Romanian Journal of Oral Rehabilitation
Vol. 18, No.2 April-June 2026

ENDODONTIC TREATMENT OUTCOMES IN ACUTE APICAL PERIODONTITIS: INFLUENCE OF PATIENT, SYSTEMIC, AND DENTAL FACTORS ON PAI CHANGE

Sorina G. Zahiu [1], Ovidiu Fratila[2]

1. Doctoral School of Biomedical Sciences, University of Oradea, Oradea, ROU
2. Department of Medical Disciplines, Faculty of Medicine and Pharmacy, University of Oradea, Oradea, ROU

Abstract

To evaluate clinical-radiological outcomes after endodontic treatment in patients with acute apical periodontitis and to investigate associations between demographic, systemic, and dental characteristics and PAI evolution over time. Methods - This retrospective observational cohort study included 110 patients diagnosed with acute apical periodontitis, comprising a total of 128 affected teeth. The study was approved by the Ethics Committee of the Faculty of Medicine and Pharmacy Oradea (CEFMF/4/30.10.2023) and conducted in accordance with the Declaration of Helsinki. Outcomes were assessed using PAI at baseline, 12 months, and 24 months post-treatment. Teeth were classified at the final follow-up as healed, healing, or failed based on clinical signs/symptoms and radiographic PAI changes. Statistical analysis was performed using IBM SPSS 25, applying non-parametric tests and Spearman's correlation ($\alpha = 0.05$, with Bonferroni correction as appropriate). Results - At 12 months, outcomes were predominantly favorable, and by 24 months the proportion of healed teeth increased to 85.9%. Lower initial PAI scores were significantly associated with healing at both follow-up time points ($p < 0.001$), whereas higher or worsening PAI scores characterized unfavorable outcomes ($p < 0.001$). Age was significantly associated with a more unfavorable PAI change over time (Age vs PAI: $p = 0.028$, $R = -0.194$). In addition, smoking was associated with a higher number of teeth affected by apical periodontitis ($p = 0.018$). Systemic comorbidities and urban residence were linked to older patient age and greater periapical disease burden ($p = 0.001$ and $p = 0.044$, respectively). Conclusions - Endodontic treatment of AAP resulted in high healing rates, particularly by 24 months. Baseline disease severity (initial PAI) and patient age were key predictors of PAI evolution, while smoking and systemic comorbidities were associated with a greater burden of affected teeth.

Keywords : retrospective observational study, patient and dental characteristics, PAI (PAI evolution), Smoking, systemic comorbidities

Introduction

Apical periodontitis is a multifaceted inflammatory condition of the periradicular tissues, fundamentally precipitated by the microbial colonization of the root canal system and the subsequent diffusion of bacterial antigens, endotoxins, and other pathogenic byproducts into the periapical region[1].

The host immune response, orchestrated through a complex interplay of pro-inflammatory cytokines, immune cell recruitment, and osteoclastic activity, serves as the primary defense mechanism against microbial dissemination; however, this response paradoxically contributes to progressive periapical tissue destruction, alveolar bone resorption, and the potential development of periapical lesions such as granulomas and radicular cysts [2,3].

This condition represents one of the most prevalent dental pathologies worldwide, with epidemiological studies reporting prevalence rates ranging from 16% to 78.6% of individuals [4,5,6]. Apical periodontitis significantly impacts patients' quality of life through pain, discomfort, and functional limitations [7], while also placing a significant economic strain on healthcare systems because of the need for intricate endodontic procedures [8].

Acute apical periodontitis is clinically distinguished by its symptomatic presentation, including spontaneous pain and

DOI : 10.62610/RJOR.2026.2.18.20

marked sensitivity to percussion and palpation, whether or not accompanied by radiological changes [9,10,11]. In contrast to chronic apical periodontitis, which often presents asymptomatically for prolonged periods, acute apical periodontitis manifests as an active inflammatory process that drives patients to seek urgent dental treatment [12]. The condition results from bacterial invasion of the root canal system following pulp necrosis, with diverse polymicrobial communities contributing to periapical inflammation [13,14]. Diagnosis relies on the combination of clinical findings (pain characteristics, percussion sensitivity, negative pulp testing) and radiographic evidence of periapical radiolucency [15,16,17]. The Periapical Index (PAI) scoring system, introduced by Ørstavik et al., is recognized as the gold standard for radiographic evaluation of periapical conditions, providing a standardized framework for assessment and monitoring of treatment outcomes. Accurate diagnosis and appropriate management of acute apical periodontitis are essential objectives for achieving symptom resolution, bacterial elimination, and tooth preservation, as supported by systematic reviews and clinical guidelines [18,19,20].

The primary objectives of endodontic treatment encompass the elimination of intracanal infection, prevention of reinfection, and facilitation of periapical tissue healing [21]. Treatment success is conventionally defined as the absence of clinical symptoms in conjunction with radiographic evidence of periapical healing or stable periapical status [22]. The European Society of Endodontology recommends a minimum follow-up period of 12 months, with 24-month or extended evaluations preferable for determining definitive outcomes [23]. Nevertheless, there is considerable variation in reported treatment outcomes, suggesting that factors other than technical skill play a significant role in determining treatment prognosis [24]. A comprehensive understanding of these prognostic determinants is fundamental for evidence-based treatment planning, informed patient counseling, and enhancement of overall endodontic treatment outcomes.

