Case Report

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Periapical microsurgical endodontic treatment of the maxillary second premolar: a clinical case

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Abstract

The primary objective of endodontic treatment and apical surgery is the prevention or elimination of inflammatory conditions in the periapical tissues. Such inflammation develops as a result of the metabolic activity of diverse colonies of pathogenic and opportunistic microorganisms colonizing the root canal system. Apical microsurgical intervention represents a promising treatment modality for teeth resistant to conventional (orthograde) therapy. The reported success rate of this procedure exceeds 90%, even in the presence of complications. The occurrence of such complications is often associated with insufficient theoretical training of narrowly specialized clinicians, a lack of appropriate instrumentation, and limited access to magnification equipment, such as binocular loupes or a stationary operating microscope. In some cases, repeated endodontic retreatment proves ineffective and leads to the persistence of apical periodontitis despite technically successful conservative therapy. In these situations, the inflammatory focus is localized within the periodontal space at the apex of the affected tooth. Its etiology is attributed to bacteria persisting in anatomically inaccessible areas of the root canal system. The bacterial biofilm in the apical portion of the root canal system exhibits a complex anatomical configuration, which often cannot be completely eliminated using conventional endodontic techniques.

Keywords: endodontic microsurgery, apical periodontitis, CBCT, apicoectomy, endodontic treatment failure

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Периапикальная микрохирургическая эндодонтия второго премоляра верхней челюсти: клинический случай

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Резюме

Основная цель эндодонтического лечения и апикальной хирургии – профилактика или ликвидация воспалительного состояния верхушечных перирадикулярных тканях. Такое воспаление развивается вследствие активной жизнедеятельности разнообразных колоний патогенных и условно-патогенных микроорганизмов, колонизующих корневые каналы.

Апикальная микрохирургическая операция – перспективный способ лечения зубов, резистентных к традиционной (ортоградной) терапии. Показатель успешности этой процедуры достигает более 90%, даже при наличии осложнений. Их проявление зачастую связано с недостаточной теоретической подготовленностью узкоспециализированных медиков, дефицита необходимого инструментария и увеличительного оборудования –например, бинокулярные лупы или стационарный операционный микроскоп. Иногда повторное эндодонтическое вмешательство оказывается неэффективным и приводит к персистированию апикального периодонтита даже после успешного терапевтического вмешательства. В этом случае воспалительный очаг локализуется в периодонтальном пространстве у верхушки данного зуба. Его причиной становятся бактерии, сохранившиеся в труднодоступных участках корневого канала.Бактериальная биопленка апикальной части системы корневых каналов имеет сложную анатомическую конфигурацию. Традиционные эндодонтические методики зачастую не позволяют полностью устранить такие очаги инфекции.

Ключевые слова: эндодонтическая микрохирургия, апикальный периодонтит, КЛКТ, апикоэктомия, неудачность эндодонтического лечения

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INTRODUCTION

Apical periodontitis is a form of chronic inflammatory disease of the periradicular tissues, accompanied by destructive changes in the alveolar bone of the jaws [1]. The key etiological factors acting as inflammatory agents are anaerobic microorganisms and their antigenic components. The primary objective of endodontic interventions, both conservative and surgical, is the resolution of apical periodontitis or the prevention of its development. The effectiveness of therapy directly depends on the thorough elimination of intracanal microflora, necrotic tissue, and organic remnants within the pulp space [2, pp. 567–578].

The apical portion of the root canal system has a complex anatomical and morphological structure, which promotes the retention of residual microorganisms and contributes to unsatisfactory treatment outcomes. As a result, achieving complete obturation of this region is often technically challenging [3; 4].

Apical microsurgery is a specialized surgical approach aimed at preserving teeth with endodontic pathology when the prognosis of repeated nonsurgical root canal treatment is questionable [5]. When evaluating the outcomes of apicoectomy, the likelihood of success is also high and comparable to that of nonsurgical endodontic therapy [6; 7]. Endodontic failure has been associated with inadequate instrumentation, irrigation, and obturation of the root canal system, particularly in the apical delta. Resection of 3 mm of the apical portion of the root significantly reduces apical ramifications and lateral canals by approximately 95% and 93%, respectively [8].

