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Comparative analysis of prognostic outcomes between isolated endodontic lesions and endodontic-periodontal combined lesions following microsurgical intervention

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Abstract

INTRODUCTION. Endodontic microsurgery (EMS) has become an effective modality regarding the treatment of enduring periapical pathology after non-surgical failure of retreatment of the root canal. Nevertheless, the predictability of EMS in periodontal destruction that accompanies teeth is still an area of controversy. The aim of the study was to determine the difference in clinical and radiographic healing of isolated endodontic lesions (IEL) and endodontic-periodontal combined lesions (EPCL) after using microsurgical intervention.

MATERIALS AND METHODS. A cohort retrospective study was carried out on 148 teeth among 148 patients who attended EMS between the year 2022 and 2024. Cases were classified into two according to the preoperative probing depths in radiograph and clinical probing depths: Group A (IEL, n = 76) which included lesions of a strictly endodontic nature, and Group B (EPCL, n = 72) which included lesions of a true combined nature with periodontal communication. Each of the procedures involved the use of an operating microscope, ultrasonic retropreparation, and bioceramic retrograde filling. Group B also was targeted with guided tissue regeneration (GTR). Molven criteria were used to determine clinical and radiographic healing at a 12-month follow-up.

RESULTS. The general success rate was 87.2. The success rate of Group A (IEL) was much higher, 94.7% (72/76), than the success rate of Group B (EPCL) was, 79.2% (57/72) (p = 0.006). The average decrease in lesion size was 84.3 ± 12.1 in Group A and 66.8 ± 18.4 in Group B ($p < 0.001$). Although the marginal stability of the bone was attained at 88 per cent in EPCL cases, full regeneration of the periodontial apparatus was not predictable as compared with apical bone healing.

CONCLUSIONS. Although endodontic-periodontal mixed lesions have lower success rate of treatment than endodontic lesion alone, combination of microsurgery with regenerative therapies is still a tooth-saving procedure. But the level of periodontal loss is a decisive prognostic factor.

Keywords: endodontic microsurgery, endodontic-periodontal lesion, periapical surgery, bioceramics, guided tissue regeneration

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Сравнительный анализ прогностических исходов изолированных эндодонтических поражений и комбинированных эндодонто-пародонтальных поражений после микрохирургического вмешательства

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Резюме

ВВЕДЕНИЕ. Эндодонтическая микрохирургия (EMS) стала эффективным методом лечения персистирующей периапикальной патологии после неудачи повторного несургического эндодонтического лечения. Однако предсказуемость EMS при наличии сопутствующего пародонтального разрушения до сих пор остается дискутабельной. Целью исследования было определить различия в клиническом и рентгенологическом заживлении изолированных эндодонтических поражений (IEL) и комбинированных эндодонто-пародонтальных поражений (EPCL) после микрохирургического вмешательства.

МАТЕРИАЛЫ И МЕТОДЫ. Проведено ретроспективное когортное исследование 148 зубов у 148 пациентов, которым выполнялась EMS в период с 2022 по 2024 г. Случаи были распределены на две группы на основании предоперационных рентгенологических данных и клинических показателей глубины пародонтального зондирования: группа A (IEL, $n = 76$) – поражения строго эндодонтической природы; группа B (EPCL, $n = 72$) – истинные комбинированные поражения с пародонтальным сообщением. Все вмешательства выполнялись с использованием операционного микроскопа, ультразвуковой ретропрепарации и биокерамического ретроградного пломбирования. В группе B дополнительно применялась направленная регенерация тканей (GTR). Для оценки клинического и рентгенологического заживления через 12 месяцев использовали критерии Molven.

РЕЗУЛЬТАТЫ. Общая успешность лечения составила 87,2%. Успешность в группе A (IEL) была значительно выше – 94,7 % (72/76), по сравнению с группой B (EPCL) – 79,2 % (57/72) ($p = 0{,}006$). Среднее уменьшение размера очага составило 84,3 ± 12,1 % в группе A и 66,8 ± 18,4 % в группе B ($p < 0{,}001$). Несмотря на достижение маргинальной стабильности кости в 88 % случаев EPCL, полная регенерация пародонтального аппарата была менее предсказуемой по сравнению с апикальным костным заживлением.