Numerous factors have been identified as potential predictors of endodontic treatment outcomes. The status of previous endodontic treatment has consistently been recognized as a significant prognostic factor for endodontic outcomes. Primary root canal treatments, performed on teeth with no prior endodontic intervention, have been shown to yield considerably higher success rates when compared to retreatment cases [25]. Evidence suggests that patient-related determinants, including smoking habits and systemic comorbidities such as diabetes mellitus, may negatively impact the healing process associated with apical periodontitis [26,27]. Socioeconomic determinants, including educational level and geographic location (urban versus rural), potentially impact oral health awareness and treatment-seeking behavior [28,29]. Self-medication practices, particularly the unsupervised use of antibiotics and analgesics before professional treatment, represent an emerging concern that may affect diagnostic accuracy and treatment outcomes [30,31].

Despite extensive literature on individual prognostic factors, comprehensive multifactorial studies examining the simultaneous influence of patient demographics, socioeconomic status, oral health burden, tooth-specific characteristics, and treatment variables on apical periodontitis remain limited [32,33,34].

This study aimed to identify clinical, demographic, and socioeconomic prognostic factors associated with endodontic treatment outcomes in acute apical periodontitis over a 24-month follow-up, assessed radiographically using the Periapical Index (PAI) at 12 and 24 months. We evaluated the influence of patient characteristics, tooth-specific variables (tooth location and previous treatment status), and treatment-related factors) on healing success. We hypothesized that multiple patient- and tooth-related factors may be associated with PAI evolution, and that understanding these relationships could

DOI : 10.62610/RJOR.2026.2.18.20

provide improved insight for clinical decision-making and patient management. Identifying prognostic factors in acute apical periodontitis has direct clinical implications for treatment planning, risk stratification, and evidence-based patient counseling. Recognizing potentially modifiable risk factors, such as smoking and behaviors related to self-medication, may support targeted patient education and follow-up strategies. In addition, identifying high-risk patient profiles may help clinicians prioritize recall intensity and consider alternative treatment approaches in cases with unfavorable radiographic evolution.

Methodology

1.1 Study Population

Study Design and Ethics Approval

This retrospective observational cohort study analyzed clinical and radiological characteristics of acute apical periodontitis and treatment outcomes. The study protocol was approved by the Ethics Committee of the Faculty of Medicine and Pharmacy Oradea (CEFMF/4/30.10.2023), and the study was conducted in accordance with the Declaration of Helsinki.

Patient Selection

Between January 3, 2020, and September 30, 2021, clinical records of 200 consecutive patients who underwent endodontic treatment for apical periodontitis at the host clinic were reviewed. All patients had provided written informed consent for treatment and prospective clinical data collection at the time of their initial presentation. Each patient had completed a comprehensive medical history questionnaire and undergone a thorough clinical and radiographic examination.
A diagnosis of acute apical periodontitis was established when all of the following criteria were met:
1. Spontaneous pain reported by patient
2. Marked tenderness to percussion and/or palpation
3. Negative response to pulp sensibility testing
4. Radiographic evidence of periapical radiolucency (PAI ≥ 3)
5. Absence of periodontal pocket >4mm to exclude periodontal origin

After applying the exclusion criteria, 110 patients met the eligibility criteria and were included in the study, resulting in a total of 128 teeth assessed. The remaining 89 patients with chronic apical periodontitis were excluded from this analysis.
Patients diagnosed with acute apical periodontitis, including those with acute apical abscess formation, were included. While all received endodontic treatment, some cases with abscess may have received adjunctive therapy (antibiotics and/or incision and drainage) at the treating clinician's discretion. These adjunctive treatments were not systematically documented, representing a limitation of this retrospective study.

Data Collection and Follow-up
Clinical and radiographic data had been collected prospectively during routine patient care. Treatment outcomes were assessed using the Periapical Index (PAI) scoring system at baseline (pre-treatment), 12 months, and 24 months post-treatment.

1.2 Radiographic examination and evolution

The periapical status of all teeth (except for third molars) was examined using the periapical index scoring system (PAI), proposed by Ørstavik et al. which scores the apical area of the radiographic images as follows: 1. normal periapical structures; 2. small changes in the bone structure; 3. changes in bone structure with some mineral loss; 4. periodontitis with a well-defined radiolucent area; 5. severe periodontitis with exacerbating features. A score of PAI 1 and 2 was defined as a normal periapical region and PAI scores (3, 4, and 5) were evaluated as apical periodontitis. One observer with 6

DOI : 10.62610/RJOR.2026.2.18.20

years of clinical experience in endodontics examined the radiographs. In multi-rooted teeth, the biggest root with the biggest PAI score was chosen. All participants underwent radiographic examinations at baseline, at 12 and at 24 months following endodontic treatment.Teeth were categorized as healed, healing, or diseased based on clinical signs, symptoms, and PAI scores :

1. Healed: Clinically normal with radiographic PAI scores of 1 or 2.
2. Healing: Clinically normal except for tenderness to percussion, with a reduction in the size of the periradicular lesion or a decrease in PAI score.
3. Failed: Presence of clinical signs and symptoms, with a radiographic PAI score of 3 or higher, or an increase in the size of the periradicular lesion or PAI score.