CLINICAL CASE

Patient I., 36 years old, presented to a dental clinic in 2023 with intermittent complaints of pain in the region of tooth 1.5 during mastication, radiating along the maxilla to the temporal area and the ear. The medical history revealed that approximately one year earlier the patient had undergone endodontic treatment followed by a direct composite restoration. After the intervention, the symptoms persisted, which led to the decision to perform orthograde retreatment of the root canals. Postobturation pain was reported over several years.

During this period, the patient periodically consulted an otorhinolaryngologist and was prescribed broad-spectrum antibacterial agents and nonsteroidal anti-inflammatory drugs. Following a comprehensive interdisciplinary consultation, a decision was made to perform an apicoectomy.

Fig. 1. Preoperative intraoral photograph of tooth 1.5

Рис. 1. Предоперационная внутриоральная фотография зуба 1.5

Intraoral examination of the coronal portion of the affected tooth revealed a composite restoration (Fig. 1). The IROPZ index was 0.6. The tooth was painful on percussion, tenderness was noted upon palpation of the vestibular fold, and the response to thermal stimuli was negative (Endo-Ice test).

Palpation of the regional lymph nodes revealed no lymphadenopathy in the submandibular or cervical regions. The extraoral soft tissues showed no visible pathological changes. The temporomandibular joint was within physiological limits: no clicking was detected and mouth opening was not restricted. Examination of the oral mucosa adjacent to the apex of the involved tooth demonstrated increased sensitivity.

No pathological changes were observed in the attached or marginal gingiva. For a detailed assessment of the condition of the alveolar bone and the dentoalveolar system, cone-beam computed tomography (CBCT) of the maxillary segment in the region of tooth 1.5 was performed. In the buccal projection of the apex of tooth 1.5, a round, well-defined area of bone tissue destruction is identified (Fig. 2, *A*). The root canals, converging in the apical region, are obturated with filling material short of the radiographic apex by 1.7 mm and 1.0 mm, respectively (Fig. 2, *B*).

According to CBCT findings, the tooth has a single root with two converging root canals in close proximity to the apical foramen. The buccal canal is obturated with filling material terminating 1.0 mm short of the

radiographic apex, while the palatal canal is obturated 1.7 mm short of the radiographic apex. In the apical portion of the root, a round, well-circumscribed area of bone destruction is identified, with clearly visualized margins and without disruption of the vestibular cortical plate. The periodontal status of the tooth is within physiological limits, and the lamina dura is preserved. No radiographically evident changes are observed in the right paranasal sinuses. The maxillary sinus demonstrates a sclerotic type of structure with well-defined bony walls; the posterior superior alveolar artery is visualized along the anterior wall of the maxilla in close proximity to the Schneiderian membrane.

Based on the clinical and radiographic findings, the patient was diagnosed with K04.5 – chronic apical periodontitis and K04.8 – radicular cyst of tooth 1.5. Surgical endodontic treatment was recommended in order to preserve the tooth, followed by dynamic follow-up. The patient was informed in detail about the apical microsurgical technique and alternative treatment options, including tooth extraction with subsequent implant placement or the fabrication of a fixed partial denture. The patient approved a combined surgical and prosthetic treatment plan, including coverage of the tooth with an indirect ceramic restoration.

