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Comparison of the effect of endodontic-periodontal combined lesions on clinical outcomes

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Abstract

INTRODUCTION. Endodontic-periodontal combined lesions are complicated clinical cases with prognoses that vary in their predictability with regard to the underlying etiology and involvement. The interdependence between lesion classification and outcome of treatment is yet to be fully defined.

MATERIALS AND METHODS. 165 teeth with endodontic-periodontal lesions were used in a prospective cohort study (Group A primary endodontic lesions with secondary periodontal involvement, n = 55), Group B primary periodontal lesions with secondary endodontic involvement, n = 55) and Group C true combined lesions, n = 55). Every tooth was subjected to the right endodontic and periodontal treatment. Clinical outcomes such as probing pocket depth (PPD), clinical attachment level (CAL), tooth mobility, as well as periapical index after 3, 6, 12 months were evaluated. Success with the treatment, survival of the teeth, and patient-reported outcomes were assessed.

RESULTS. The general success rate of treatment was 73.3 and the differences between the groups were significant: Group A (89.1%), Group B (69.1%), Group C (61.8%), p<0.001. Groups A showed better results with 4.82 plus or minus 1.24 mm difference in mean PPD reduction compared to 3.41 plus or minus 1.38 mm difference in Group B and 2.87 plus or minus 1.52 mm difference in Group C at the age of 12 months ($p < 0.001$). Group A, Group B and Group C showed a mean CAL gain of 4.15 + 1.18 mm, 2.94 + 1.32 mm and 2.31 + 1.45 mm respectively ($p < 0.001$). The tooth survival rates in Group A (94.5), Group B (83.6), and Group C (76.4) were significant ($p = 0.012$). Patients with initial PPD >7 mm (OR = 3.84, $p < 0.001$) and true combined lesions (OR = 4.92, $p < 0.001$) were important predictors of treatment failure.

CONCLUSIONS. Primary endodontic lesions through secondary periodontal involvement portray highly better treatment results than primary periodontal lesions or true combined lesions. Lesion classification is a vital prognostic factor, which is used in the treatment planning and counseling of patients.

Keywords: endodontic-periodontal lesion, endo-perio lesion, combined lesion, treatment outcome, prognosis, regeneration, endodontics, periodontology

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Сравнение влияния сочетанных эндодонтическо-пародонтальных поражений на клинические исходы

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Резюме

ВВЕДЕНИЕ. Сочетанные эндодонтическо-пародонтальные поражения представляют собой сложные клинические случаи с вариабельным и не всегда предсказуемым прогнозом, зависящим от этиологии и степени вовлечения тканей. Взаимосвязь между классификацией поражения и результатами лечения до настоящего времени окончательно не определена.

МАТЕРИАЛЫ И МЕТОДЫ. В проспективное когортное исследование включено 165 зубов с эндодонтическо-пародонтальными поражениями: группа А – первичные эндодонтические поражения с вторичным пародонтальным вовлечением (n = 55); группа В – первичные пародонтальные поражения с вторичным эндодонтическим вовлечением (n = 55); группа С – истинные сочетанные поражения (n = 55). Всем зубам проведено соответствующее эндодонтическое и пародонтологическое лечение. Оценка клинических исходов включала глубину зондирования пародонтальных карманов (PPD), уровень клинического прикрепления (CAL), подвижность зубов и периапикальный индекс через 3, 6 и 12 месяцев. Анализировались эффективность лечения, выживаемость зубов и показатели, сообщаемые пациентами.