Healing outcomes were established in advance using periapical tissue status and were determined independently of any events occurring during the procedure. A tooth was classified as “healed” when, at follow-up, the PAI score was 2 or less and there were no clinical signs or symptoms present.

1.3 Inclusion and exclusion criteria

Inclusion criteria:
Patients were included if they met all of the following criteria: permanent teeth (excluding third molars) diagnosed with acute apical periodontitis, teeth suitable for endodontic treatment and functional restoration, willingness to attend follow-up appointments at 12 and 24 months, and provision of written informed consent

Exclusion criteria:
Patients were excluded if any of the following criteria were present:

Tooth-related: primary (deciduous) teeth, third molars, teeth with combined endodontic-periodontal lesions, non-restorable teeth: vertical root fracture, extensive coronal/root destruction, insufficient tooth structure for adequate restoration

Patient-related: pregnancy, inability or unwillingness to attend follow-up evaluations, incomplete treatment or follow-up records.

1.4 Data collection and statistical analysis.

Data collection was performed by a single investigator using a standardized data extraction form. All variables were extracted from patient medical records and radiographic archives. Cases with incomplete data or missing follow-up radiographs were excluded from analysis.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 25 and Microsoft Office Excel/Word 2024. Quantitative variables were tested for distribution using the Shapiro–Wilk test and were reported as means with standard deviations or medians with interpercentile ranges. Independent quantitative variables with a non-parametric distribution were tested using the Mann–Whitney U / Kruskal–Wallis H tests (along with post-hoc Dunn–Bonferroni tests), and any correlations between them were calculated using Spearman’s rho correlation coefficient. Paired quantitative variables with a non-parametric distribution were tested using the Wilcoxon test.

Qualitative variables were expressed as absolute numbers or percentages. Differences between independent qualitative variables were tested using Fisher’s Exact Test. Z-tests with Bonferroni correction were used to further detail the results obtained in contingency tables. The threshold for statistical significance chosen for this study was $\alpha = 0.05$.

Patient Demographics and Characteristics

Demographic data collected included gender (male/female), residential environment

DOI : 10.62610/RJOR.2026.2.18.20

classified as urban or rural, smoking status (current smoker or non-smoker), and educational level categorized as primary education (≤8 years of schooling), secondary education (9-12 years, high school completion), or higher education (university degree or higher).

Medical and Oral Health Status

The presence or absence of systemic medical conditions was documented based on patient-completed medical history questionnaires, including cardiovascular disease, diabetes mellitus, respiratory disorders, autoimmune conditions, and other chronic diseases. Oral health parameters included the total number of teeth present (excluding third molars, range 0-28) and the total number of teeth affected by apical periodontitis (acute or chronic, identified by clinical symptoms and/or radiographic evidence with PAI ≥ 3).

Tooth-Specific Variables

For each tooth diagnosed with acute apical periodontitis, the following variables were recorded: affected jaw (maxilla or mandibula), specific tooth location using FDI two-digit notation, tooth type (anterior: incisors and canines; posterior: premolars and molars), and previous endodontic treatment: primary endodontic treatment (teeth with no previous root canal therapy, representing primary infection), or (2) endodontic retreatment (teeth with existing root canal treatment, representing secondary or persistent infection).

Treatment Variables

Self-medication was defined as patient-initiated use of analgesics, anti-inflammatory drugs, or antibiotics prior to seeking professional dental care (yes/no). The number of clinical treatment sessions required to complete endodontic therapy was documented, ranging from single-visit treatment (1 session) to multiple-visit treatment (2 or more sessions).

Protocol

Following dental anesthesia administered via plexus or nerve block to avoid direct injection into inflamed tissues, each tooth was isolated with a rubber dam. Where teeth presented with dental posts, extensive carious lesions, or marginally defective composite restorations, these were removed and the coronal structure was fully reconstructed as needed to ensure optimal coronal sealing, after which all teeth underwent occlusal reduction. In the primary treatment group, canal negotiation was initiated with #08, #10, or #15 K-files (Maillefer, Switzerland) to eliminate coronal interferences, working length was established using an electronic apex locator (Root ZX, Morita, Japan), and canals were subsequently shaped with HyFlex CM/EDM rotary instruments driven by a VDW Gold electric motor (VDW, Munich, Germany) at 300 rpm and 2.5 N·cm torque using the crown-down technique. In the retreatment group, existing dental posts, separated instruments, and excess gutta-percha were first removed using Woodpecker ultrasonic endodontic tips (Woodpecker Ultrasonic Scaler U6 LED), after which instrumentation commenced with a 25/.12 HyFlex EDM file followed by VDW RECIPROC® R25 insertion to the estimated working length, with the integrated apex locator of the VDW.GOLD® RECIPROC® system remaining continuously active throughout, and apical fit re-evaluated upon completion. A uniform irrigation protocol was applied to both groups, consisting of continuous 5.25% NaOCl irrigation during instrumentation, followed by a final rinse sequence of 5 mL of 17% EDTA and 5 mL of 5.25% NaOCl, after which canals were dried with absorbent paper points. Root canal obturation was performed using the warm vertical compaction technique with gutta-percha and AH Plus sealer (Dentsply, Germany) delivered via master cones. Coronal restoration was completed using a total-etch adhesive technique (Single Bond 2, 3M ESPE, USA), with flowable resin composite (GC Gradia Direct Flo, GC Corporation, Tokyo, Japan) used to seal canal orifices and direct resin composite (Gradia Direct, GC Corporation, Tokyo, Japan) used

