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Original Article

Comparative Evaluation of Success Rates in Endodontic Therapy versus Oral Interventions in the Management of Chronic Periapical Lesions

Dr Zunaid Ahmed[1], Dr. Kanchan Malawat P[2], Dr Meetu Mathur [3], Dr. Meenal Ahuja[4], Dr Shikha Kansra[5], Dr Sadaf Ali[6]

[1]Consultant Endodontist, Dental Department, M. N. Hospital & Research Centre, Hospital, Bikaner, Rajasthan
[2]Senior Resident, Department of Dentistry, Sardar Patel Medical College, Bikaner, Rajasthan.
[3]Professor and Head, Dept of Conservative Dentistry and Endodontics, Rajasthan Dental College and Hospital, Nirwan University Jaipur (Rajasthan)
[4]Reader, Dept of Conservative Dentistry and Endodontics, Maharaja Gangasingh College & Research Centre, Sriganganagar Rajasthan 335001
[5]MDS, Reader, Department of Conservative Dentistry and Endodontics, Surendera Dental College and research Institute, Sriganganagar, Rajasthan, India
[6]Bachlor of Dental Surgeon, General Dentist, Bihani Dental Clinic, Bikaner.

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Corresponding Author:

Dr. Zunaid Ahmed
Senior Resident
Dental Department
M. N. Hospital & Research Centre, Bikaner, Raj
Email-zunaidahmed960@gmail.com.

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ABSTRACT

Background: Chronic periapical lesions are inflammatory conditions of periradicular tissues resulting from microbial invasion of the root canal system. Management strategies commonly include conventional endodontic therapy and oral surgical interventions. Selection of an appropriate treatment modality remains a challenge and depends on lesion size, patient-related factors, and prognosis.
Aim: To comparatively evaluate the success rates of endodontic therapy and oral interventions in the management of chronic periapical lesions.
Materials and Methods: A prospective comparative clinical study was conducted among 100 patients diagnosed with chronic periapical lesions. Patients were divided into two groups: Group I (n=50) underwent nonsurgical endodontic therapy, while Group II (n=50) received oral surgical intervention including periapical surgery, cyst enucleation, or extraction with curettage. Clinical and radiographic outcomes were assessed at baseline, 3 months, 6 months, and 12 months. Success was determined by absence of pain, swelling, sinus tract, tenderness, and evidence of radiographic healing. Statistical analysis was performed using Chi-square test and independent t-test. A p-value <0.05 was considered statistically significant.
Results: Endodontic therapy demonstrated an overall success rate of 88%, while oral interventions showed a success rate of 80% at one-year follow-up. Smaller lesions (<5 mm) exhibited significantly better healing with endodontic therapy. Larger lesions and cystic lesions showed relatively favorable outcomes following oral interventions. Statistical analysis revealed a significant difference in success rates between groups (p=0.041).
Conclusion: Endodontic therapy demonstrated superior outcomes in the management of chronic periapical lesions and should remain the first-line treatment approach. Oral surgical interventions serve as effective alternatives in selected cases involving extensive lesions or failed nonsurgical treatment.

Keywords*: Chronic periapical lesions, endodontic therapy, oral surgery, apicoectomy, periapical healing, treatment outcomes.*

INTRODUCTION

Chronic periapical lesions are inflammatory disorders involving the periapical tissues surrounding the apex of teeth with infected and necrotic pulp. These lesions arise primarily due to microbial invasion of the root canal system and subsequent host inflammatory responses. Persistent infection initiates complex immunological reactions that lead to destruction of

periapical bone and formation of pathological lesions such as periapical granulomas, radicular cysts, and chronic apical abscesses. These conditions collectively represent one of the most frequently encountered pathologies in endodontic practice and significantly contribute to tooth morbidity and loss.[1]

The pathogenesis of chronic periapical lesions is multifactorial and involves interactions between microorganisms and host defense mechanisms. Bacterial endotoxins and metabolic byproducts stimulate inflammatory mediators including prostaglandins, cytokines, interleukins, and tumor necrosis factors, resulting in recruitment of inflammatory cells and activation of osteoclastic activity.[2] The progression of these inflammatory processes eventually causes resorption of surrounding alveolar bone and formation of radiographically detectable periapical radiolucencies.