РЕЗУЛЬТАТЫ. Общая эффективность лечения составила 73,3%, при этом различия между группами были статистически значимыми: группа А – 89,1%, группа В – 69,1%, группа С – 61,8% (p < 0,001). В группе А отмечено более выраженное снижение средней глубины зондирования (4,82 ± 1,24 мм) по сравнению с группой В (3,41 ± 1,38 мм) и группой С (2,87 ± 1,52 мм) через 12 месяцев (p < 0,001). Прирост CAL составил соответственно 4,15 ± 1,18 мм в группе А, 2,94 ± 1,32 мм в группе В и 2,31 ± 1,45 мм в группе С (p < 0,001). Показатели выживаемости зубов были значимо выше в группе А (94,5%) по сравнению с группой В (83,6%) и группой С (76,4%) (p = 0,012). Исходная глубина зондирования >7 мм (OR = 3,84; p < 0,001) и наличие истинного сочетанного поражения (OR = 4,92; p < 0,001) являлись значимыми предикторами неудачи лечения.

ВЫВОДЫ. Первичные эндодонтические поражения с вторичным пародонтальным вовлечением демонстрируют значительно лучшие результаты лечения по сравнению с первичными пародонтальными и истинными сочетанными поражениями. Классификация поражения является важным прогностическим фактором, который следует учитывать при планировании лечения и консультировании пациентов.

Ключевые слова: эндодонтическо-пародонтальное поражение, эндо-перио поражение, сочетанное поражение, исход лечения, прогноз, регенерация, эндодонтия, пародонтология

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INTRODUCTION

Endodontic-periodontal lesions are peculiar diagnostic and treatment issues in clinical dentistry, which includes the concomitant or secondary participation of the dental pulp and periodontal supporting structures [1]. The anatomical and vascular relationships between the pulp and periodontium via apical foramina, lateral canals, dentinal tubules and furcation sites offer channels of bi-direction disease progression [2]. The interrelationship of endodontic and periodontal pathology is important in the correct diagnosis, correct sequence of treatment, and realistic prognostic evaluation [3].

Endodontic-periodontal lesions are more common in clinical practice affecting between 3–10% of endodontic cases and 5–18% of periodontal cases on the basis of population factors and diagnostic protocols [4; 5]. They may have a pulp-based pathology that extends via accessory canals into periodontal tissues (primary endodontic lesions with secondary periodontal involvement), periodontal disease that advances apically to pulpal vitality (primary periodontal lesions with secon-

dary endodontic involvement), or both of these disease conditions may co-exist (true combined lesions) [6].

A commonly used system of endodontics periodontal lesion classification was suggested by Simon et al. [7], which is based on the location of the disease origin and the range of its involvement. This classification is divided into: primary endodontic lesions, primary periodontal lesions, primary endodontic lesions with secondary periodontal lesion, secondary endodontic lesion with primary periodontal lesion and true combined lesions. Later refinements and changes have been suggested, such as the 2017 classification of World Workshop that focuses on periodontal status and endodontic diagnosis [8].

Endodontic-periodontal lesion is the result of intricate microbiological and immunological connections [9]. Both periodontal diseases and endodontic infections are polymicrobial in nature with a great deal of overlap of bacteria species including Porphyromonas gingivalis, Prevotella intermedia, Fusobacterium nucleatum and Aggregatibacter actinomycetemcomitans [10]. This process can result in self-perpetuating inflammatory cycles with the inflammatory products of one site infiltrating the disease progression of another site, and vice versa.

Endodontic-periodontal lesions should be diagnosed through the use of extensive clinical and radiographic assessment [11]. Such diagnostic procedures as: pulp vitality testing, periodontal probing to identify vertical bone defects or furcation involvement, assessment of tooth mobility, percussion and palpation tests, radiographic examination to determine the pattern of periapical pathology and bone loss are essential [12]. The more sophisticated imaging modalities (including cone-beam computed tomography (CBCT)) can help to offer useful three-dimensional data on the degree of bone destruction and anatomical complexities [13].

The management of endodontic-periodontal lesions would require the consideration of both endodontic and periodontal aspects in a logical, sequenced manner [14]. The general rule is to have the first endodontic therapy to remove the pulpal infection, followed by a period of adequate rest (usually 2–3 months), and a periodontal therapy is carried out in case of residual periodontal defects [15]. Primary endodontic lesions with secondary periodontal involvement tend to heal well with pure root canal therapy but primary periodontal or true combined lesions need full periodontal treatment comprising of surgical debridement and perhaps regenerative treatment [16].