DOI : 10.62610/RJOR.2026.2.18.20

for the definitive coronal restoration; in cases requiring fiber post placement, HiRem Quartz Fibre Posts (Over Fibers, Italy) were cemented with Connexio® Dual-Cure (Centrix, Germany) and built up with Maxcem Elite™ (Kerr). In cases where adequate canal drying could not be achieved, calcium hydroxide (Cerkamed) was placed as an interim medicament, the access cavity was sealed with PTFE tape and glass ionomer cement (Kavitan Cem, Pentron), and definitive obturation was completed at a one-week recall appointment. The differentiation in instrumentation between groups was deliberate and protocol-predefined, with HyFlex CM/EDM selected for primary treatment to achieve conservative, controlled shaping in intact canals in accordance with contemporary guidelines, and RECIPROC Blue chosen for retreatment cases due to its efficiency in removing obturation materials and managing canal obstructions, reflecting established retreatment workflow recommendations. All post-endodontic restorations were completed in the same clinical session by the same clinician under standardized conditions.

Rezultate

Among the 200 patients assessed, 110 patients who presented with a total of 128 teeth were diagnosed with acute apical periodontitis. The baseline demographic, behavioral, and clinical characteristics of the study population are summarized in Table I.

Table I. Characteristics of the studied patients

Parameter	Values
Gender (No., %)	68 (61.8%) Female, 42 (38.2%) Male
Age (Mean ± SD, Median (IQR))	35.14 ± 14.43, 31.5 (23-46.25)
Environment of origin (No., %)	43 (39.1%) Rural, 67 (60.9%) Urban
Smokers (No., %)	19 (17.3%) Present
Level of education (Nr., %)	1 (0.9%) Primary school, 3 (2.7%)Gymnasium, 55 (50%) High School/ Vocational School, 51 (46.4%) University education
Automedication (No., %)	62 (56.2%) Absent, 10 (9.1%) Antibiotic, 17 (15.5%) Anti-inflammatory drug, 21 (19.1%) Antibiotic+Anti-inflammatory drug
Total number of teeth present (Mean ± SD, Median (IQR))	25.17 ± 3.8, 27 (24-28)
Total number of teeth with apical periodontitis (Mean ± SD, Median (IQR))	1.82 ± 1.1, 1 (1-2)
General condition (Nr., %)	16 (14.5%) Present
Cardiovascular disease	7 (6.4%) Present
Respiratory conditions	0 (0%) Present
Gastrointestinal conditions	4 (3.6%) Present
Liver disorders	1 (0.9%) Present
Neuropsychiatric disorders	2 (1.8%) Present
Blood disorders	0 (0%) Present
Imunne disorders	2 (1.8%) Present
Allergic disease	5 (4.5%) Present
Endocrine disorders	1 (0.9%) Present
No. of diseases (No. = 111) (Mean ± SD, Median (IQR))	94 (85.5%) Absent, 11 (10%) One disease, 5 (4.5%) Two diseases

DOI : 10.62610/RJOR.2026.2.18.20

Table II presents the dental characteristics of the studied patients. Overall, affected teeth were distributed almost equally between the maxilla (50.8%, n=65) and the mandible (49.2%, n=63). Regarding tooth types, incisors accounted for 25.8% (n=33), canines for 2.3% (n=3), premolars for 35.2% (n=45), and molars for 36.7% (n=47). The most frequently affected subgroup was mandibular 1st molars (21.1%, n=27), while the most frequently affected individual teeth were 36 (10.2%) and 46 (10.9%). Prior treatment was absent in 60.2% (n=77) of cases and present in 39.8% (n=51) (root canal treatment). The mean duration of prior treatment was 1.84 ± 2.44 years, with a median of 0.5 years (IQR 0–4), and most teeth were treated in one session (59.4%, n=76). The mean initial PAI score was 3.4 ± 0.9 (median 3, IQR 3–4), while the mean final PAI score was 1.33 ± 0.97 (median 1, IQR 1–1). At the 12-month recall, 53.1% of the teeth were healed, whereas at the last recall (24 months) healing increased markedly to 85.9%.

