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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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PROSPECTS AND LONG-TERM RESULTS AFTER ENDODONTIC SURGERY

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Abstract.

Aim: To analyze the current literature data on the topic of prospects and distant results after endodontic surgery.

Materials and Methods: A systematic review was conducted following the PRISMA 2020 guidelines. This review was written with the help of literature searches in the electronic databases Google Scholar and PubMed. This systematic review aims to assess the current literature data on the topic perspectives and long-term results after endodontic surgery.

Results: A total of 952 articles were reviewed. After analyzing the literature according to the inclusion criteria, the final number was 52. Articles whose content related to the concept of prospective and distant results after endodontic surgery were selected and included in the review.

Conclusion: Endodontic surgery is a useful tool for the dentist to ensure long-term tooth preservation. The long-term results of surgical interventions show different outcomes and dependence on many factors.

Key words. Endodontic surgery, periapical surgery, apicoectomy, cystectomy, retrograde filling.

Introduction.

Endodontic surgery is an important tool in the dentist's arsenal for the treatment of complex endodontic cases. This area of dental practice allows access to pathologic foci associated with the roots of teeth, which are inaccessible in non-surgical endodontic treatment. Surgical endodontics allows to achieve complete treatment of the affected area and create favorable conditions for tissue healing.

Current trends in endodontics indicate that microsurgical techniques are becoming more widespread. Microsurgical protocols, due to their minimally invasive nature, provide a less traumatic surgical intervention and accelerated tissue recovery in the postoperative period.

However, despite advances in technology and surgical techniques, many questions about the long-term efficacy and prospects of endodontic surgery remain open.

This systematic review aims to assess the current literature data on the topic perspectives and long-term results after endodontic surgery.

Materials and Methods.

An electronic search was carried out using the following databases: PubMed, Google Scholar with content related to the prospects and long-term results after endodontic surgery were selected and included in the review. The search assessed all the literature published internationally no later than 2010 year. Four medical subject heading (MeSH) terms: endodontic surgery, periapical surgery, cystectomy, retrograde filling.

1) Study design:

This systematic review was conducted following the PRISMA guidelines. The review adhered to the PRISMA 2020 Checklist and was carried out in line with current recommendations for systematic reviews and meta-analyses [1,2].

PICO Question: What are the prospects and long-term results after endodontic surgery, which materials and techniques perform better in extended time?

- P (Population): Teeth undergoing endodontic surgery due to pathological processes related to the roots of teeth.
- I (Intervention): Usage of conventional protocol and MTA as a filling material.
- C (Comparison): The long-term results for operations with diagnostic techniques, other restorative materials, and surgical protocols.
- O (Outcomes): Long-term outcomes and prospects after endodontic surgery, with focus on materials and techniques exhibiting extended efficacy over time.

2) Eligibility criteria:

Publications were included based on the following inclusion criteria:

1. Articles dated 2010 and later.
2. Examination of the relevance of data on dental health saving programmes for students in the Russian Federation.
3. Consideration of the effectiveness of the implemented prevention programmes.

The articles were reviewed and analysed in several stages. The first selection criterion was the choice of publications whose titles included at least 1 search term. Next, papers dated later than 2010 were excluded. At the last stage, the content of full-text versions of the selected articles was studied.

Inclusion criteria:

1) Articles published in the English language or those having a summary in English.
2) Articles published in the Russian language.
3) Case series.
4) In vivo studies.
5) Randomized controlled trials.
6) Randomized experimental trials.

[Studies in which endodontic surgeries were performed using traditional and modified protocols and various filling materials.]

Exclusion criteria:

1) Articles published in language other than English, Russian.
2) Systematic reviews.
3) Abstracts.
4) Letters to editors.

3) Data collection and data items:

Two authors conducted an initial comprehensive screening to identify articles meeting the eligibility criteria. Full-text articles were retrieved for further evaluation if they met the inclusion criteria. Articles with insufficient data were excluded. Discrepancies were resolved through discussion until agreement was reached between the two primary authors.

Data extraction.

A Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, Washington) was specifically designed to document inclusion and exclusion criteria, along with detailed reasons for data extraction processing. Two authors comprehensively selected the studies, and any discrepancies were resolved through discussion to reach a consensus (Figure 1).

Discussion.

Endodontic surgery has become an integral part of dental practice, providing an opportunity to save a tooth in case of ineffectiveness of conservative methods of treatment of inflammatory diseases of periodontal tissues, cystic formations and errors during endodontic treatment of tooth canals.