Histopathological investigations have demonstrated that periapical granulomas constitute approximately 50–60% of chronic periapical lesions, while radicular cysts account for 15–35% of cases and chronic abscesses comprise the remaining proportion.[3] Distinguishing among these entities using conventional radiographs alone remains challenging because lesions frequently demonstrate overlapping clinical and radiographic appearances. Consequently, treatment planning often relies on lesion size, clinical presentation, pulp vitality status, and therapeutic response.

Clinically, chronic periapical lesions are often asymptomatic and are discovered incidentally during routine radiographic examination. However, some patients may present with symptoms such as dull pain, tenderness on percussion, recurrent swelling, sinus tract formation, or discomfort during mastication. The asymptomatic nature of these lesions often leads to delayed diagnosis and progression toward more extensive periapical destruction.[4]

The primary objective of treatment in chronic periapical pathology is eradication of infection and promotion of regeneration of the periapical tissues. Conventional nonsurgical endodontic therapy remains the preferred and most conservative treatment approach. Root canal treatment aims to eliminate microorganisms and infected tissue through biomechanical preparation, irrigation, intracanal medicaments, and obturation of the root canal system. Healing following endodontic therapy is dependent on complete disinfection and establishment of an environment favorable for tissue repair.[5]

Several studies have reported high success rates following conventional endodontic treatment ranging between 74% and 95%.[6] Modern advancements in rotary instrumentation systems, irrigation protocols, intracanal medicaments, and obturation techniques have further improved treatment outcomes. Despite these advances, complete healing does not always occur. Persistent lesions may arise due to intraradicular microorganisms, extraradicular biofilms, foreign body reactions, true cyst formation, missed canals, procedural errors, or inadequate coronal sealing.[7]

In cases where nonsurgical endodontic treatment fails or where lesion characteristics indicate poor prognosis, oral surgical interventions become necessary. Surgical procedures including apicoectomy, periapical curettage, root-end resection, cyst enucleation, decompression, and extraction with lesion removal provide direct access to pathological tissues and facilitate elimination of persistent infection.[8]

The introduction of microsurgical endodontics has significantly transformed surgical management. Use of operating microscopes, ultrasonic retropreparation, magnification systems, and biocompatible root-end filling materials has improved precision and enhanced healing rates. Studies have reported success rates ranging from 80–95% with contemporary microsurgical techniques.[9],[10]

Despite the widespread use of both treatment modalities, the literature remains limited regarding direct comparative evaluation of conventional endodontic therapy and oral interventions for management of chronic periapical lesions. Furthermore, treatment decisions are often influenced by clinician preference and lesion characteristics rather than robust comparative evidence.

Therefore, the present study was undertaken to comparatively evaluate the success rates of endodontic therapy and oral interventions in the management of chronic periapical lesions and to determine the effectiveness of each treatment modality in achieving favorable clinical and radiographic outcomes.

MATERIALS AND METHODS

Study Design and Setting

The present prospective comparative clinical study was conducted in the Department of Conservative Dentistry and Endodontics in association with the Department of Oral and Maxillofacial Surgery at a tertiary care dental teaching institution over a period of 18 months. The study protocol was reviewed and approved by the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants before enrollment.

Sample Size Determination

The sample size was calculated considering an anticipated difference in treatment success rates between endodontic therapy and oral interventions with a confidence interval of 95% and power of 80%. Based on previous literature and feasibility of patient recruitment, a total sample size of 100 patients was included.

Study Population : Patients attending the outpatient department with clinical and radiographic diagnosis of chronic periapical lesions were screened for eligibility. Detailed medical and dental histories were recorded. Participants fulfilling selection criteria were recruited consecutively and allocated into two study groups consisting of 50 subjects each. Group I Patients treated with conventional nonsurgical endodontic therapy (n=50) and Group II Patients treated with oral interventions (n=50)

Inclusion Criteria

- Patients aged between 18 and 60 years
- Teeth diagnosed with pulp necrosis associated with chronic periapical lesions
- Presence of radiographic periapical radiolucency >2 mm
- Single-rooted and multirooted permanent teeth
- Patients willing to participate and comply with follow-up protocol

Exclusion Criteria

- Acute periapical abscess
- Teeth with root fractures
- Grade III mobility
- Advanced periodontal disease
- Previously treated root canal teeth
- Pregnant and lactating women
- Medically compromised or immunocompromised individuals
- Patients unwilling to participate
- Clinical Examination