Although there is massive clinical experience and published literature regarding the endodontic-periodontal lesions, there are still gaps in knowledge. The current literature is predominantly retrospective case series or cross-sectional studies and has a short follow-up [17]. There are limited comparative prospective studies of the outcomes of various treatment of lesions based on the classification of lesions. Moreover, the effects of the nature of certain lesions, including lesion size, tooth position and patient variables on the healing outcomes should be investigated systematically [18]. Determination of credible prognostic factors may lead to better clinical judgments on the mode of treatment or rather extraction advice.

This knowledge on the heterogeneity of the response of different forms of endodontic-periodontal lesions to different treatments has significant implications in clinical practice in terms of treatment planning, resource utilization and patient education on the expected outcome and prognosis [19]. Also, this knowledge may be used to inform the adjustments to the classification systems and treatment protocols [20].

Thus, the objective of the current study was to prospectively compare clinical outcome of varying types of endodontic-periodontal combined lesions using standardized treatment treatment regimes, to evaluate how lesion classification varies with clinical outcome in terms of successful and failure of treatment, to determine how clinical outcome varies with time in terms of lesion type, and to determine independent prognostic factors related to treatment success and failure.

MATERIALS AND METHODS

Study design and setting

this prospective cohort study was conducted at the Department of Conservative Dentistry and Endodontics from January 2021 to March 2023.

Sample size calculation

sample size was determined using G*Power software version 3.1.9.7 for comparing three independent groups, considering an effect size of 0.35 based on pilot data, alpha error of 0.05, and power of 85%. The minimum required sample size was calculated as 48 participants per group. Accounting for 15% potential dropout rate, 55 participants were recruited for each group, yielding a total sample of 165 teeth.

Study population

The study population comprised 165 teeth in 148 patients presenting with endodontic-periodontal lesions. Teeth were classified into three groups based on clinical and radiographic diagnosis:

Group A: Primary endodontic lesions with secondary periodontal involvement ($n = 55$).

Group B: Primary periodontal lesions with secondary endodontic involvement ($n = 55$).

Group C: True combined lesions (simultaneous independent endodontic and periodontal pathology) ($n = 55$).

Diagnostic criteria

Group A: Negative pulp vitality test, presence of sinus tract or acute periapical abscess, vertical bone loss communicating with periapical lesion, recent onset of periodontal involvement.

Group B: Generalized periodontal disease with probing depths ⩾5 mm, horizontal bone loss pattern, pulp vitality recently compromised, established periodontal history.

Group C: Non-vital pulp, periapical radiolucency, extensive periodontal bone loss (⩾50% bone loss), probing depths ⩾6mm, no clear temporal sequence of disease onset.

Inclusion criteria

1. Age 25–65 years.
2. Single or multi-rooted permanent teeth with endodontic-periodontal lesions.
3. Teeth deemed restorable with adequate coronal structure.
4. Probing pocket depth ⩾5 mm with radiographic bone loss.
5. Patient willing to comply with treatment and follow-up protocols.
6. Adequate oral hygiene (Plaque Index < 1.5 after initial therapy).

Exclusion criteria

1. Uncontrolled systemic diseases (diabetes mellitus with HbA1c > 7%, cardiovascular disease, immunocompromised states).
2. Pregnancy or lactation.
3. Smokers (> 10 cigarettes/day).
4. Teeth with vertical root fractures or perforations.
5. Severe tooth mobility (Grade III) with hopeless prognosis.
6. Previous endodontic treatment.
7. Antibiotic use within 3 months.
8. Inability to maintain adequate oral hygiene.

Treatment protocol

All patients received standardized treatment protocols administered by calibrated clinicians.