Tabel II. Dental characteristics of the studied patients

Parameter	Value
Affected maxillary side (No., %)	65 (50.8%) Maxilla, 63 (49.2%) Mandible
Dental group (No., %)	33 (25.8%) Incisors, 3 (2.3%) Canines, 45 (35.2%) Premolars, 47 (36.7%) Molars
Distribution of affected tooth groups (No., %)	13 (10.2%) Maxillary central incisors 17 (13.3%) Maxillary lateral incisors 2 (1.6%) Maxillary canines 14 (10.9%) Maxillary 1st premolars 12 (9.4%) Maxillary 2nd premolars 8 (6.3%) Maxillary 1st molars 4 (3.1%) Maxillary 2nd molars 1 (0.8%) Mandibular central incisors 1 (0.8%) Mandibular lateral incisors 7 (5.5%) Mandibular 1st premolars 13 (10.2%) Mandibular 2nd premolars 27 (21.1%) Mandibular 1st molars 9 (7%) Mandibular 2nd molars
Affected tooth (No., %)	11 – 9 (7%), 12 – 11 (8.6%), 14 – 6 (4.7%),15 – 8 (6.3%), 16 – 4 (3.1%), 17 – 1 (0.8%), 21 – 3 (2.3%), 22 – 7 (5.5%), 24 – 6 (4.7%), 25 – 4 (3.1%), 26 – 4 (3.1%), 27 – 3 (2.3%), 32 – 1 (0.8%), 33 – 3 (0.8%), 34 – 3 (2.3%), 35 – 8 (6.3%), 36 – 13 (10.2%), 37 – 3 (2.3%), 41 – 1 (0.8%), 43 – 1 (0.8%), 44 – 4 (3.1%), 45 – 7 (5.5%), 46 – 14 (10.9%), 47 – 6 (4.7%)
Prior treatment(No., %)	77 (60.2%) Absent, 51 (39.8%) Root canal treatment
Duration of previous treatment (years) Mean ± SD, Median (IQR)	1.84 ± 2.44, 0.5 (0-4)
Number of treatment sessions (n, %)	77 (60.2%) One session, 50 (39.1%)Two sessions,1 (0.8%) Three sessions
Initial PAI score (Mean ± SD, Median (IQR))	3.4 ± 0.9, 3 (3-4)

DOI : 10.62610/RJOR.2026.2.18.20

Outcome at first recall – 12 months (N=128) (n, %)	68 (53.1%) Healed, 14 (10.9%) Stationary, 5 (3.9%) Failing, 41 (32%) Healing
Outcome at last recall – 24 months (N=128) (n, %)	110 (85.9%) Healed, 7 (5.5%) Failing, 11 (8.6%) Healing
Final PAI score (Mean ± SD, Median (IQR))	1.33 ± 0.97, 1 (1-1)

After comparing patients' ages by their environment of origin, the differences were statistically significant (p = 0.025). Patients from urban areas had a significantly higher median age (median = 39, IQR = 25–49) than those from rural areas (median = 28, IQR = 22–37).

After stratifying patients by the presence of general comorbidities, a statistically significant difference in age was identified (p = 0.001). Specifically, patients with general comorbidities had a higher median age (52.5 years, IQR: 40–60.75) than patients without general comorbidities (29 years, IQR: 23–42.25).

The results shown in Table III compare the number of teeth affected by apical periodontitis between patients with and without gastrointestinal conditions. The difference was statistically significant (p = 0.003). Specifically, patients with gastrointestinal conditions presented a higher median number of affected teeth (median = 3.5, IQR = 3–4) compared with those without such conditions (median = 1, IQR = 1–2). In the remaining cases, the systemic diseases did not significantly influence the presence of apical periodontitis.

Gastrointestinal conditions	Mean ± SD,	Median (IQR)	Mean rank, p-value*	p*
Absent	1.75 ± 1.06	1 (1-2)	53.88	0.003
Present	3.5 ± 0.57	3.5 (3-4)	98.50	

Table III. Comparison of teeth affected by apical periodontitis by gastrointestinal status

After assessing the number of teeth affected by apical periodontitis according to patients' environment of origin, statistically significant differences were observed (p = 0.044). Patients from urban areas demonstrated a higher median number of teeth with apical periodontitis (median = 2, IQR: 1–3) than patients from rural areas (median = 1, IQR: 1–2).

Comparison of the number of teeth presenting with apical periodontitis by smoking status revealed statistically significant differences (p = 0.018). Smokers had a significantly higher median number of affected teeth (median = 2, IQR: 1–3) compared with non-smokers (median = 1, IQR: 1–2).

The data presented in Table IV and Figure 1 describe the distribution of patients by sex according to self-medication status. The differences observed were statistically significant (p = 0.042). Post hoc Z-tests with Bonferroni correction indicated that patients without self-medication were more frequently men than women (59.5% vs. 54.4%, respectively).