Studies show that the prevalence of apical periodontitis affecting at least one tooth ranges from 12% to 52%. The predominant number of patients is found in countries with developing economies. There is a clear correlation between the development of periodontitis and the presence of somatic pathologies. Patients with such diseases as diabetes mellitus, liver, blood and bone diseases have an increased risk of inflammation and subsequent destruction of periodontal tissues [3-6]. Quite often canals omitted during the endodontic treatment can lead to periodontal complications and the need for apical surgery [7].

Radicular cysts arising from inflammation and infection of dental tissues occupy one of the leading positions among periapical lesions. The main mechanism of their pathogenesis is associated with the proliferation of epithelial islets of Malasse, which are activated under conditions of persistent inflammatory process [8]. In the case of initial treatment, pathologic formations are subjected to standard endodontic therapy. In the absence of the expected therapeutic effect and persistence of clinical symptoms, the dentist has to resort to endodontic surgery [9].

Endodontic treatment, despite the high degree of development, is not without the risk of errors. The most serious complications,

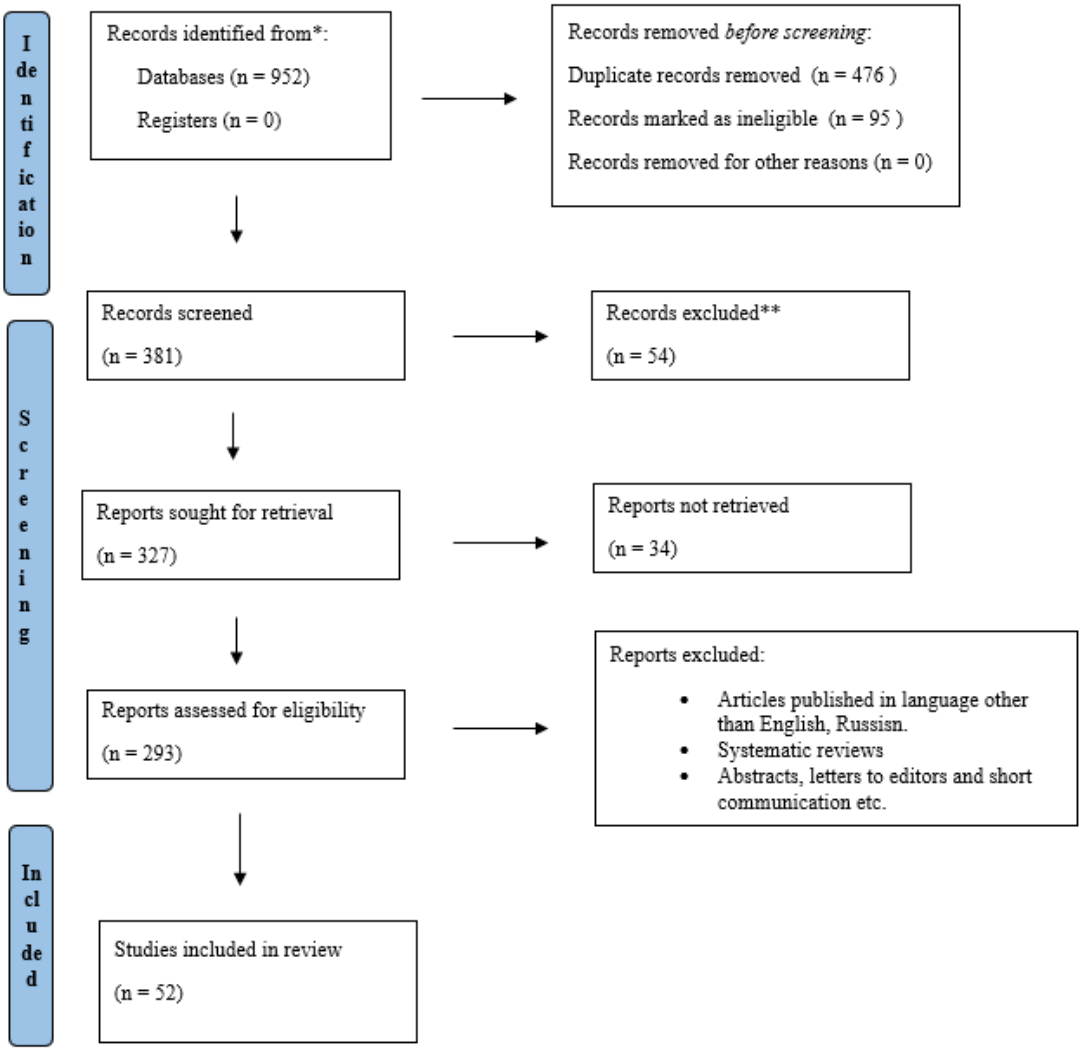

Figure 1. *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow diagram [1,2].*