Initial phase therapy

1. Oral hygiene instruction and motivation.
2. Supragingival and subgingival scaling.
3. Re-evaluation after 4 weeks.

Endodontic treatment

All teeth received non-surgical root canal treatment following standardized protocols:

1. Access cavity preparation under rubber dam isolation.
2. Working length determination using electronic apex locator and radiographic confirmation.
3. Cleaning and shaping using crown-down technique with rotary nickel-titanium instruments.
4. Irrigation with 2.5% sodium hypochlorite and 17% EDTA.
5. Obturation using lateral compaction technique with gutta-percha and AH Plus sealer.
6. Coronal restoration with composite resin or indirect restoration as indicated.

Periodontal treatment

Following endodontic treatment completion and 8-week healing period:

1. Re-probing to assess residual periodontal defects.
2. Open flap debridement for persistent defects ⩾5 mm.
3. Bone grafting with demineralized freeze-dried bone allograft for intrabony defects > 3 mm.
4. Guided tissue regeneration using resorbable membranes for selected cases.
5. Postoperative care and maintenance.

Outcome assessment

Clinical examinations were performed by calibrated examiners (inter-examiner reliability $\kappa = 0.91$) blinded to group allocation at baseline, 3-, 6-, and 12-months post-treatment.

Primary outcome

Treatment success: defined as tooth retention with resolution of symptoms, pocket depth ⩽4 mm, no suppuration, and radiographic evidence of bone fill or stability.

Secondary outcomes

Clinical parameters

Probing Pocket Depth (PPD): measured at six sites per tooth using UNC-15 probe.

Clinical Attachment Level (CAL): measured from CEJ to pocket base.

Tooth Mobility: assessed using Miller's classification (0–III).

Bleeding on Probing (BOP): percentage of sites with bleeding.

Gingival Index (GI): Löe and Silness index.

Radiographic assessment

Periapical Index (PAI): scored 1-5 according to Orstavik criteria.

Bone level measurements: assessed on standardized periapical radiographs using digital analysis software.

Patient-reported outcomes

pain: assessed using Visual Analog Scale (VAS, 0–10).

Satisfaction: 5-point Likert scale.

Quality of life: Oral Health Impact Profile-14 (OHIP-14).

Statistical analysis

Data were analyzed using SPSS version 28.0 and *R* software version 4.2.2. Normality was assessed using the Shapiro-Wilk test. Continuous variables were expressed as mean ± standard deviation and compared using one-way ANOVA with post-hoc Tukey's HSD test for multiple comparisons. Repeated measures ANOVA was employed to assess temporal changes within groups. Categorical variables were presented as frequencies and percentages and analyzed using chi-square test or Fisher's exact test. Kaplan-Meier survival analysis with log-rank test was performed to compare tooth survival across groups. Binary logistic regression analysis was conducted to identify independent predictors of treatment success. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic and baseline characteristics

The study included 165 teeth in 148 patients (mean age 42.8 ± 11.3 years; 87 females, 61 males). Group A comprised 55 teeth (mean age 40.6 ± 10.8 years), Group B 55 teeth (mean age 43.8 ± 11.4 years), and Group C 55 teeth (mean age 44.1 ± 11.7 years), with no significant age difference ($p = 0.182$). Tooth distribution included 68 maxillary teeth (41.2%) and 97 mandibular teeth (58.8%). Single-rooted teeth comprised 58.2% ($n = 96$) and multi-rooted teeth 41.8% ($n = 69$).

Treatment outcomes and success rates

Overall treatment success rate at 12 months was 73.3% (121/165 teeth), with significant variation across groups (Table 1).

Clinical parameter changes

Table 2 presents the comparison of clinical parameters across groups at baseline and 12 months post-treatment.

Repeated measures ANOVA revealed significant improvement in all clinical parameters over time within each group ($p < 0.001$), with significant group × time interaction effects ($p < 0.001$), indicating differential healing patterns.

Radiographic bone fill

Table 3 demonstrates radiographic bone fill measurements at 12 months across groups.

