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Healing outcomes of single-visit endodontic therapy versus combined endo-perio therapy in grade II furcation involvement

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Abstract:
Grade II furcation involvement with endo-periodontal lesions is a complex clinical problem. Therefore, it is of interest to examine the healing of single-visit endodontic therapy and combined endodontic periodontal therapy in Grade II furcation involvement. Hence, 80 patients who were treated by single-visit root canal therapy and endodontically followed by periodontal debridement and regenerative procedures. Clinical parameters like probing pocket depth, clinical attachment level and tooth mobility were evaluated. Thus, data shows the combined endodontic–periodontal therapy provides significantly better healing outcomes than single-visit endodontic treatment.

Keywords: Clinical attachment level (CAL), endo-periodontal lesion, endodontic therapy, Grade II furcation, periodontal regeneration, radiographic healing

Background:
Endodontic-periodontal lesions involving Grade II furcation defects remain among the most challenging clinical conditions in contemporary dentistry because they involve the simultaneous destruction of pulpal and periodontal tissues, compromising both tooth prognosis and long-term functional stability **[1].** The intricate anatomical communication through accessory canals, dentinal tubules and the apical foramen facilitates the bidirectional spread of infection, making accurate diagnosis and appropriate sequencing of treatment essential for successful healing **[2].** Although advances in biomaterials, regenerative techniques and minimally invasive endodontic procedures have considerably improved treatment outcomes, the optimal therapeutic approach for teeth presenting with Grade II furcation involvement remains a subject of ongoing investigation **[3].** The biological relationship between pulpal and periodontal tissues suggests that elimination of intracanal infection may positively influence periodontal healing. Previous investigations have showed that successful root canal therapy contributes significantly to the resolution of inflammatory lesions and enhances healing following periodontal intervention **[4].** Similarly, conventional non-surgical periodontal therapy has consistently shown effectiveness in reducing periodontal inflammation and improving clinical attachment when biofilm control is adequately achieved **[5].** Nevertheless, molars exhibiting furcation involvement frequently present with complex anatomical and microbial challenges that limit the predictability of isolated therapeutic approaches, thereby necessitating multidisciplinary management strategies **[6].** Clinical management of endo-periodontal lesions has increasingly shifted toward coordinated treatment protocols integrating endodontic therapy with periodontal debridement and regenerative procedures. Sequential treatment approaches have been reported to achieve favorable clinical and radiographic outcomes by first eliminating pulpal infection and subsequently addressing periodontal destruction **[7]**. Furthermore, prospective evidence indicates that the severity of periodontal disease significantly influences the healing response following non-surgical endodontic treatment, emphasizing the importance of considering periodontal status during treatment planning **[8].** Recent case reports and clinical series have highlighted encouraging outcomes following combined endodontic and periodontal regenerative therapies employing bone grafts, platelet concentrates, calcium-silicate biomaterials and guided tissue regeneration **[2, 3, 9 and 10].** These multidisciplinary interventions have showed improvements in probing depth reduction, bone fill, attachment gain and tooth retention in carefully selected cases. Likewise, various clinical reports have illustrated that individualized treatment protocols combining endodontic disinfection with regenerative periodontal therapy can successfully preserve teeth that might otherwise be considered for extraction **[11, 12].** However, most available evidence is derived from isolated case reports, case series, retrospective analyses, or heterogeneous clinical populations, thereby limiting the generalizability of their findings. Despite the expanding body of literature on endo-periodontal management, a substantial research gap persists regarding direct comparative evaluation of single-visit endodontic therapy alone versus combined endodontic-periodontal therapy specifically in teeth with Grade II furcation involvement. Existing studies primarily describe treatment success within individual therapeutic modalities without employing standardized comparative designs, objective healing parameters, or uniform follow-up protocols **[12].** Therefore it is of interest to examine the clinical and radiographic healing of single-visit endodontic therapy and combined endodontic periodontal therapy in Grade II furcation involvement