Gender / Automedication	Female		Male		p*
	Nr.	%	Nr.	%	
Absent	37	54.4%	25	59.5%	0.042
Anti-inflammatory drugs	10	14.7%	0	0%	
Antibiotic	10	14.7%	7	16.7%	

DOI : 10.62610/RJOR.2026.2.18.20

Anti-inflammatory +antibiotic	11	16.2%	10	23.8%	

*Fisher's Exact Test

Table IV. Distribution of Patients by Sex and Self-Medication

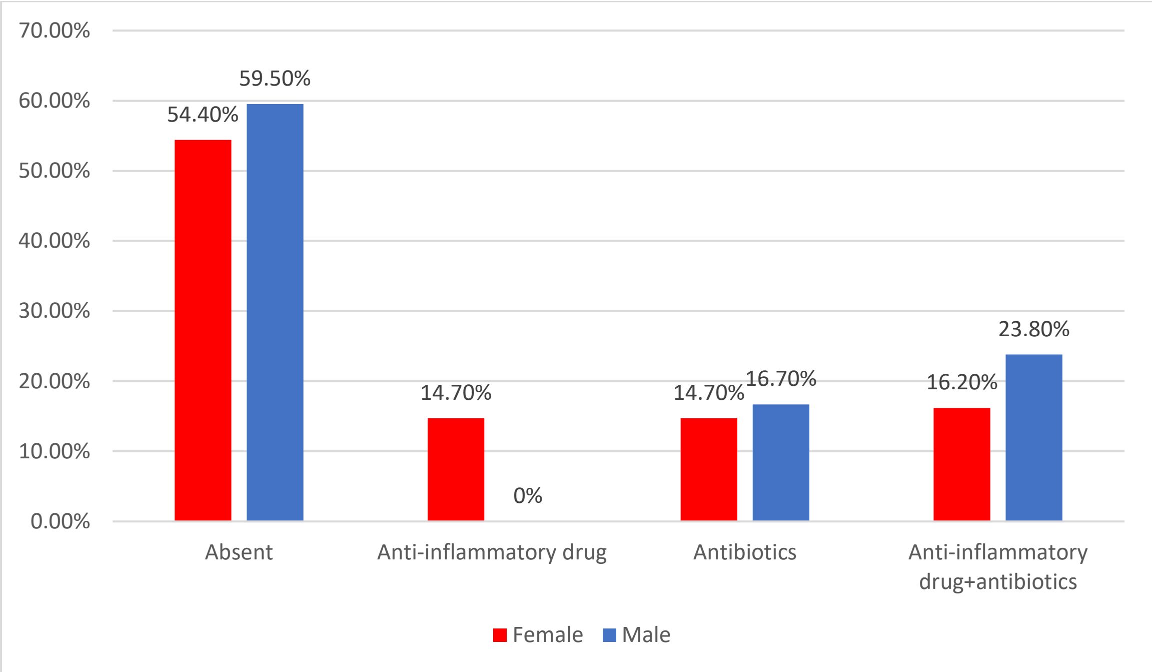

Figure 1. Distribution of Patients by Sex and Self-Medication

After analyzing the correlations between age and dental findings, the correlation between age and the total number of teeth present was statistically significant and negative, with moderate strength ($p < 0.001$, $R = -0.572$), suggesting that older patients tended to have fewer teeth and vice versa. Likewise, the correlation between age and the total number of teeth with apical periodontitis was statistically significant and positive, but of low strength ($p = 0.002$, $R = 0.287$), indicating that increasing age was associated with a higher number of teeth affected by apical periodontitis. In addition, the correlation between the total number of present teeth and the total number of teeth with apical periodontitis was statistically significant and negative, with moderate strength ($p < 0.001$, $R = -0.425$), showing that patients with a lower total number of present teeth were more frequently associated with a higher total number of teeth exhibiting apical periodontitis, and conversely.

The data from Table V and Figure 2 represent the distribution of the analyzed cases according to the presence of prior treatment and the level of education. The observed differences were statistically significant ($p = 0.028$). Z-tests with Bonferroni correction showed that patients with a high school / vocational training education were more frequently associated with absence of prior treatment (57.1% vs. 37.3%), whereas patients with a university education were more frequently associated with prior root canal treatment (60.8% vs. 36.4%).

Table V. Distribution of the analyzed cases according to the presence of prior treatment and education level

Prior treatment/ Education level	Absent		Root canal treatment		p*
	No.	%	No.	%	
Primary school	2	2.6%	0	0%	0.028
Secondary school	3	3.9%	1	2%	

DOI : 10.62610/RJOR.2026.2.18.20

High school/Vocational school	44	57.1%	19	37.3%	
University studies	28	36.4%	31	60.8%	