Table 1. Treatment success rates and tooth survival across groups

Таблица 1. Показатели успешности лечения и выживаемости зубов в разных группах

Outcome Parameter	Group A ($n = 55$)	Group B ($n = 55$)	Group C ($n = 55$)	*p*-value*
Treatment Success at 12 months, *n* (%)	49 (89.1)	38 (69.1)	34 (61.8)	0.002
Complete Healing, *n* (%)	42 (76.4)	28 (50.9)	22 (40.0)	< 0.001
Partial Healing, *n* (%)	7 (12.7)	10 (18.2)	12 (21.8)	0.387
Treatment Failure, *n* (%)	6 (10.9)	17 (30.9)	21 (38.2)	0.002
Tooth Survival, *n* (%)	52 (94.5)	46 (83.6)	42 (76.4)	0.012
Tooth Extraction, *n* (%)	3 (5.5)	9 (16.4)	13 (23.6)	0.012
Reasons for Extraction				
Persistent symptoms	1 (1.8)	4 (7.3)	6 (10.9)	–
Progressive bone loss	1 (1.8)	3 (5.5)	5 (9.1)	–
Root fracture	1 (1.8)	2 (3.6)	2 (3.6)	–
Mean Time to Failure (months) ± SD	4.2 ± 2.1	5.8 ± 2.7	6.3 ± 3.1	0.216†

Note: * Chi-square test or Fisher's exact test; † One-way ANOVA

Примечание: * Критерий Хи-квадрат или точный критерий Фишера; † Односторонний дисперсионный анализ

Table 2. Comparison of clinical parameters at baseline and 12 months

Таблица 2. Сравнение клинических показателей на исходном этапе и через 12 месяцев

Parameter	Time Point	Group A ($n = 52$) Mean ± SD	Group B ($n = 46$) Mean ± SD	Group C ($n = 42$) Mean ± SD	*p*-value*
Probing Pocket Depth (mm)	Baseline	7.24 ± 1.48	7.63 ± 1.52	8.12 ± 1.64	0.014
	12 months	2.42 ± 0.86	4.22 ± 1.24	5.25 ± 1.38	< 0.001
	Reduction	4.82 ± 1.24	3.41 ± 1.38	2.87 ± 1.52	< 0.001†
Clinical Attachment Level (mm)	Baseline	7.86 ± 1.52	8.34 ± 1.68	8.92 ± 1.76	0.006
	12 months	3.71 ± 1.08	5.40 ± 1.42	6.61 ± 1.58	< 0.001
	Gain	4.15 ± 1.18	2.94 ± 1.32	2.31 ± 1.45	< 0.001†
Tooth Mobility (0–3 scale)	Baseline	1.62 ± 0.68	1.89 ± 0.72	2.18 ± 0.76	< 0.001
	12 months	0.38 ± 0.52	0.87 ± 0.64	1.24 ± 0.71	< 0.001
	Improvement	1.24 ± 0.58	1.02 ± 0.62	0.94 ± 0.68	0.044†
Bleeding on Probing (%)	Baseline	78.4 ± 16.2	82.3 ± 14.8	86.2 ± 13.6	0.018
	12 months	18.6 ± 12.4	32.8 ± 16.7	41.5 ± 18.9	< 0.001
Periapical Index (1–5)	Baseline	3.84 ± 0.82	3.12 ± 0.94	3.96 ± 0.88	< 0.001
	12 months	1.42 ± 0.61	1.87 ± 0.78	2.31 ± 0.86	< 0.001

Note: * One-way ANOVA comparing groups at each time point; † Post-hoc Tukey's test showed significant differences between Group A vs. B ($p < 0.05$), Group A vs. C ($p < 0.001$), and Group B vs. C ($p < 0.05$) for most parameters.

Примечание: * Односторонний анализ ANOVA, сравнивающий группы в каждый момент времени; † Последующий тест Тьюки показал достоверные различия между группами А и В ($p < 0{,}05$), А и С ($p < 0{,}001$) и В и С ($p < 0{,}05$) по большинству параметров.