ВЫВОДЫ. Несмотря на то, что комбинированные эндодонто-пародонтальные поражения имеют более низкую успешность лечения по сравнению с изолированными эндодонтическими поражениями, сочетание микрохирургии с регенеративными методами остается зубосохраняющей процедурой. При этом степень пародонтальной утраты является определяющим прогностическим фактором.

Ключевые слова: эндодонтическая микрохирургия, эндодонто-пародонтальное поражение, периапикальная хирургия, биокерамика, направленная регенерация тканей

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INTRODUCTION

Conservation of natural dentition is the main goal of the modern endodontics. Although non-surgical root canal treatment (RCT) has high success rates, in some instances, persistence of apical periodontitis (10–15% of cases) is a result of intraradicular infection, extraradicular biofilm or complicated anatomy [1]. Traditional apical surgery has traditionally been considered to be a last resort whose effects are uncertain. Nonetheless, the development of endodontic microsurgery (EMS), which is defined by high-power magnification, ultrasonic root-end preparation, and biocompatible filling materials has transformed the landscape putting reported success rates at more than 90 percent [2].

In spite of these progresses, the prognosis of teeth with concomitant periodontal involvement that can be considered as endodontic-periodontal combined lesions (EPCL) is complicated. And the pulp and the pe-

riodontium have an anatomical relationship through the apical foramen, lateral canals, and dentinal tubules, which forms a bilateral pathway, in which the pathogen spreads [3]. These lesions were firstly categorized by Simon et al. and they said that so called true combinations lesions, in which endodontic and periodontal discrete pathologies converge, are the most difficult ones to treat [4].

Although there is a solid literature on the literature outcome of EMS on isolated endodontic lesions (IEL), there is a lack of comparative literature specifically on EPCLs treated by using modern microsurgical methods. Previous research involving conventional amalgam retrofills and lack of guided tissue regeneration (GTR) showed pathetic success rates of combined lesions which normally resulted in extraction [5]. According to recent research, it can be proposed that the use of GTR membranes and bone grafts in the microsurgery practice could significantly enhance the prognosis of through-and-through defects or dehiscences related to EPCLs [6]. However, the actual effect of marginal periodontal loss on the sealing property of the retrograde filling and the subsequent apical healing is yet to be explained.

The existing studies tended to combine different types of lesions, which does not separate the prognosis difference between the pure endodontic failures and the periodontal communicational failures. Such a gap makes it difficult to offer proper prognostic predictions of the patients with EPCLs by the clinician. Thus, the objective of the research was to compare the prognostic results of the isolated endodontic lesions and endodontic-periodontal combined lesions subject to standardized micro surgical treatment.

MATERIALS AND METHODS

Study design and population

this retrospective cohort study was conducted in a university-affiliated specialized endodontic clinic. The study protocol was approved by the Institutional Review Board. Clinical records of patients who underwent endodontic microsurgery between January 2022 and January 2024 were reviewed.

Inclusion and exclusion criteria

inclusion criteria were: (1) Teeth with persistent apical periodontitis following non-surgical retreatment; (2) 12-month minimum follow-up data; (3) Adequate quality of pre- and post-operative Cone Beam Computed Tomography (CBCT) and periapical radiographs. Exclusion criteria included: (1) Vertical root fractures (VRF); (2) Tooth mobility > Grade II; (3) Unrestorable teeth; (4) Patients with uncontrolled systemic diseases affecting wound healing (e.g., uncontrolled diabetes, bisphosphonate therapy).

Group allocation

Teeth were categorized into two groups:

Group A (Isolated Endodontic Lesions – IEL): Periapical radiolucency present, intact lamina dura along the lateral root surface, and normal probing depths (< 4mm).

Group B (Endodontic-Periodontal Combined Lesions – EPCL): Periapical radiolucency merging with marginal alveolar bone loss, confirmed by a "J-shaped" radiolucency or deep narrow probing defects (>6mm) communicating with the apex, excluding VRF.