Clinical Examination: All patients underwent detailed clinical examination including: Visual inspection, Percussion tests, Palpation, Mobility assessment, Pulp vitality testing, Evaluation of swelling and sinus tract. Preoperative intraoral periapical radiographs were obtained using standardized paralleling techniques. Lesion dimensions were measured in millimeters using radiographic software. Lesions were categorized as: Small (<5 mm), Medium (5–10 mm) & Large (>10 mm)

Clinical parameters assessed included:

- Pain
- Tenderness
- Swelling
- Sinus tract
- Tooth mobility

Radiographic assessment evaluated:

- Reduction in lesion size
- Bone regeneration
- Complete resolution of radiolucency

Treatment Procedures

Group I: Endodontic Therapy

Local anesthesia was administered whenever indicated and rubber dam isolation was performed. Access cavity preparation was carried out followed by working length determination using electronic apex locators and radiographic confirmation. Cleaning and shaping of canals were performed using rotary nickel–titanium instruments according to crown-down technique. Root canal irrigation done. Calcium hydroxide intracanal medicament was placed in cases requiring multiple visits. Obturation was completed using gutta-percha and resin sealer employing lateral condensation technique. Permanent coronal restoration was subsequently placed.

Group II: Oral Intervention Group

Surgical procedures were selected according to lesion characteristics and included: Apicoectomy, Periapical curettage, Root-end resection, Cyst enucleation, Extraction with lesion removal. After administration of local anesthesia, mucoperiosteal flap elevation was performed and lesions were surgically exposed. Pathological tissues were curetted and removed completely. Apicoectomy with retrograde filling was performed whenever indicated. Surgical sites were irrigated and sutured under aseptic conditions. Postoperative medications including antibiotics and analgesics were prescribed.

Follow-up Evaluation: Patients were evaluated postoperatively at: 3 months, 6 months & 12 months. Treatment was considered successful when complete absence of clinical symptoms and satisfactory radiographic healing were observed.

Statistical Analysis Data obtained were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS version 26.0). Descriptive statistics included mean, standard deviation, frequencies, and percentages. Comparisons between groups were performed using: Chi-square test **&** Independent t-test**.** A p-value <0.05 was considered statistically significant.

RESULTS:

A total of 100 patients diagnosed with chronic periapical lesions were included in the present study. Participants were equally divided into two groups: Group I (Endodontic therapy, n=50) and Group II (Oral intervention, n=50). Demographic characteristics, lesion features, clinical outcomes, and treatment success rates were evaluated and compared over a follow-up period of 12 months.

The majority of study participants belonged to the 31–40 years age group (38%), followed by the 18–30 years age category (29%). Mean ages in both treatment groups were comparable with no statistically significant difference (p=0.872), indicating homogeneity between groups and minimizing age-related confounding variables. Males constituted 58% of the study population, while females represented 42%. No statistically significant difference was observed between groups regarding gender distribution (p=0.681), suggesting similar baseline demographic characteristics. (Table 1)

Small lesions (<5 mm) constituted the majority of cases and were more commonly managed using endodontic therapy. Larger lesions (>10 mm) were relatively more frequent in the oral intervention group. Statistical analysis demonstrated a significant difference between groups (p=0.032), indicating lesion size influenced treatment selection. Periapical granuloma represented the most common lesion type (52%), followed by radicular cysts (25%). Radicular cysts were more frequently treated by oral interventions because of their larger size and greater tissue involvement; however, differences were not statistically significant. (Table2)

Pain reduction progressively improved in both groups throughout follow-up. Patients receiving endodontic therapy demonstrated significantly greater improvement at all follow-up intervals compared with oral intervention patients (p<0.05).(Table3)

Complete radiographic healing was observed in 70% of patients in the endodontic group compared with 56% in the oral intervention group. Persistent lesions were more common following oral intervention. Statistical significance suggests greater radiographic success associated with endodontic therapy.(table4)

Both treatment modalities demonstrated substantial improvement in clinical symptoms. Pain resolution and tenderness reduction showed statistically significant differences favoring endodontic therapy, whereas swelling, sinus tract closure, and mobility improvements were comparable between groups.(Table5)

Overall treatment success was observed in 84% of study participants. Endodontic therapy demonstrated a significantly higher success rate (88%) than oral interventions (80%) (p=0.041). This finding supports the role of conventional endodontic treatment as the preferred initial approach in chronic periapical lesion management.(Table6)

Table 1: Demographic distribution of study participants according to age& gender.