Table 3. Radiographic bone fills at 12 months

Таблица 3. Рентгенографические данные о заполнении костной ткани через 12 месяцев

Bone Fill Parameter	Group A (*n* = 52)	Group B (*n* = 46)	Group C (*n* = 42)	*p*-value*
Mean Bone Fill (mm) ± SD	3.68 ± 1.24	2.41 ± 1.38	1.87 ± 1.42	< 0.001†
Percentage Bone Fill (%) ± SD	62.4 ± 18.6	41.3 ± 22.4	32.6 ± 20.8	< 0.001†
Bone Fill Categories:				
Excellent (> 75% fill), *n* (%)	18 (34.6)	8 (17.4)	4 (9.5)	0.006
Good (50–75% fill), *n* (%)	21 (40.4)	14 (30.4)	10 (23.8)	0.178
Moderate (25–50% fill), *n* (%)	9 (17.3)	16 (34.8)	18 (42.9)	0.016
Poor (< 25% fill), *n* (%)	4 (7.7)	8 (17.4)	10 (23.8)	0.077
Complete Resolution of Periapical Lesion, *n* (%)	44 (84.6)	32 (69.6)	26 (61.9)	0.021
Reduction in Lesion Size ⩾ 50%, *n* (%)	7 (13.5)	10 (21.7)	11 (26.2)	0.248
No Change or Progression, *n* (%)	1 (1.9)	4 (8.7)	5 (11.9)	0.111

Note: * Chi-square test; † One-way ANOVA with post-hoc Tukey's test showing significant differences between all group pairs ($p < 0.05$)

Примечание: * Критерий Хи-квадрат; † Односторонний дисперсионный анализ с последующим использованием теста Тьюки, показывающий достоверные различия между всеми парами групп ($p < 0,05$)

Patient-reported outcomes

Pain scores (VAS) decreased significantly from baseline to 12 months in all groups: Group A (6.84 ± 1.92 to 0.52 ± 0.84), Group B (6.92 ± 2.04 to 1.24 ± 1.12), Group C (7.16 ± 2.12 to 1.86 ± 1.34), with Group A demonstrating significantly lower pain at 12 months ($p < 0.001$).

Patient satisfaction rates (satisfied or very satisfied) at 12 months were: Group A (88.5%), Group B (71.7%), Group C (64.3%), $p = 0.008$.

OHIP-14 total scores improved across all groups, with Group A showing greatest improvement: baseline 24.6 ± 6.8 to 12-month 8.4±4.2 (improvement 16.2 ± 5.6), compared to Group B (improvement 11.8 ± 6.4) and Group C (improvement 9.7 ± 6.8), $p = 0.001$.

Prognostic factors

Binary logistic regression analysis identified independent predictors of treatment failure:

1. Initial PPD > 7 mm: OR = 3.84 (95% CI: 1.82–8.12), – < 0.001.

2. True combined lesion (Group C): OR = 4.92 (95% CI: 2.14–11.31), $p < 0.001$.

3. Multi-rooted tooth: OR = 2.67 (95% CI: 1.23–5.79), $p = 0.013$.

4. Furcation involvement Grade II–III: OR = 3.21 (95% CI: 1.45–7.11), $p = 0.004$.

5. Age >50 years: OR = 1.86 (95% CI: 0.89–3.88), $p = 0.098$ (non-significant).

Kaplan-Meier survival analysis demonstrated significant differences in tooth survival across groups (log-rank test, $\chi^2 = 9.84$, $p = 0.007$), with 12-month survival estimates of 94.5% (Group A), 83.6% (Group B), and 76.4% (Group C).

DISCUSSION

In this prospective cohort study, the clinical outcome of 165 teeth with endodontic-periodontal combined lesions was thoroughly examined in three categories of classification and demonstrated a significant variation in the healing of the teeth, success rates of the treatment, and tooth survival. The results indicate that a classification of lesions is a vital prognostic factor, and primary endodontic lesions with secondary periodontal involvement have significantly good prognoses relative to primary periodontal lesions or genuine combined lesions.

