely used material is β -tricalcium phosphate (β -TCP). According to several authors, filling sockets after atypical lower third molar extraction with β -TCP promotes the formation of a complete bone regenerate and reduces the risk of inflammatory complications. El-Chaar et al. (2012) applied a biocomposite consisting of 15% hydroxyapatite and 85% β -tricalcium phosphate incorporated into a collagen matrix (putty paste) for filling extraction sockets. The authors reported that this composition preserved alveolar ridge volume and accelerated the formation of mature bone tissue, which is of great significance for subsequent dental implantation.

The use of biocomposites combining osteoinductive and osteoconductive properties represents a promising approach in maxillofacial surgery [38, 39].

Aim of the dissertation research: improving the effectiveness of surgical treatment for atypical lower third molar extraction.

Research objectives:

1. To study the frequency and pattern of inflammatory complications associated with difficult eruption of the lower third molar following its atypical extraction, based on data from the Maxillofacial Department No. 2 of City Clinical Hospital No. 5 in Almaty.

2. To study treatment outcomes based on clinical, radiographic, and densitometry data using a biocomposite and PRP for atypical lower third molar extraction.

3. To conduct a comparative cytological analysis of socket healing in the lower third molar under a blood clot and under a biocomposite and PRP.

4. To determine quality of life and patient satisfaction after surgery for atypical lower third molar extraction using a biocomposite and PRP. Research objectives:

Research methods:

Study design: open, controlled, retrospective–prospective study.

The following methods were applied:

Clinical examination methods.

Radiological diagnostic methods: orthopantomography was performed in all patients in both groups; 3D computed tomography was performed prior to atypical extraction of the lower third molar in both the study and comparison groups, involving 60 patients (28.6%). Densitometry: conducted to assess the density of jaw bone tissue after treatment. Examinations were performed in 60 patients (28.6%; 30 in each group) at 3, 6, 9, and 12 months to measure bone density in the filled defect area, expressed in Hounsfield units (HU). Cytomorphological method: applied to study the surface of sockets after atypical extraction of the third lower molar in 120 patients (60 in each group). Material was collected on the 2nd, 5th, 7th, and 10th postoperative days. Patient satisfaction assessment: 210 patients were surveyed using a questionnaire on the 2nd, 5th, and 10th postoperative days. Pain intensity was evaluated using the Visual Analogue Scale (VAS). Statistical analysis: comparison of groups by sex and complication rate was performed using the χ^2 -test with Yates' correction. Differences in bone density and pain levels (VAS) were assessed with the Mann–Whitney U-test. Statistical significance was set at $p < 0.05$. Data were processed using SPSS 21.0 (IBM, USA).

Object of the study:

A total of 210 patients (105 in the main group and 105 in the comparison group), aged 18 to 45 years, treated at the Department of Maxillofacial Surgery No. 2 and the Admissions Department of City Clinical Hospital No. 5 in Almaty between 2019 and 2024.

Subject of the study:

The healing process of the socket following atypical extraction of the lower third molar using a biocomposite in combination with plasma enriched with platelet factors.

Main provisions submitted for defense:

1. The incidence of inflammatory complications after atypical removal of the lower third molar was 10.8%.

2. The treatment method involving a biocomposite and plasma enriched with platelet factors proved effective in optimizing socket healing after atypical third

molar extraction, as confirmed by positive clinical, radiological, cytological, and densitometric outcomes in the postoperative period.

3. The application of a biocomposite to fill the socket, in combination with plasma enriched with platelet factors, reduced the incidence of inflammatory complications in the postoperative period to 5.3%.

4. The combined use of a biocomposite and plasma enriched with platelet factors improved patients' quality of life after atypical third molar extraction, as demonstrated by questionnaire results (Visual Analogue Scale, VAS).

Description of the main results of the study:

The study included a retrospective analysis of 2,109 medical records of patients hospitalized in the Maxillofacial Surgery Department No. 2 of Almaty City Clinical Hospital No. 5 from 2018 to 2021 with a diagnosis of "difficult eruption of the lower third molar". Of these, 1,390 (65.9%) were female and 719 (34.1%) were male.

The medial-oblique position of the tooth was the most frequent finding (69.98%). The overall complication rate after atypical removal of the lower third molar was 10.8%.

The results of treatment of patients using a biocomposite in combination with plasma enriched with platelet factors after surgery for atypical removal of the lower third molar showed that the number of complications decreased: if in the comparison group the number of complications was 10.8%, then in the main group the number of complications decreased to 5.3% ($p < 0.05$).