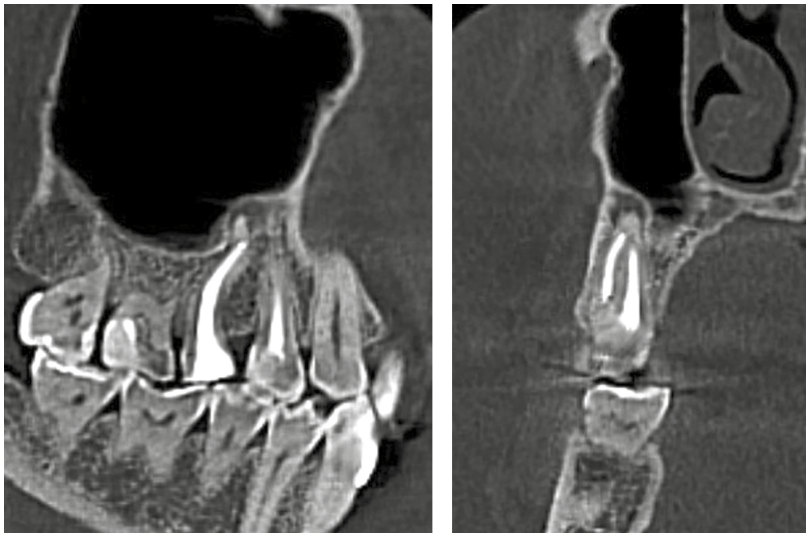
The procedure was performed under periapical infiltration anesthesia using two cartridges of 4% articaine with epinephrine (1:100,000) administered from the vestibular side, as well as half a cartridge in the area of the elevated flap and half a cartridge from the palatal side. A triangular full-thickness mucoperiosteal flap was raised using a 15C blade with an intrasulcular incision extending from the mesial aspect of tooth 1.4 to the distal aspect of tooth 1.6. After flap elevation, no signs of cortical plate resorption or visible periapical changes were noted.

Based on CBCT visualization, surgical access was established: at a depth of 18 mm apical to the alveolar crest, a circular osteotomy with a diameter of 6 mm was created using a sterile round bur under copious irrigation with physiological saline. For hemostasis and improved visualization, sterile cotton pellets soaked in epinephrine solution were used for tamponade. Under an operating microscope, resection of 3 mm of the root apex was performed, followed by curettage of the pathologically altered tissues with final copious irrigation and achievement of hemostasis (Fig. 3).

A critical stage of the surgical procedure involved visualization, retrograde preparation, and obturation of the apical delta. The apical portion of the root canal was treated using an NSK Varios 970 handpiece with an E31D ultrasonic tip to a depth of 3 mm. Following this, the canal was dried and excess moisture removed with paper points, after which Mineral Trioxide Aggregate (ProRoot MTA) was placed and densely condensed (Fig. 4).

The surgical field was irrigated with sterile saline solution. A periapical radiograph was taken to assess the quality of the retrograde filling (Fig. 5).

Non-resorbable polypropylene 5.0 sutures were applied to the wound (Fig. 6), totaling 5 sutures. Postoperative instructions were provided in writing and verbally clarified to address the patient's questions. A follow-up CBCT was performed one and a half years later (Fig. 7), showing positive tissue regeneration in the periodontium around the treated tooth. The pathological clinical presentation has resolved, and the bone defect is gradually being filled with newly formed bone tissue.



A B

Fig. 2. Sagittal (*A*) and coronal (*B*) sections of tooth 1.5

Рис. 2. Сагиттальный (*A*) и корональный (*B*) срез зуба 1.5

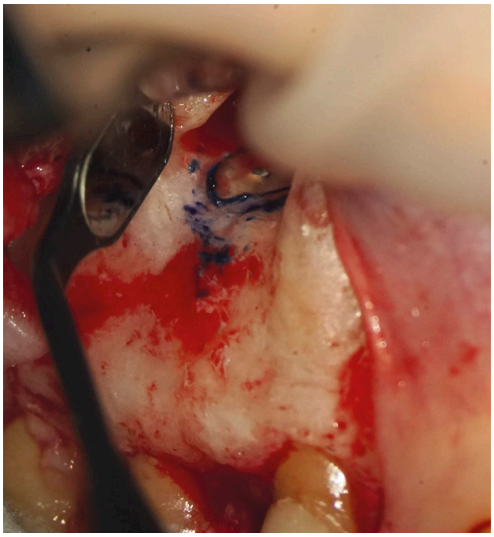


Fig. 3. Resection of 3 mm of the root apex, curettage of pathologically altered tissues, followed by copious irrigation and achievement of hemostasis

Рис. 3. Резецирование 3-х мм апекса корня зуба, кюретаж патологически измененных тканей с окончательной обильной ирригацией и гемостазом