potentially jeopardizing the patient's health, are the withdrawal of filling material beyond the apical opening of the tooth root, apical perforation, and fragmentation of the instrument in the tooth canal [10-13].

Tooth-preserving surgeries promote alveolar bone maintenance, soft tissue aesthetics, and shortened rehabilitation period after intervention [14].

Apical resection.

Analysis of the clinical outcomes of different apical resection protocols demonstrates significant differences in treatment success in different postoperative periods (Table 1).

Table 1. *Comparison of operation protocols.*

Surgical protocols	Absence of clinical symptoms (1-year follow-up)	Full restoration of bone structure
Traditional protocol (low-speed handpieces for osteotomy, 45° tooth root sectioning and amalgam use)	67%	60%
Modernized protocol (Use of a microscope, 90-degree resection, use of an ultrasonic handpiece and retrograde MTA filling)	90–92%	71%

A study of the traditional protocol for root apex resection, including the use of low-speed osteotomy tips with a 45° tooth root section and the use of amalgam as a filling material, showed partial success of the performed method. One year after the operation clinical symptoms were absent in 67% of patients, complete restoration of bone tissue was observed in 60% of patients. The obtained data are confirmed in the study of Alkhuwaitir S et al, where the success rate of amalgam as a restorative material was estimated at 48% [15].

A modernised method of operation involving the use of microscope, 90-degree root resection, ultrasonic root canal treatment and retrograde filling with mineral trioxide aggregate cement (MTA) in endodontic surgery resulted in a significant increase in success rate. Successful postoperative recovery was observed in 90%-92% of cases. Complete healing of the defect was recorded in 71% of cases. A five-year follow-up showed that dental treatment with MTA is slightly but superior to amalgam in terms of clinical outcome. The recurrence rate in the group with MTA was only 4%. Piezoelectric instruments for osteotomy and resection contribute to a better clinical outcome, demonstrating one year after treatment, complete bone recovery in 94% of patients [16,17]. Current endodontic microsurgery protocols have demonstrated improved efficacy and reduced complication rates compared to traditional techniques. A great role in the success of treatment has a qualitative homogeneous preliminary filling of the tooth root, which can be achieved by using sound and ultrasonic condensation of endodontic filling materials within a short time (2 s) [18].

The retrograde filling technique can increase the success of apexification by reducing root canal contamination and creating a seal. The most routine and effective material for this technique is MTA. This is largely due to its ability to activate cement formation [19-21]. This material demonstrates excellent apical sealing, due to its lack of shrinkage, and has a bacteriostatic effect (Table 2 and Figure 2) [22].

Table 2. *Comparison of density changes according to groups.*

Materials	Pre-op density	Post-op density
MTA	286.47 (199–396.78)	687.73 (103.56–1289.7)
LPRF	305.3 (71.22–377)	670.81 (186.22–904.86)
MTA+PRF	85.72 (44.33–200)	728.07 (495.27–1485.27)