Age group (years)	Endodontic Therapy (n=50)	Oral Intervention (n=50)	Total (%)	P value
18–30	15	14	29 (29%)	0.872(NS)
31–40	18	20	38 (38%)	
41–50	11	10	21 (21%)	
51–60	6	6	12 (12%)	
Gender				
Male	28	30	58 (58%)	0.681(NS)
Female	22	20	42 (42%)	
Mean Age	37.9 ± 8.4 years	39.6 ± 9.1 years		

Table 2: Distribution of study participants according to lesion size

Lesion size	Endodontic Therapy	Oral Intervention	Total	P value
<5 mm	30	21	51 (51%)	0.032(S)
5–10 mm	15	20	35 (35%)	
>10 mm	5	9	14 (14%)	
Lesion type				

Lesion size	Endodontic Therapy	Oral Intervention	Total	P value
Periapical granuloma	28	24	52 (52%)	0.214(NS)
Radicular cyst	10	15	25 (25%)	
Chronic abscess	12	11	23 (23%)	

Table 3: Comparison of pain reduction at follow-up periods

Follow-up period	Endodontic Therapy (%)	Oral Intervention (%)	P value
Baseline	100	100	—
3 months	72	60	0.041*
6 months	86	74	0.038*
12 months	92	86	0.048*

Table 4: Comparison of radiographic healing at one-year follow-up

Radiographic outcome	Endodontic Therapy	Oral Intervention	P value
Complete healing	35 (70%)	28 (56%)	0.028*
Partial healing	9 (18%)	12 (24%)	
No healing	6 (12%)	10 (20%)	

Inference

Table 5: Clinical outcomes after 12 months

Clinical parameter	Endodontic Therapy (%)	Oral Intervention (%)	P value
Pain resolution	92	86	0.048*
Tenderness absent	90	82	0.041*
Swelling resolution	94	90	0.064
Sinus tract closure	96	92	0.083
Mobility reduction	90	84	0.071

Table 6: Comparison of overall treatment success rates

Outcome	Endodontic Therapy	Oral Intervention	Total	P value
Successful	44 (88%)	40 (80%)	84 (84%)	0.041*
Failure	6 (12%)	10 (20%)	16 (16%)	

DISCUSSION

Chronic periapical lesions represent a common consequence of pulpal necrosis and persistent microbial infection within the root canal system. The pathogenesis involves complex interactions between bacterial biofilms and host inflammatory mediators, leading to periapical bone destruction and lesion formation. Recent evidence has emphasized the role of cytokine-mediated bone remodeling pathways and regenerative mechanisms in chronic apical periodontitis, further influencing healing outcomes and treatment response.[11]

The present study demonstrated favorable outcomes with both treatment modalities; however, nonsurgical endodontic therapy consistently exhibited superior clinical and radiographic success. Smaller lesions showed greater healing potential following conventional root canal treatment, whereas larger and cystic lesions required surgical management more frequently. These findings emphasize the importance of individualized treatment planning based on lesion characteristics and prognosis.

The present study comparatively evaluated the effectiveness of conventional endodontic therapy and oral interventions in the management of chronic periapical lesions and demonstrated an overall success rate of 88% in the endodontic therapy group and 80% in the oral intervention group. These findings indicate that both treatment modalities are clinically effective; however, nonsurgical endodontic treatment achieved comparatively superior outcomes.

The favorable outcomes observed in the endodontic group may be attributed to effective elimination of intracanal microorganisms, reduction in bacterial load, and preservation of natural tooth structures. Advances in irrigation protocols, nickel–titanium rotary instrumentation, calcium hydroxide medicaments, and contemporary obturation techniques have

considerably enhanced healing potential in chronic periapical lesions. Persistent intraradicular infection remains the principal cause of endodontic failure, and adequate disinfection continues to be the cornerstone for successful treatment.[8] The present findings are consistent with previous studies reporting favorable outcomes following nonsurgical root canal treatment. Ng et al. reported long-term success rates exceeding 85% following primary endodontic treatment.[7] More recently, Luo et al. emphasized that healing of chronic periapical lesions depends not only upon microbial elimination but also on restoration of normal osteoimmune pathways and regulation of inflammatory mediators responsible for bone remodeling.[11]