The mean duration of temporary disability decreased by 2.8 days in the main group — from 7 ± 0.4 days in the comparison group to 4.2 ± 0.3 days ($p < 0.05$).

Radiographic analysis confirmed that bone regeneration in the extraction socket occurred at a faster rate in the main group. Complete filling of the socket with bone tissue was achieved after 9 ± 0.1 months in the main group compared to 12 ± 0.5 months in the comparison group ($p < 0.05$).

Densitometry results at 3, 6, 9, and 12 months after surgery showed significantly higher bone density values in the main group at 6 and 9 months compared with the comparison group. However, after applying the Bonferroni correction, only the intergroup difference at 9 months remained statistically significant.

Cytological studies demonstrated optimization of all stages of socket healing after AUNTM surgery following the use of the biocomposite and PRP therapy. Patients in the study group demonstrated earlier fibroblast appearance in smears and an increased number of epithelial cells, which improved granulation tissue formation and reduced epithelialization time. Analysis of the dynamics of cytological parameters (ILS and VDI) showed that active cell proliferation in patients in the study group peaked on day 10, while degenerative changes were most pronounced on day 5 and then gradually decreased by day 10.

The Visual Analogue Scale (VAS) results revealed a lower pain intensity in patients of the main group, in whom the extraction socket was filled with a biocomposite. Statistically significant differences in pain levels between the two groups were observed on days 2, 5, and 10 postoperatively ($p < 0.05$ for all time points).

Scientific novelty:

1. A retrospective analysis of archival material from patients who underwent atypical removal of the lower third molar (AUNTM) in the Maxillofacial Surgery Department No. 2 and the Emergency Department of City Clinical Hospital No. 5 in Almaty revealed that the incidence of inflammatory complications after this operation was 10.8%.

2. For the first time, a biocomposite composition was developed, consisting of plasma gel and an osteoplastic synthetic material in a 1:3 ratio (Author's Certificate No. 56041). A novel method for filling the extraction socket with this biocomposite and introducing plasma enriched with platelet factors into the transitional fold was also created (Patent of the Republic of Kazakhstan No. 37194).

3. It was established that the combined use of a biocomposite and plasma enriched with platelet factors after atypical removal of the lower third molars reduced the incidence of postoperative inflammatory complications fourfold (from 10.8% to 5.3%).

4. Radiological and densitometric studies demonstrated that bone regeneration in the extraction socket of the lower third molar occurred at a significantly faster rate in patients of the main group. Complete bone tissue formation was achieved after 9.0 ± 0.1 months compared with the control group ($p < 0.05$).

5. Cytomorphological analysis substantiated and confirmed the effectiveness of the developed treatment method, showing a reduction in acute inflammation, accelerated involution of neutrophilic elements, and enhanced activation of regenerative processes in the proliferative phase.

6. According to the Visual Analogue Scale (VAS) pain questionnaire (Scott and Huskisson), patients treated with the developed biocomposite method demonstrated significantly greater satisfaction with treatment outcomes.

Practical significance:

1. The proposed treatment method accelerated bone tissue regeneration and reduced the period of temporary disability in patients after atypical removal of the lower third molar by 2.8 days - from 7.0 ± 0.4 days in the comparison group to 4.2 ± 0.3 days in the main group ($p < 0.05$).

2. CT-based densitometry provided an objective assessment of bone density and treatment effectiveness. In the main group, mature bone density (> 1250 HU) was achieved after 9 months, while in the comparison group recovery was slower, and bone density after 12 months remained within 850–1250 HU ($p < 0.001$).

3. The techniques used for obtaining plasma enriched with platelet factors and plasma gel are simple, cost-effective, and easily applicable in routine clinical practice.

4. The Visual Analogue Scale (VAS) pain questionnaire proved to be an accessible and convenient tool, enabling the assessment of higher patient satisfaction with treatment outcomes when using a biocomposite and plasma enriched with platelet factors.

5. The use of artificial intelligence (AI) made it possible to calculate the optimal volume of the biocomposite and its components required for filling the socket of the lower third molar.

Personal contribution:

The author independently conducted a comprehensive literature review and developed the study design, including the formation of inclusion and exclusion criteria for the prospective study. During the research, the author personally interpreted densitometry results.

The dissertation candidate actively contributed to the formulation of conclusions, as well as to the publication of research findings in specialized scientific journals and their presentation at scientific conferences.