*Fisher's Exact Test

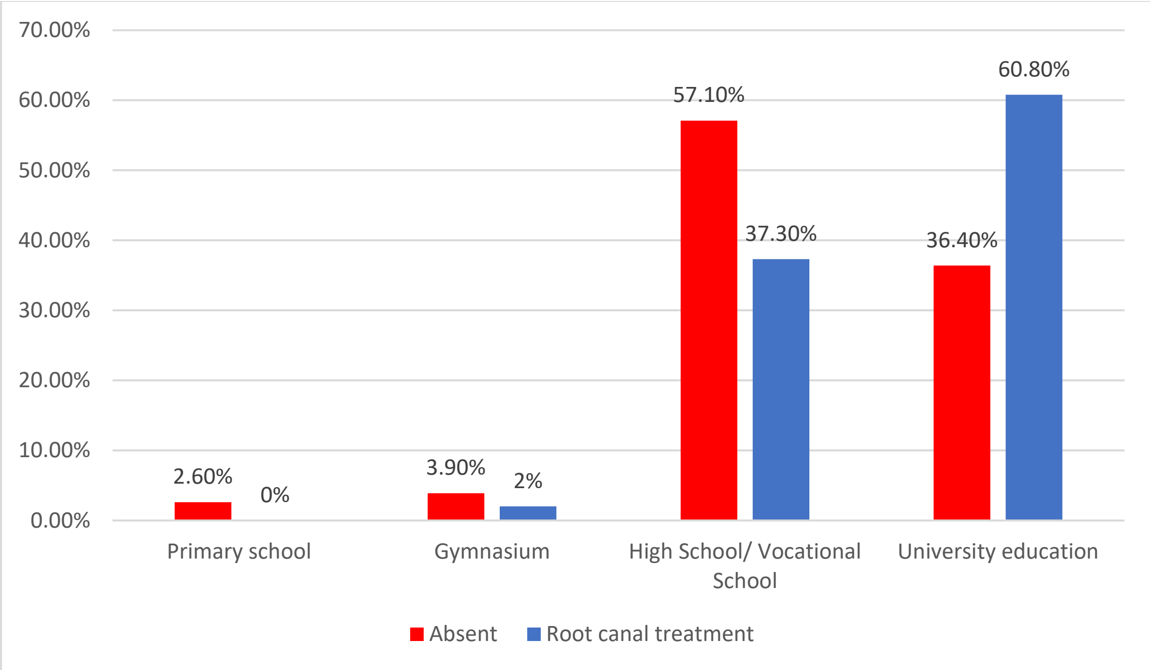

Figure 2. Distribution of the analyzed cases according to the presence of prior treatment and education level

The correlation between age and the initial PAI score was statistically significant and negative, with low strength ($p = 0.030$, $R = -0.192$). This suggests that higher age was more frequently associated with a lower initial PAI score.

The correlation between the duration of prior treatment and the initial PAI score was statistically significant and positive, with low strength ($p = 0.024$, $R = 0.199$). This indicates that a longer duration of prior treatment was more often associated with a higher initial PAI score.

After comparing the initial PAI score according to the 12-month outcome, statistically significant differences were found ($p < 0.001$). Post hoc Dunn–Bonferroni tests revealed that cases characterized by healing at 12 months had a significantly lower initial PAI score (median = 3, IQR = 2.25–3) than those associated with stabilization (median = 4, IQR = 3–4.25; $p = 0.006$) or remission (median = 4, IQR = 3–5; $p < 0.001$). Similarly, when comparing the initial PAI score by the 24-month outcome, the differences remained statistically significant ($p < 0.001$); specifically, the initial PAI score was significantly lower in cases showing healing at 24 months (median = 3, IQR = 3–4) compared with cases with increase/worsening (median = 4, IQR = 4–5; $p = 0.012$) or remission (median = 4, IQR = 3–5; $p = 0.007$).

When comparing the final PAI score by the 12-month outcome, the observed differences were statistically significant ($p < 0.001$). Post hoc Dunn–Bonferroni analyses indicated that cases associated with increase/worsening at 12 months had a significantly higher final PAI value (median = 5, IQR = 2.5–5) than cases

DOI : 10.62610/RJOR.2026.2.18.20

showing healing (median = 1, IQR = 1–1; p < 0.001), stabilization (median = 1, IQR = 1–1; p < 0.001), or remission (median = 1, IQR = 1–1.5; p = 0.001). Additionally, the final PAI score was significantly higher in cases associated with remission than in those with healing (p = 0.002). For the 24-month outcome, differences in the final PAI score were also statistically significant (p < 0.001); specifically, cases with healing at 24 months had a significantly lower final PAI value (median = 1, IQR = 1–1) compared with cases with increase/worsening (median = 5, IQR = 5–5; p < 0.001) or remission (median = 2, IQR = 2–3; p < 0.001).

The data from Table XXXI and Figure 29 represent the correlation between age and the difference in the evolution of the PAI score. The analyzed correlation was statistically significant and negative, with low strength (p = 0.028, R = −0.194). This indicates that in cases with higher age, a smaller value for the difference in the evolution of the PAI score was more frequently observed, and vice versa.