The present study further demonstrated that lesions measuring less than 5 mm exhibited significantly greater healing following conventional endodontic treatment, whereas larger lesions and cystic pathologies more frequently required surgical intervention. Lesion size remains a critical prognostic determinant because larger lesions frequently contain epithelial proliferation, true cystic cavities, or persistent extraradicular infection that may compromise nonsurgical healing. Similar observations have been reported by Caliskan et al. and have been supported by contemporary investigations.[9]

Among lesion types, periapical granulomas represented the majority of cases followed by radicular cysts and chronic abscesses. This distribution corresponds with previous histopathological studies showing granulomas as the most prevalent chronic periapical lesions.[2] Greater prevalence of granulomatous lesions may partially explain the favorable response observed with nonsurgical treatment because these lesions often resolve following elimination of etiologic factors.

The oral intervention group demonstrated an overall success rate of 80%. Surgical management remains an important treatment option in persistent lesions, failed root canal therapy, inaccessible anatomy, extraradicular biofilm-associated lesions, and true cysts. Surgical procedures facilitate direct access and removal of pathological tissues and infected apical areas.[4]

Recent advances in endodontic microsurgery have considerably improved treatment outcomes. Modern surgical approaches involving operating microscopes, ultrasonic retropreparation, microsurgical instruments, and bioceramic root-end materials have significantly enhanced healing rates. A recent systematic review by Sabeti et al. reported pooled success rates approaching 84–90% following contemporary endodontic microsurgery.[12] Similar success rates were observed in the present investigation.

Long-term studies evaluating endodontic microsurgery outcomes have shown that some lesions initially demonstrating complete healing may exhibit delayed recurrence over prolonged follow-up periods. Song et al. assessed long-term microsurgical outcomes and reported excellent early healing rates, emphasizing the need for extended follow-up before confirming definitive treatment success.[13]

The present study also demonstrated significantly greater pain resolution and tenderness reduction among patients treated with endodontic therapy compared with oral interventions. These findings may be explained by the invasive nature of surgical procedures and postoperative tissue trauma associated with flap elevation and tissue manipulation. Although oral interventions effectively remove pathological lesions, temporary postoperative discomfort and inflammation may influence short-term clinical outcomes.

Recent international expert consensus on apical microsurgery highlighted that treatment success largely depends upon case selection, operator experience, magnification systems, and surgical techniques. Wang et al. reported that success rates may exceed 90% when microsurgery is performed under standardized protocols and with advanced armamentarium.[14]

Contemporary regenerative approaches have also improved surgical outcomes. Choi et al. demonstrated favorable healing outcomes using guided tissue regeneration and bone grafting procedures in extensive apicomarginal defects, suggesting enhanced bone regeneration and improved long-term prognosis.[15] Such regenerative strategies may be particularly beneficial in large chronic lesions associated with significant osseous destruction.

Several prognostic factors affecting surgical outcomes have also been identified. Hard tissue defects and periodontal attachment loss have shown significant influence on healing following microsurgery. Sabeti et al. demonstrated that extensive osseous defects negatively impact long-term treatment outcomes.[12]

Overall, the present study findings support the concept that conventional endodontic therapy should remain the primary treatment modality for chronic periapical lesions because of its minimally invasive nature, preservation of natural dentition, and comparatively higher success rates. Oral interventions should be reserved for persistent lesions, failed nonsurgical therapy, and cases where lesion characteristics suggest reduced probability of conservative healing.

The present study has several limitations including single-center design, moderate sample size, and limited follow-up duration of one year. Histopathological confirmation was unavailable for all lesions. Future multicenter studies with larger samples, longer follow-up periods, cone-beam computed tomography evaluation, and histopathological correlation are recommended for more comprehensive assessment of treatment outcomes.

Clinical Implications

Conventional endodontic therapy should be considered the first-line treatment for chronic periapical lesions because of its higher success rate and ability to preserve natural dentition. Oral interventions should be reserved for large, persistent, or non-healing lesions where conservative treatment demonstrates limited prognosis.

CONCLUSION

Both endodontic therapy and oral interventions demonstrated favorable outcomes in managing chronic periapical lesions. However, endodontic therapy exhibited significantly higher success rates and better clinical outcomes. Preservation of natural dentition through nonsurgical treatment should remain the primary objective. Surgical intervention should be considered when conservative therapy fails or when lesion characteristics indicate poor prognosis.

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