The success rate of 73.3% overall of the treatment in the present study is in line with the historical research which has shown the success rate of endodontic-periodontal lesions to be 65% to 85% with the main difference in studies being brought about by the heterogeneous nature of diagnostic criteria, treatment regimen and follow-up periods [1]. The much better outcome of Group A (89.1) than those of Groups B (69.1) and C (61.8) supports the well-known clinical rule according to which lesions of primary endodontic origin tend to show more positive prognoses [2].

The pathophysiology of primary endodontic lesions to produce the best results is associated with the fact that secondary periodontal involvement is reversible in case the primary focus of infection is removed [3]. Pulpal necrosis and consequent periapical inflammation in Group A lesions may spread along accessory canals, apical foramen or lateral communications to develop periodontal defects. Nevertheless, the defects are usually continuations of endodontic pathology and not really periodontal breakdown. Treatment of endodontic disease removes the bacterial reservoir, and periodontal tissues will regenerate, and through inflammation resolution and new attachments formation [4]. This effect was the cause of the significant reduction in PPD (4.82 ± 1.24 mm) and the CAL gain (4.15 ± 1.18 mm), which was achieved to a great extent during the post-endodontic condition only after endodontic treatment with minimal periodontal intervention in Group A.

Group B lesions (primary periodontal with secondary endodontic involvement), on the contrary, had intermediate outcomes. Such cases are characterized by chronic periodontal disease that has advanced in-

vasions that go apically to jeopardize the vitality of the pulp by means of lateral canals or apical communications [5]. The periodontal breakdown that is established and has lost the connective tissue attachment, bone resorption and microbial ecology pose more challenges in regeneration [6]. Periodontal defects present prior to the endodontic treatment are left even with the successful endodontic treatment which removes the pulpal infection and the periodontal defects need to be completely addressed through periodontal therapy. The mild decrease (3.41 ± 1.38 mm) and CAL increase (2.94 ± 1.32 mm) of this group indicate the low regenerative ability of periodontal tissues that have been destroyed by chronic inflammation.

The worst results were found in the group C lesions (true combined) and this finding is in line with the available literature that reported this category of lesions to have the poorest prognosis [7]. True combined lesions include independent pathological processes of the periodontal and pulpal tissues simultaneously, which is typical of the teeth with a high periodontal breakdown and pulpal necrosis. The dual etiology requires the thorough treatment of both components, but due to the excessive tissue damage and extensive inflammatory burden, the regenerative capability is compromised [8]. The low level of clinical response (PD reduction 2.87 ± 1.52 mm, CAL gain 2.31 ± 1.45 mm) and high rate of failure (38.2%) in this group highlight the biological constraints of the present treatment modalities in case of severely compromised teeth.

The radiographic bone fill data are some objective evidences to the clinical findings. Group A exhibited a mean bone fill 3.68 ± 1.24 mm (62.4% fill), which was much better than Groups B and C. This is a significant bone regeneration in initial endodontic lesions which is an indicator of the healing potential in the presence of the elimination of infectious source. The 84.6 percent rate of full periapical lesion resolution in the Group A agrees with anticipated results of endodontic treatment [9]. The gradual worsening of the groups in terms of bone fill is associated with the growing severity and complexity of periodontal involvement.

There are clinical implications of identifying initial PPD > 7 mm as an important predictor of treatment failure (OR = 3.84). Deep periodontal pockets pose several problems such as the inability to eliminate bacteria completely, impaired blood supply to the area making healing difficult and increased tissue destruction which is a limitation to regenerative processes [10]. This observation implies that teeth with severe periodontal destruction can be considered to undergo more aggressive treatments, such as regenerative therapy or even removal with a restoration alternative.

The much lower results in the case of multi-rooted teeth (OR = 2.67) and the presence of furcation (OR = 3.21) are due to the anatomical complexity of such cases [11]. The furcation areas pose special challenges because of the access difficulty of instrumentation, complicated structure of the anatomy with many accessory canals, and disability of the blood supply. It has always been shown that the survival of teeth with furcations is low in the long-term in comparison to the survival of teeth without furcation [12].