Materials and Methods:
The study was conducted based on the ethical principles laid down in the Declaration of Helsinki and each participant was asked to sign the informed consent before starting any clinical procedures.
The sample size was calculated using the standard formula for the comparison of two independent proportions:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

where n represents the required sample size per group. $Z_{\alpha/2}$ = 1.96 corresponds to a 95% confidence interval, Z_{β} = 0.84 represents 80% statistical power. P_1 = 0.70 denotes the anticipated healing proportion in the single-visit endodontic therapy group. P = 0.90 represents the expected healing proportion in the combined endodontic-periodontal therapy group. Based on these assumptions, the minimum calculated sample size was 36 participants per group. To improve statistical reliability and compensate for potential loss to follow-up, the

final sample size was increased to 80 participants, with 40 subjects allocated to each treatment group. Patients within the age range of 18-60 years having restorable permanent molars with primary endodontic lesions and Grade II furcation involvement, as well as cases of pulpal necrosis or irreversible pulpitis necessitating root canal treatment with periodontal probing depths not less than 5 mm in the furcation area, were the main criteria for inclusion. Teeth with Grade III furcation involvement, previously undergone endodontic treatment, vertical root fracture, severe mobility, non-restorable crown structure, systemic diseases adversely impacting wound healing that is not controlled pregnancy tobacco use, recent antibiotic therapy, immunocompromised conditions, or inability to follow-up schedule compliance were the reasons for exclusion from the study. After the initial periodontal and radiographic examinations, patients were randomly divided between the two groups in an equal manner based on a computer-generated randomization sequence. Besides, the concealment of allocation was ensured by using sequentially numbered opaque sealed envelopes. Group I received standardized single-visit endodontic treatment with rubber dam isolation including electronic working length determination plus radiographic confirmation, biomechanical preparation employing nickel-titanium rotary instruments, irrigation using 3% sodium hypochlorite and 17% EDTA, obturation in the same visit with gutta-percha and a resin-based sealer and finally, the coronal restoration was done. Group II was given the same endodontic treatment method, but their periodontal treatment was carried out two to four weeks later and was involved of scaling and root planing, flap debridement in case of necessity, furcation degranulation with a thorough and careful approach and regenerative periodontal therapy using bone graft with/without platelet-rich fibrin as standardized institutional protocols. Baseline demographic data, clinical findings, periodontal parameters and standardized digital intraoral periapical radiographs were documented before treatment. Clinical outcome variables were probing pocket depth, clinical attachment level, furcation involvement, tooth mobility, plaque index, gingival index, pain intensity, percussion tenderness and sinus tract while radiographic assessment focused on periapical healing, reduction in radiolucency, furcation bone fill, periodontal bone regeneration and overall healing status. A blinded examiner, unaware of the treatment allocation, performed follow-up examinations at baseline 3, 6 and 12 months by employing standardized clinical protocols and the paralleling technique for radiographs. All records were made using structured case record forms that were later entered into a secure electronic database for statistical processing. IBM SPSS Statistics, version 26.0 was utilized for data processing. Continuous variables were represented as mean standard deviation, while frequencies and percentages were used for categorical data. The Shapiro-Wilk test was used to assess the normality of data. Based on the distribution, independent-samples t-test or Mann Whitney U test was used for intergroup comparison, whereas repeated-measures ANOVA or Friedman test was applied for assessing longitudinal changes within each group. Categorical variables were evaluated using the Chi-square or Fisher's exact test and a two-sided p value of <0.05 was regarded as statistically significant.

Results:

At baseline, both groups were well balanced with no statistically significant differences across demographic or clinical parameters, indicating comparability prior to intervention. The mean age was similar between Group I (39.7 ± 8.6 years) and Group II (40.3 ± 9.1 years; $p = 0.748$), with comparable gender distribution and molar involvement patterns. Clinically, baseline periodontal and endodontic disease severity was also equivalent, as evidenced by similar probing pocket depth (6.92 ± 0.74 mm vs 7.01 ± 0.79 mm; $p = 0.598$), clinical attachment loss (6.08 ± 0.88 mm vs 6.19 ± 0.82 mm; $p = 0.562$) and tooth mobility scores (1.48 ± 0.50 vs 1.53 ± 0.51; $p = 0.668$). Radiographically, the presence of periapical radiolucency was likewise comparable between Group I and Group II (92.5% vs 95.0%; $p = 0.643$). Overall, the absence of significant baseline differences confirms adequate group matching, strengthening the validity of subsequent outcome comparisons **Table 1.** At 12-month follow-up, Group II demonstrated significantly better overall clinical healing outcomes compared to Group I. Mean probing pocket depth was significantly reduced in Group II (2.96 ± 0.58 mm) versus Group I (4.31 ± 0.71 mm; $p < 0.001$), along with a greater gain in clinical attachment level (3.08 ± 0.81 mm vs 1.72 ± 0.62 mm; $p < 0.001$), indicating superior periodontal improvement. Gingival health and tooth stability were also significantly better in Group II, with lower Gingival Index scores (0.61 ± 0.24 vs 0.88 ± 0.30; $p = 0.001$) and reduced tooth mobility (0.38 ± 0.21 vs 0.82 ± 0.39; $p < 0.001$). Although Plaque Index was slightly lower in Group II, the difference was not statistically significant (0.82 ± 0.29 vs 0.96 ± 0.33; $p = 0.051$). Clinically, pain absence was high in both groups but not statistically different (97.5% vs 87.5%; $p = 0.091$), whereas sinus tract healing was significantly more frequent in Group II (100% vs 90.0%; $p = 0.040$), collectively indicating more consistent and complete periodontal and periapical resolution in Group II compared to Group I **Table 2.** At 12-month follow-up, Group II showed significantly superior radiographic healing outcomes compared to Group I across all evaluated parameters. Complete healing was observed in 87.5% (35/40) of cases in Group II versus 60.0% (24/40) in Group I, while partial and unsatisfactory healing were notably lower in Group II, with no cases of unsatisfactory healing reported ($p = 0.005$). Additionally, Group II showed markedly greater furcation bone fill (71.5 ± 10.8% vs 42.8 ± 9.7%) and a higher reduction in periapical radiolucency (84.6 ± 9.2% vs 63.9 ± 12.6%), both highly significant ($p < 0.001$). Overall treatment success was also superior in Group II (95.0% vs 77.5%, $p = 0.021$), indicating more effective and predictable radiographic resolution of lesions compared to Group I **Table 3.**

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Table 1: Baseline demographic and clinical characteristics of the study participants (N = 80)

Variable	Group I (Single-Visit Endodontic Therapy) (n=40)	Group II (Combined Endo-Perio Therapy) (n=40)	p-value
Age (years), Mean ± SD	39.7 ± 8.6	40.3 ± 9.1	0.748
Male, n (%)	22 (55.0)	24 (60.0)	0.651
Female, n (%)	18 (45.0)	16 (40.0)	
Mandibular molars, n (%)	26 (65.0)	25 (62.5)	0.817
Maxillary molars, n (%)	14 (35.0)	15 (37.5)	
Baseline probing pocket depth (mm)	6.92 ± 0.74	7.01 ± 0.79	0.598
Clinical attachment loss (mm)	6.08 ± 0.88	6.19 ± 0.82	0.562
Tooth mobility score	1.48 ± 0.50	1.53 ± 0.51	0.668
Periapical radiolucency present, n (%)	37 (92.5)	38 (95.0)	0.643

P- Insignificant

Table 2: Comparison of clinical healing outcomes at 12-month follow-up

Clinical Parameter	Group I (n=40)	Group II (n=40)	p-value
Probing pocket depth (mm)	4.31 ± 0.71	2.96 ± 0.58	**<0.001**
Clinical attachment level gain (mm)	1.72 ± 0.62	3.08 ± 0.81	**<0.001**
Plaque Index	0.96 ± 0.33	0.82 ± 0.29	0.051
Gingival Index	0.88 ± 0.30	0.61 ± 0.24	**0.001**
Tooth mobility	0.82 ± 0.39	0.38 ± 0.21	**<0.001**
Pain absent, n (%)	35 (87.5)	39 (97.5)	0.091
Sinus tract healed, n (%)	36 (90.0)	40 (100.0)	0.040*

**Statistically significant.*

Table 3: Radiographic healing outcomes after 12 months

Radiographic Outcome	Group I (n=40)	Group II (n=40)	p-value
Complete healing, n (%)	24 (60.0)	35 (87.5)	**0.005**
Partial healing, n (%)	12 (30.0)	5 (12.5)	
Unsatisfactory healing, n (%)	4 (10.0)	0 (0.0)	
Furcation bone fill (%)	42.8 ± 9.7	71.5 ± 10.8	**<0.001**
Reduction in periapical radiolucency (%)	63.9 ± 12.6	84.6 ± 9.2	**<0.001**
Overall treatment success, n (%)	31 (77.5)	38 (95.0)	**0.021**

Discussion:

The present study compared the clinical and radiographic healing outcomes of single-visit endodontic therapy and combined endodontic–periodontal therapy in teeth with Grade II furcation involvement, a condition known for its complex anatomical and microbiological challenges. The findings show a consistent and statistically significant advantage of the combined therapeutic approach in achieving superior periodontal regeneration, improved radiographic healing and higher overall treatment success. These results reinforce the concept that endodontic and periodontal lesions are biologically interconnected and that isolated endodontic intervention may be insufficient in cases with advanced furcation involvement **[1, 2].** At baseline, both groups were comparable in terms of demographic and clinical parameters, ensuring that post-treatment differences could be attributed to the intervention rather than confounding variables. This strengthens the internal validity of the study. The absence of significant differences in probing depth, attachment loss, tooth mobility and radiographic status aligns with the requirement for homogeneity in comparative clinical trials evaluating regenerative outcomes **[6].** Clinically, Group II demonstrated significantly greater reductions in probing pocket depth and superior gains in clinical attachment level compared to Group I. These findings are consistent with previous reports indicating that adjunctive periodontal therapy enhances healing by eliminating residual subgingival biofilm and promoting reattachment of periodontal tissues **[5, 7].** The significant improvement in gingival health and tooth mobility further supports the role of periodontal debridement and regenerative intervention in restoring functional stability. Similar observations have been reported in sequential treatment protocols for endo-periodontal lesions, where staged management leads to improved periodontal resolution compared to endodontic therapy alone **[7].** Radiographically, Group II showed markedly higher furcation bone fill and greater reduction in periapical radiolucency, indicating enhanced regenerative potential. This may be attributed to the combined effect of thorough endodontic disinfection and periodontal regenerative procedures such as bone grafting and guided tissue repair, which facilitate osteogenesis and periodontal ligament regeneration **[2, 9].** The absence of unsatisfactory healing in Group II further highlights the predictability of combined therapy in managing complex furcation defects. These findings are consistent with case series and clinical reports that have showed favorable outcomes using regenerative materials in endo-periodontal lesions **[3, 10].** The higher overall treatment success rate in Group II also underscores the clinical relevance of integrating periodontal therapy into the management of Grade II furcation involvement. The synergistic effect of addressing both pulpal and periodontal infection pathways likely explains the improved outcomes observed. Previous studies have emphasized that untreated periodontal inflammation can compromise endodontic healing, thereby reducing long-term success when therapy is limited to root canal treatment alone **[4, 8]**. However, despite the superiority of combined therapy, single-visit endodontic treatment still demonstrated substantial healing outcomes, particularly in terms of pain relief and partial radiographic resolution. This suggests that in selected cases with limited periodontal destruction, endodontic therapy alone may still provide acceptable outcomes. Nonetheless, the persistence of residual periodontal defects in Group I highlights the limitations of a unidimensional approach in advanced furcation involvement **[1, 6].** Overall, the present findings support a multidisciplinary treatment approach for managing Grade II furcation-involved teeth, where integration of endodontic disinfection with periodontal regenerative therapy yields superior clinical and radiographic outcomes. These results align with the growing body of literature advocating for biologically guided, stage-wise management of endo-periodontal lesions to enhance long-term tooth survival and functional stability **[11, 12].** Mergoni *et al.* came to the conclusion that during the 12-month post-operative period, neither regimen can avoid

discomfort and other problems. There were no differences between single-visit and multiple-visit subgroups **[13]**. There was no discernible difference in the two therapy groups' recovery rates, according to a meta-analysis **[14]**. Single-visit therapy should be taken into consideration to reduce the potential of contamination between consultations and to avoid flare-ups, according to Bekhit *et al.* **[15]**. Sabeti *et al.* found no considerable variation among single over two-visit endodontics procedure for necrotic teeth treatment **[16]**.

Conclusion:
Combined endodontic–periodontal therapy showed significantly superior clinical and radiographic healing outcomes compared to single-visit endodontic therapy alone in teeth with Grade II furcation involvement. The integrated approach resulted in greater periodontal regeneration, improved bone fill and higher overall treatment success, highlighting the importance of interdisciplinary management for predictable long-term tooth preservation.

Limitation:
The study is limited by its single-center design and relatively small sample size, which may restrict generalizability of the findings.

Future perspective:
Future multicentre randomized trials with larger cohorts and long-term follow-up are warranted to validate and refine combined endodontic–periodontal treatment protocols for furcation-involved teeth.

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