Surgical protocol

All surgeries were performed by two board-certified endodontists using an operating microscope (Global Surgical Corp, St. Louis, MO) at 10x–20x magnification. Following local anesthesia (2% Lidocaine with 1 : 50,000 epinephrine), a full-thickness mucoperiosteal flap was elevated. Osteotomy was performed using a sterile round bur under saline irrigation. The apical 3 mm of the root was resected perpendicular to the long axis. The root surface was stained with methylene blue to inspect for fractures or isthmi.

Root-end preparation was extended 3 mm coronally using ultrasonic tips (Kis tips, Obtura Spartan). The cavity was dried and filled with a bioceramic root repair material (EndoSequence BC RRM, Brasseler USA).

Specific Intervention for Group B: In EPCL cases presenting with dehiscence or fenestration, Guided Tissue Regeneration (GTR) was employed using a resorbable collagen membrane (Bio-Gide, Geistlich) and corticocancellous bone graft (Bio-Oss, Geistlich). Flaps were repositioned and sutured with 5-0 monofilament sutures. Sutures were removed after 4–7 days.

Outcome evaluation

Outcomes were assessed at 12 months clinically (absence of sinus tract, swelling, tenderness, mobility) and radiographically (CBCT/PA). Healing was classified according to Molven's criteria:

1. Healed: Complete bone filling or reformation of lamina dura.

2. Incomplete Healing: Reduction in lesion size, irregular outcome.

3. Uncertain / Failure: No reduction or enlargement of lesion. For statistical analysis, "Healed" and "Incomplete Healing" (with no symptoms) were considered "Success". "Uncertain / Failure" and symptomatic cases were "Failure".

Statistical analysis

Data were analyzed using SPSS software (version 25.0). Descriptive statistics (mean ± SD, frequencies) were calculated. Differences in success rates between groups were analyzed using the Chi-square test. Continuous variables (lesion size reduction) were analyzed using the independent t-test. Significance was set at $p < 0.05$.

RESULTS

A total of 148 teeth in 148 patients (68 males, 80 females; mean age 45.2 ± 12.4 years) met the inclusion criteria and were analyzed. Group A (IEL) consisted of 76 teeth, and Group B (EPCL) consisted of 72 teeth. There were no statistically significant differences regarding age, gender, or tooth distribution (anterior/posterior) between the two groups ($p > 0.05$).

Clinical and radiographic outcomes

at the 12-month follow-up, the overall success rate for the entire cohort was 87.2% (129/148). When stratified by group, Group A (IEL) showed a significantly superior outcome compared to Group B (EPCL). Specifically, 72 out of 76 cases in Group A were deemed successful (94.7%), whereas 57 out of 72 cases in Group B achieved success (79.2%). This difference was statistically significant ($p = 0.006$).

Quantitative healing kinetics

Radiographic analysis revealed that Group A experienced a greater percentage of bone fill. The mean reduction in radiolucency size was 84.3 ± 12.1% for Group A, compared to 66.8 ± 18.4% for Group B ($p < 0.001$). While periapical healing was evident in Group B, the marginal bone levels showed less predictable regeneration despite GTR application.

Table 1. Demographic and clinical characteristics of the study population

Таблица 1. Демографические и клинические характеристики исследуемой популяции

Variable	Group A (IEL) (*n* = 76)	Group B (EPCL) (*n* = 72)	*p*-value
Age (Mean ± SD)	44.8 ± 11.5	45.7 ± 13.2	0.645
Gender (M/F)	34/42	34/38	0.812
Tooth Type			
Anterior/Premolar	46 (60.5%)	40 (55.6%)	0.541
Molar	30 (39.5%)	32 (44.4%)	
Pre-op Lesion Size (mm)	6.4 ± 2.1	7.1 ± 2.8	0.092

Table 2. Clinical and radiographic outcomes at 12-month follow-up

Таблица 2. Клинические и рентгенологические результаты через 12 месяцев наблюдения

Outcome Category	Group A (IEL) *n* (%)	Group B (EPCL) *n* (%)
Complete Healing	65 (85.5%)	41 (56.9%)
Incomplete Healing	7 (9.2%)	16 (22.2%)
Uncertain/Failure	4 (5.3%)	15 (20.8%)
Total Success	72 (94.7%)	57 (79.2%)

Note: Total Success = Complete Healing + Incomplete Healing (asymptomatic).