The patient-reported outcomes such as the reduction of pain, satisfaction and the improvement of quality of life corroborated clinical and radiographic results. The much higher results in Group A in all patient-centered measures, point to the fact that objective clinical gains are converted to tangible patient benefits. The Group A increase of 16.2 points in OHIP-14 is a clinically significant improvement in oral health-related quality of life [13].

The patterns of time-dependent healing as indicated by repeated measures analysis indicated that the largest amounts of clinical improvement were found during the initial 3-6 months with a gradual continuous improvement up to 12 months. This time course is similar to the healing processes in biology, as soft tissue recovery happens first, and bone regeneration occurs more slowly [14]. Although the follow-up period (12 months) will present useful outcome data, long-term stability may be missed. Findings on 3–5-year follow-up studies have also indicated the presence of other late failures, and hence, there is the need to extend follow-up [15].

The clinical implications of these findings are great. Correct diagnosis of endodontic-periodontal lesions is the key to a prognostic evaluation and treatment planning. As clinicians should know that primary endodontic lesions with secondary periodontal involvement should be treated firstly with endodontic treatment with re-examination before periodontal treatment, since most periodontal defects can be self-limiting [16]. Secondary endodontic involvement of primary periodontal lesions needs a complete periodontal treatment besides endodontic treatment. Combined lesions are the most difficult and they might be considered extraction and replacement options, especially when various negative prognostic factors are combined [17].

The strengths of the study are prospective design, large sample size with equal group distribution, standard treatment procedures, extensive outcome evaluation such as clinical, radiographic, and patient-reported outcomes and sufficient follow-up period. There are a number of limitations that should be taken into consideration. The 12 months follow-up is not extensive enough to reflect long-term results or the eventual failure. Generalizability is limited by the exclusion of patients with medical limitations and smokers. There was no control group that was not being treated as the study was an ethical consideration. Also, classification was based on clinical judgement and subjectivity is inherent in subjective clinical judgement regardless of the normative diagnostic criteria [18].

The future research needs to be done over a longer period (at least 3–5 years) to determine long-term stability, exploration of adjunctive treatments such as regenerative materials and laser-assisted treatment, microbial profiling of the bacterial profiles in each type of lesion, genetic and molecular marker research to determine individual variation in healing capacity, and cost-effectiveness studies comparing treatment with extraction and replacement approaches [19; 20].

CONCLUSION

This proposed comparative trial shows that the use of endodontic-periodontal lesion classification has a strong impact on the outcome of treatment and prognosis. Primary endodontic lesions that have secondary periodontal involvement show significantly better healing response than primary periodontal lesions or true combined lesions and the success rate of the treatment is 89.1 versus 69.1 and 61.8 respectively. Primary endodontic lesions are shown to be treated with endodontic therapy alone with significant periodontal healing, which typically does not require the extensive periodontal intervention. True combined lesions, on the contrary, are the most difficult to treat, have low regenerative capacity, and have high failure rates.

Such critical prognostic factors as initial probing depth (more than 7 mm), lesion classification type, furcation involvement, and tooth type (multi-rooted versus single-rooted) are considered. These needs ought to be considered in the treatment planning and patient counselling on the realistic expectation of outcomes. In cases of teeth having both negative prognostic factors, especially the true combined ones that have extensively broken down their periodontium and the furcation, extraction and replacement options should be taken into serious consideration.

The results underline the need to consider proper differential diagnosis in the endodontic-periodontal lesion because the classification has a direct impact on the sequencing of treatment, the intensity of intervention, and anticipated results. Clinicians need to use a holistic diagnostic regimen such as pulp vitality test, proper periodontal examination and radiology to properly classify lesions prior to commencing treatment. Endodontic-periodontal lesions management a systematic, evidence-based strategy based on the classification of the lesion and individual prognostic factors would maximize clinical outcomes and tooth survival, as well as help with the proper choice of treatment in this problematic type of dental pathology.

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