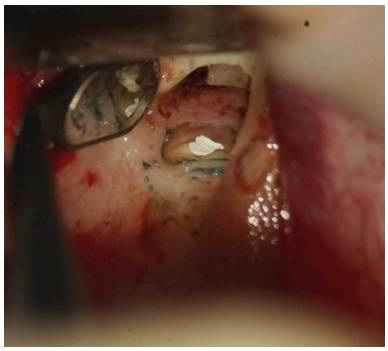


Fig. 4. Apex of tooth 1.5 obturated and condensed with Mineral Trioxide Aggregate (MTA)

Рис. 4. Верхушка корня зуба 1.5 запломбированная и уплотненная Минерал Триоксид Агрегатом

Fig. 5. Periapical radiograph immediately following the surgical procedure

Рис. 5. Периапикальная рентгенограмма сразу после хирургического вмешательства

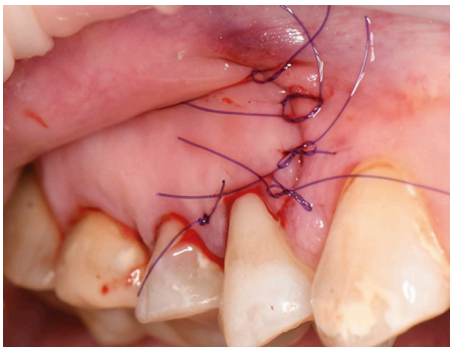
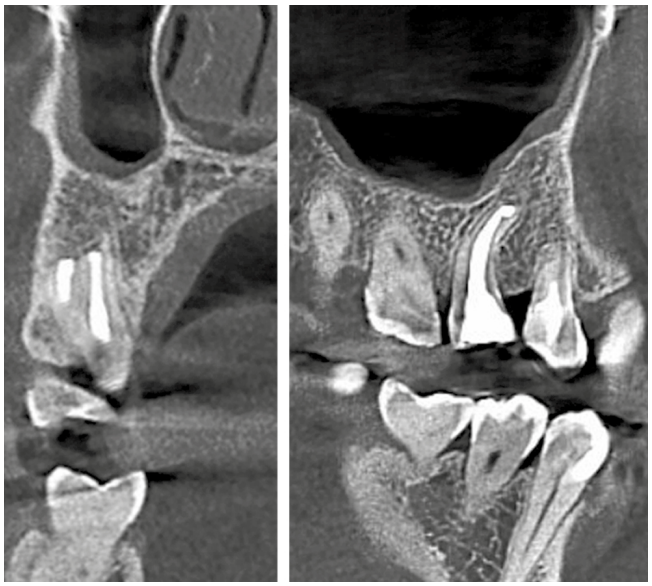


Fig. 6. Closure of the wound with non-resorbable polypropylene 5.0 sutures

Рис. 6. Ушивание раны нерезорбируемым шовным материалом Полипропилен 5.0



A **B**

Fig. 7. CBCT sagittal (*A*) and coronal (*B*) views of tooth 1.5, 18 months post-surgery

Рис. 7. КЛКТ сагитальной (*A*) и корональной (*B*) проекции зуба 1.5 через 18 мес. после хирургического вмешательства

DISCUSSION

In this clinical case, the root canal obturation did not extend to the physiological constriction. This allowed pathogenic microorganisms to proliferate and spread into the periradicular tissues, contributing to the development of apical periodontitis even after repeated interventions. Surgical treatment enabled, under significant magnification, the removal of the unfilled portion of the root and meticulous cleaning and obturation of the apical portion of the canal. As a result, bacterial antigen leakage was significantly reduced – and is expected to be completely eliminated over time – thereby promoting normalization of the patient's immune response.

CONCLUSION

This clinical case illustrates an alternative approach to the treatment of teeth, particularly in situations where conventional endodontic instrumentation, irrigation, and orthograde canal obturation – including achieving apical seal – are limited by root curvature. It suggests the potential for utilizing modern microsurgical equipment and an operating microscope in combination with cone-beam computed tomography (CBCT) to enhance treatment outcomes and preserve teeth with similar clinical presentations that were previously considered candidates for extraction.

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AUTHOR'S CONTRIBUTION

All the authors made equal contributions to the publication preparation in terms of the idea and design of the article; data collection; critical revision of the article in terms of significant intellectual content and final approval of the version of the article for publication.

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