Примечание: Полный успех = Полное исцеление + Неполное исцеление (бессимптомное).

Table 3. Statistical comparison of success rates Group A vs. Group B

Таблица 3. Статистическое сравнение показателей успешности группы А к группе В

Indicator	Value
Success Rate Difference	15.5%
Chi-Square Value	7.642
p-value	0.006*

Significant differences were noted in the failure etiology. In Group A, failures were primarily attributed to persistent apical infection (recrudescence). In Group B, 60% of the failures (9/15) were attributed to progression of periodontal disease or loss of attachment, rather than purely apical pathology.

DISCUSSION

The current research study gives a comparative analysis of the results of microsurgical outcome using isolated endodontic lesions and combined endo-perio lesions. These results support the hypothesis that although the microsurgery in modern practice is very effective, the presence of periodontal involvement has a great impact on the prognostic outcome. The 94.7% success rate of isolated lesions follows the high standards of a recent meta-analysis by Torabinejad et al. and Setzer et al., who quote 89 to 94 percent of modern techniques [7; 8]. Conversely, the success rate of combined lesions is lower at 79.2 percent, but it proves that such affected teeth do not have to be extracted.

The statistically significant difference ($p = 0.006$) between the groups points out to the biological challenge of EPCLs. In single lesions that are situated in isolation in endodontics the defect is a four walled bony crypt that offers an excellent habitat to osteogenesis and clot stability [9]. On the other hand, combined lesions can be in the form of through-and-through defects or dehiscences of the marginal bone. Despite GFR, as used in this case, the absence of a coronal stop of the coagulum, as well as the constant presence of the oral microbiome through the gingival sulcus, makes healing difficult [10].

We have found similar results with EPCLs in the study of Kim et al, who found that marginal bone loss was a notable negative predictor of microsurgical success [11]. Nevertheless, our current success rate of close to 80 percent of EPCLs is greater than the conventional survival data during the pre-microsurgical period. The latter can probably be ascribed to two aspects such as the employability of biocompatible bioceramic root-end fillings and the implementation of GTR. Bioceramics demonstrate osteoconductivity and establish a chemical bond with dentin, which could increase the seal to periodontal pathogen ingress [12; 13]. Moreover, group B was intended to use collagen membranes and bone grafts to eliminate epithelial down-growth, which is recommended by Tsesis et al. to prevent the use on such endodontic-periodontal defects [14].

It is important to note that Group B (22.2) had a higher number of cases of incomplete healing compared to Group A (9.2%). This implies that although, the apical pathology could heal, the periodontal ligament (PDL) and alveolar crest regeneration may be slower and leads to scar tissue instead of complete regeneration [15]. A functional fibrous repair and active disease are some of the things that clinicians have to differentiate during the assessment of EPCL after the surgery.

The shortcomings of this research are its retrospective nature and 12 months follow up period. Although

Song et al. posit that most of the healing or failure processes take place within a year, periodontal breakdown is often a chronic, slow-paced phenomenon that may take a longer period to be completely observed [16]. Prospective randomized controlled trials to compare various GTR materials in EPCLs are recommended in future to streamline the protocols.

Finally, the paper has highlighted the significance of case selection. Whereas IELs are very predictable, EPCLs demand keen evaluation of loss of attachment. In case the periodontal defect involves the furcation or leads to Grade III mobility, the prognosis is likely to be lower than the current 79% and thus, implant replacement will become a more viable solution [17].

CONCLUSION

In the scope of this study, it may be deduced that endodontic microsurgery is of high success rates in isolated cases of endodontic lesions. Concomitant periodontal involvement leads to a high rate of failure of healing and the result shows a success rate of about 79 percent as opposed to almost 95 percent with the isolated lesions. Nevertheless, endodontic-periodontal combined lesions can still be maintained in most of the cases when the adjunct use of guided tissue regeneration and biocompatible retrograde fillings is used. Periodontal communication must be perceived as a prognostic complication, but not a contraindication to the use of microsurgical treatment.

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