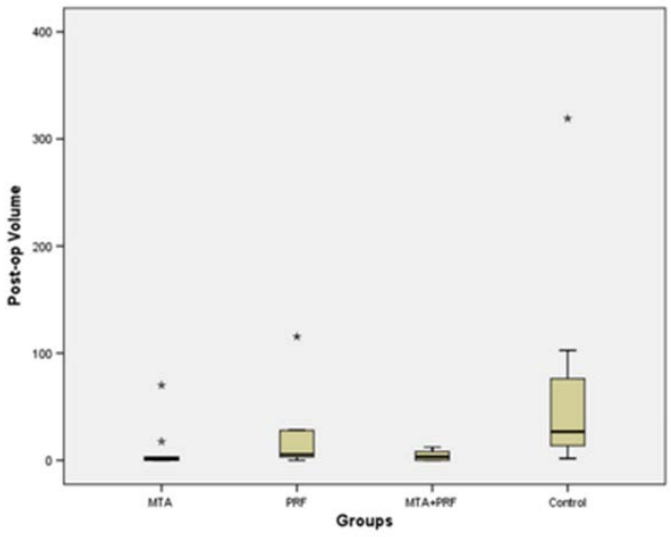

Figure 2. *Post-op volume.*

A study of MTA in combination with platelet-rich fibrin (LPRF) found that using MTA as a retrograde filling material resulted in better outcomes than using LPRF alone. The group receiving LPRF alone showed the least success, while the group receiving MTA in combination with LPRF showed results superior to the LPRF group and the maximum density increase was found in the MTA+PRF group. The study showed that the inclusion of LPRF in the root apex resection procedure did not improve bone healing compared to the control group. The use of MTA as a retrograde filling material, alone or in combination with LPRF, was significantly more effective than in the control group. Although not statistically significant, the results suggest a possibly better return with MTA alone compared to the combination of MTA and LPRF. Thus, the data suggest that LPRF does not contribute significantly to periapical healing and the choice of appropriate retrograde material is paramount to a successful outcome [23]. The use of MTA as a retrograde filling material increases the success rate of surgical outcome by 1.5 times in both the short term (1 year) and long term (Table 3) [24].

Compared to a polymer composite (Retroplast), MTA is significantly superior in terms of healing percentage, demonstrating almost complete tissue recovery [25]. To a minor

Table 3. *Distant outcomes with various materials.*

Researches	Materials	Outcomes	Value
Alkhuwaitir S, et al. (2-year follow-up)	MTA	63,7%	P = 0,018
	Biodentine	95,5%	
Von Arx T, et al. (1-year follow up)	MTA	91,3%	P = 0,003
	Retroplast	79,5%	
Kim S, et al. (1-year follow up)	MTA	91,6%	P = 0,08
	Super EBA	89,9%	
(4-year follow up)	MTA	89,5%	P =0,063
	Super EBA		

Table 4. *Inter-group comparison of bone healing.*

Follow-up interval	Result	LPRF-group	FDBA-group	Volume
6 months	Uncertain healing	0.0%	5.6%	P = 0.002
	Incomplete healing	50.0%	94.4%	
	Complete healing	50.0%	0.0%	
12 months	Complete healing	100.0%	100.0%	NA

extent, MTA also performed better than a hardened modification of zinc-oxide-eugenol cement (Super EBA) [26]. However, in a study by Alkhuwaitir S et al, the success rate in the group of patients with MTA insertion was relatively low (64%). However, the same study looked at the application of Biodentine, which showed significantly higher efficacy, achieving success in 95% of cases. Perhaps the higher rate of complete healing with Biodentine is due to its ability to accelerate healing. This may be due to the significant formation of calcium silicate hydrate and calcium hydroxide that is characteristic of this silicate cement. This low success rate with MTA is probably due to the size of the pathological focus in the preoperative period [15].

The study of retrograde filling materials showed that the use of MTA and amalgam in root canals significantly stimulates angiogenesis. At the same time, Super EBA demonstrated an even lower level of angiogenesis compared to the control group. Application of sealant using CS-BG-multi bioactive glass showed insignificant proangiogenic properties comparable to the control group [27].

Cystectomy.

Apicoectomy performed during the procedure of cyst enucleation followed by retrograde filling with MTA ProRoot allowed to achieve 99% positive results. This may be due to the absence of infection in the root canal, and consequently there is no serious dependence on complete root canal sealing. A study conducted by KU JK and colleagues confirmed this assumption. Retrograde filling is not a necessary factor for successful treatment of non-inflammatory cysts, as all cases of such treatment ended positively. However, in the case of inflammatory cysts, the study showed that the absence of retrograde filling after apicoectomy also had a high efficacy rate of more than 99% [28].

Radiological observation 12 months after cystectomy noted almost complete filling of the defect with newly formed tissue [29,30]. Despite this, cases of more rapid bone regeneration have been described in the literature. Thus, in a study based on a 4-month radiologic follow-up of a patient after cystectomy of a radicular cyst using a xenograft (Bioss by Geistlish) and Bio-Gide collagen membrane, complete bone regeneration in the area of intervention was recorded (Table 4) [31].