Conclusions:

1. Based on the results of a retrospective analysis of the medical records of 2,109 patients, atypical methods of surgical removal of the third lower molar using a drill and suturing were used in 1,873 (88.80%) patients. Inflammatory complications were observed in 228 (10.8%) patients: alveolitis - in 211 patients (92.54%), acute periostitis - in 3 patients (1.32%), alveolar osteomyelitis - in 2 patients (0.88%), hematoma - in 5 patients (2.19%), prolonged healing of the socket was noted in 7 patients (3.07%).

2. It was found that the use of a biocomposite in combination with the introduction of PRP into the transitional fold after atypical extraction of the lower third molar allowed to reduce the proportion of complications in the postoperative period from 10.8% to 5.3% (by 2 times) and to shorten the duration of temporary disability of patients by an average of 2.8 days ($p < 0.05$). According to densitometry data, mature bone density of more than 1250 HU was achieved by the 9th month in the main group, in the comparison group after 12 months the bone density was 850–1250 HU ($p < 0.001$), which confirms the effectiveness of the proposed treatment method.

3. According to the results of the cytomorphological study, the use of the biocomposite in combination with platelet-rich plasma helps optimize tissue regeneration after atypical extraction of the lower third molar. In patients in the study group, epithelialization occurred on average at 10.05 ± 0.1 days, while in patients in the comparison group it occurred at 13.04 ± 0.2 days ($p < 0.05$);

4. The results of the patient questionnaire using a visual analogue scale showed that the use of the biocomposite in combination with platelet-rich plasma

reduces the intensity of postoperative pain after AUNTM. The average pain level in patients in the study group was 1.67 ± 0.14 points on the VAS scale over the entire observation period. In the comparison group, the average pain level was higher - 4.27 ± 0.18 points ($p < 0.05$).

Dissertation approval:

The main provisions of the dissertation were presented at:

1. XI International Scientific and Practical Conference “Priorities of Pharmacy and Dentistry: From Theory to Practice”, dedicated to the coordination of education, science and practice in the field of biological safety in the Republic of Kazakhstan, as well as issues of pharmaceutical and dental development. Almaty, November 4, 2022.

2. International Scientific and Practical Conference dedicated to the 80th anniversary of Ryazan State Medical University named after Academician I.P. Pavlov “Achievements of Modern Dentistry and Maxillofacial Surgery”. Ryazan, Russian Federation, May 19, 2023.

3. X International Scientific and Practical Conference “Priorities of Pharmacy and Dentistry: From Theory to Practice”. Poster presentation. Almaty, November 26, 2021.

4. 1st International Forum “Asfen.Forum, New Generation”. Almaty, June 6, 2023.

5. XII International Scientific and Practical Conference “Priorities of Pharmacy and Dentistry: From Theory to Practice”, dedicated to the 70th anniversary of Professor Omarova R.A. Almaty, November 21, 2023.

6. VI Central Asian International Scientific and Practical Conference on Medical Education “Education of the Future: Wind of Change”. Karaganda, April 20, 2023.

7. International Scientific and Practical Conference of Ryazan State Medical University named after Academician I.P. Pavlov “Approaches to the Diagnosis and Treatment of Diseases of the Oral Tissues and Organs in Patients with Somatic Pathologies”. Ryazan, Russian Federation, May 24, 2023.

8. Student Scientific and Practical Conference with International Participation “Aliyev Readings” in memory of Professor, Academician of the National Academy of Sciences of the Republic of Kazakhstan, Halyk Kaharmany Aliyev M.A. Almaty, February 2, 2024.

9. International Scientific and Practical Conference of the Ministry of Health of the Republic of Uzbekistan, Tashkent State Dental Institute “Modern Methods and Technologies in Maxillofacial Surgery”. Tashkent, Republic of Uzbekistan, March 26, 2024.

10. XIII International Scientific and Practical Conference “Priorities of Pharmacy and Dentistry: From Theory to Practice”, dedicated to the 135th anniversary of S.D. Asfendiyarov. Almaty, November 15, 2024.

11. International Forum “ANaMed Forum – New Generation 2025”. June 4–5, 2025.

Publications:

Based on the research results, 11 scientific papers were published, including: 4 articles in journals recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 1 article in a journal indexed in the Web of Science Core Collection (Clarivate Analytics) and Scopus, 6 publications in international conference proceedings (3 of them foreign), 3 additional papers in other scientific journals.

Structure and volume of the dissertation.

The dissertation is presented on 106 pages and consists of: an introduction, a literature review, three main chapters, a conclusion with findings and practical recommendations, and a list of references comprising 185 sources (82 foreign, 105 from CIS countries). The work is illustrated with 8 tables and 69 figures.