The use of regenerative materials such as platelet- and leukocyte-rich fibrin (LPRF) and bone allograft show potential to accelerate tissue healing and improve surgical success. In a study by Garg M and colleagues, it was shown that the use of LPRF and freeze-dried bone allograft (FDBA) resulted in complete healing of the bone structure within 12 months. However, analysis of dynamic parameters revealed more favorable results in patients who received LPRF [32]. One-year follow-up of patients after apical surgery confirmed the effectiveness of Bio-Gide membrane application. The application of LPRF had no significant effect on treatment outcomes [33]. Incorporation of bone regeneration materials into the cavity promotes the activation of angiogenesis. The greater angiogenic capacity of amniotic membrane compared to LPRF has been noted [34]. Corrector of bone and cartilage tissue metabolism (Alendronate) in combination with LPRF did not cause significant changes compared to the control group. The best healing results were observed in the group using LPRF in combination with hydroxyapatite [35].

One of the major challenges faced by the dentist during cystectomy is to preserve the vitality of teeth protruding into the cystic lumen. Clinical cases have described cases of successful preservation of the vitality of teeth that are in contact with the pathologic focus but are not the causative factor [36,37]. Up to 90% of such teeth can be preserved in the oral cavity after surgical intervention (Table 5) [33].

Table 5. *The dependence of recovery time on the size of the bone defect.*

Size of bone defect	Time of recovery	Healing success rate
2-5.0 mm	3-9 months ± 0.35	75-84% ± 0.45
5.1-9.9 mm	7-12 month ± 0.3	64-73% ± 0.5
>10 mm	>12 months	

There are many factors that directly affect the time and success of treatment. The size of the bone defect is one of the most significant factors determining the time of complete healing of the pathologic focus. Recovery time took from 3 to 9 months for foci of 2-5.0 mm in size, 7-12 months for foci of 5.1-9.9 mm, for foci of 10 mm in size recovery took up to a year and was noted in slightly more than half of the subjects [8,38].

A direct correlation between the success rate of treatment and the size of the bone defect has been revealed [37]. Bone defects up to 5 mm have a higher success rate (75-84%) compared to larger defects (64-73%) [40-43].

Long-term follow-up (5-9 years) showed that the percentage of complete tooth healing was significantly lower than the mid-term (1-4 years) rate of 67% [44]. This is consistent with the results obtained in a delayed (10 years) follow-up of maxillary

premolars. However, the study by von Arx et al. demonstrates a higher mean success rate of 81.5% after 10 years [45]. The tooth survival rate decreases as the postoperative period increases. Over a 10-year period, tooth survival decreases from 95% to 83% [42].

Many studies show different clinical success depending on the teeth belonging to different groups. The highest success rate was observed among the frontal group of teeth, the percentage of restoration of premolars and molars was almost at the same level. However, the study by Lai PT et al. demonstrates greater treatment success among premolars.

Diagnostic methods and modern technologies.

The use of magnifying devices during surgical procedures has become more common over the years. This helps to improve the accuracy and detail of the surgical intervention, which in turn allows for more predictable treatment and positively affects the outcome of the surgery. The success rate of endoscopic endodontic treatment has been reported to be more than 90-95% [38,46].

Despite the use of optical devices there is still a risk of making mistakes during surgical intervention and manifestation of complications in the postoperative period. The most common causes of endodontic treatment failures are isthmus and untreated root canals, the detection rate of which was 36% and 6.8%, respectively [47].

Modern endodontic surgery cannot exist without radiographic methods of diagnosis and treatment planning [48]. A study aimed at comparing 2D (periapical radiography) and 3D (CBCT) imaging methods showed no significant differences in the assessment of treatment success. However, CBCT provides more accurate visualization of the periapical area, allowing for a more accurate assessment of the degree of healing and resolving cases with uncertain treatment outcome [18]. CBCT has been found to have higher diagnostic accuracy than periapical radiography and orthopantomogram in both the pre- and postoperative periods. CBCT results provide 100% diagnostic and follow-up accuracy, which is approximately double that of the other two two-dimensional methods [49].

Static and Dynamic Navigation System (DNS) techniques, based on the creation of a surgical template through preoperative CBCT and real-time computerized tracking of instrument positions, respectively, can improve the success of tooth-preserving surgeries. The DHC-ENDO1 dynamic navigation system developed by DCARER Medical Technology has achieved a 95% success rate in osteotomy and root resection [50]. This technology can reduce access preparation time, minimize the amount of excised tissue, reduce the risk of errors, and facilitate the search for calcified canals. With dynamic navigation, the dentist can perform procedures with greater accuracy and efficiency [51]. The operative time is reduced by about 2 times when DNS is used regardless of the experience of the clinician, which certainly has a positive impact on the outcome of the surgery [52].

Conclusion.

Endodontic surgery is a valuable tool in dental practice for solving complex endodontic cases where traditional conservative methods are ineffective.

Endodontic surgery can provide successful treatment and long-term tooth preservation, improving the patient's quality of life. However, it is important to realize that the outcome of surgery depends on a few factors that have a significant impact on the success of the surgical outcome. The results of the authors of the different studies show differences in the success rate of different restorative materials, which requires further study to obtain more homogeneous results.

In the future, it is necessary to continue research in the field of endodontic surgery to optimize techniques, develop new protocols and materials, and improve the efficiency and predictability of treatment.

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РЕЗЮМЕ

ПЕРСПЕКТИВЫ И ОТДАЛЕННЫЕ РЕЗУЛЬТАТЫ ПОСЛЕ АПИКАЛЬНОЙ ХИРУРГИИ

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Цель: проанализировать современные литературные данные на тему перспектив и отдаленных результатов после эндодонтической хирургии.

Материалы и методы: систематический обзор был проведен в соответствии с рекомендациями PRISMA 2020. Обзор был написан с помощью поиска литературы в электронных базах данных Google Scholar и Pubmed. Цель данного систематического обзора - оценить современные литературные данные по теме перспектив и отдаленных результатов после эндодонтической хирургии.

Результаты: всего было проанализировано 952 статьи. После анализа литературы в соответствии с критериями включения их количество составило 54. В обзор были отобраны и включены статьи, содержание которых касалось концепции перспектив и отдаленных результатов после эндодонтической хирургии.

Заключение: эндодонтическая хирургия является полезным инструментом для стоматолога, обеспечивающим долгосрочное сохранение зуба. Отдаленные результаты хирургических вмешательств имеют различные исходы и зависят от многих факторов.

Ключевые слова: эндодонтическая хирургия, периапикальная хирургия, апикоэктомия, цистэктомия, ретроградное пломбирование.

რეზიუმე

პერსპექტივები და გრძელვადიანი შედეგები ენდოდონტიური ოპერაციის შემდეგ

ხაბაძე ზ. ს, მერ ი. ია, ფოკინა ს. ა, მიტიუშკინა თ. ა, კაკაბაძე ე. მ, ბადალოვი ფ. ვ, დოლჟიკოვი ნ. ა, საეიდიანი ს, უმაროვი ა. იუ, ვეხბი ა.

ოპერატიული სტომატოლოგიის დეპარტამენტი, პატრის ლუმუმბას სახელობის რუსეთის ხალხთა მეგობრობის უნივერსიტეტი (RUDN University), მედიცინის ინსტიტუტი, მიკლუხო-მაკლაიას ქ.n1. 6, მოსკოვი 117198, რუსეთი.

შესავალი მიზანი: ენდოდონტიური ოპერაციის შემდეგ პერსპექტივების და შორეული შედეგების თემაზე არსებული ლიტერატურის მონაცემების ანალიზი.

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ეს სისტემური მიმოხილვა მიზნად ისახავს შეაფასოს მიმდინარე ლიტერატურის მონაცემები თემაზე პერსპექტივები და გრძელვადიანი შედეგები ენდოდონტიური ქირურგიის შემდეგ. შედეგები. სულ განხილული იქნა 952 სტატია. ჩართვის კრიტერიუმების მიხედვით ლიტერატურის ანალიზის შემდეგ საბოლოო რიცხვი 54 იყო. სტატიები, რომელთა შინაარსი დაკავშირებულია ენდოდონტიური ოპერაციის შემდეგ პერსპექტიული და შორეული შედეგების კონცეფციასთან, შეირჩა და შევიდა მიმოხილვაში.

დასკვნა. ენდოდონტიური ქირურგია სტომატოლოგისთვის სასარგებლო საშუალებაა კბილების გრძელვადიანი შენარჩუნების უზრუნველსაყოფად. ქირურგიული ჩარევების გრძელვადიანი შედეგები აჩვენებს სხვადასხვა შედეგებს და ბევრ ფაქტორზე დამოკიდებულებას.

საკვანძო სიტყვები: ენდოდონტიური ქირურგია, პერიაპიკალური ქირურგია, აპიკოექტომია, ცისტექტომია, რეტროგრადული შევსება.