Table VI. Correlation between age and the difference in PAI score evolution

Correlation	p*
Age x DifPAI	0.028, R= -0.194

*Spearman's Rho Correlation Coefficient

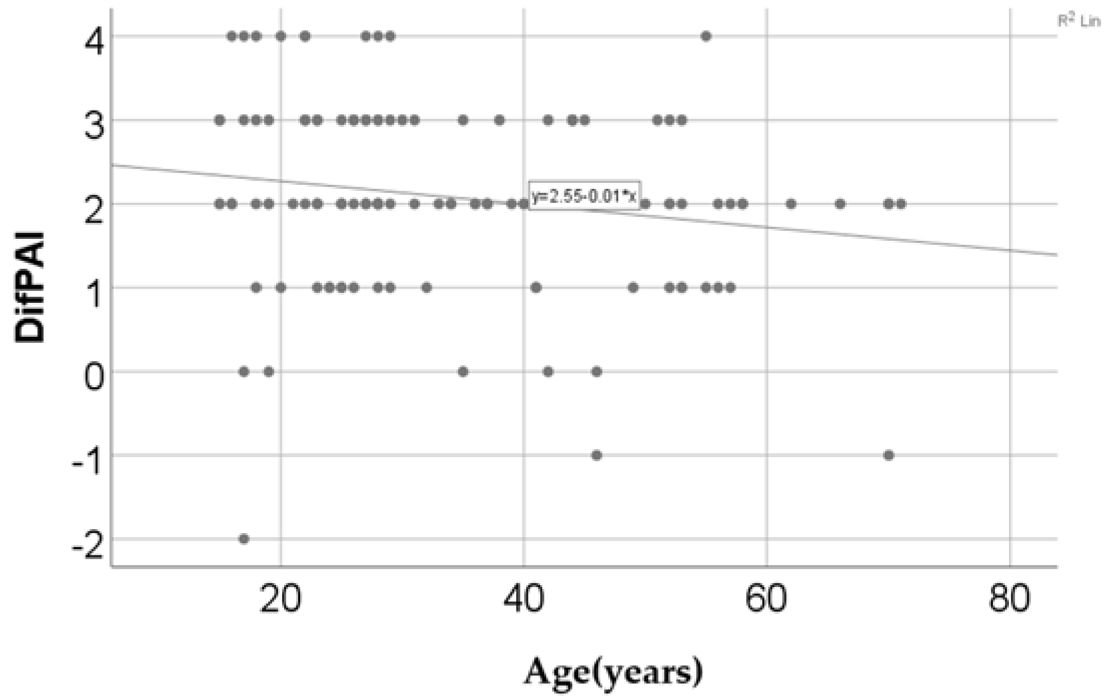

Figure 3. Correlation between age and the difference in PAI score evolution

DISCUSSIONS

A substantial proportion of patients (43.7%) reported self-medicating before seeking specialist care. While this practice may offer short-term relief from symptoms, it fails to treat the underlying cause of dental disease and can result in more serious complications over time, including delayed diagnosis and antimicrobial resistance. The decision to self-medicate is probably shaped by several factors, such as socioeconomic, cultural, and structural conditions, including limited oral health literacy, financial constraints, time pressure, easy access to over-the-counter drugs, direct-to-

DOI : 10.62610/RJOR.2026.2.18.20

consumer pharmaceutical advertising, and poor access to emergency dental services.

A statistically significant association between age and the presence of general comorbidities was observed in the study population (p = .001). Patients with at least one systemic comorbidity were considerably older, with a median age of 52.5 years (IQR: 40–60.75), compared to a median age of 29 years (IQR: 23–42.25) in those without any systemic condition. This difference of more than two decades is not surprising and aligns with the well-known epidemiological pattern showing that chronic disease burden increases progressively with age. Barnett et al. (2012) showed in a cross-sectional study that multimorbidity, defined as the coexistence of two or more chronic conditions, rises sharply with advancing age, becoming the rule rather than the exception beyond the fifth decade of life. [35] From a dental and endodontic standpoint, the clinical importance of this age-comorbidity link is considerable. Systemic conditions common in older patients can disrupt periapical tissue balance, weaken immune-mediated healing, and compromise endodontic outcomes [36,37].

In this study, the number of teeth affected by apical periodontitis was significantly higher in patients with gastrointestinal conditions than in those without, suggesting that systemic gastrointestinal pathology may represent a relevant risk factor for increased periapical disease burden. These results are in line with previous studies showing a bidirectional relationship between gastrointestinal disorders and oral health outcomes [38,39].
When comparing the number of teeth affected by apical periodontitis according to patients' environment of origin, those from urban areas had a higher median number of affected teeth than those from rural areas. This may seem counterintuitive at first, since urban populations are generally thought to benefit from better access to dental care and higher socioeconomic resources [40].

A statistically significant difference was found in the number of teeth with apical periodontitis according to smoking status, with smokers showing a notably higher median number of affected teeth compared to non-smokers. This result supports the well-established harmful effects of tobacco use on periapical tissue health and endodontic outcomes [41,42].

Although overall self-medication rates were similar between sexes, the pattern and type of medication used differed. The most notable finding was the complete absence of anti-inflammatory-only self-medication in men, while women displayed a more varied self-medication profile. This may reflect documented sex-based differences in pain perception, with women tending to report higher pain sensitivity and using more diverse analgesic strategies [43]. When men did self-medicate, they often used both antibiotics and anti-inflammatories, possibly reflecting later presentation with more severe symptoms, consistent with evidence that men are less likely to seek timely healthcare and therefore present at more advanced stages of illness [44,45]. The use of combined antibiotic and anti-inflammatory medication in this context raises concerns about unsupervised antimicrobial use, given the known link between inappropriate antibiotic consumption and antimicrobial resistance [46]. These findings emphasize sex-based behavioral differences in pain management during dental emergencies and underline the need for targeted education about the risks of unsupervised medication use in acute dental conditions.

The statistically significant association between education level and prior treatment history suggests two distinct pathways leading to acute apical periodontitis (AAP). In patients with lower educational attainment, AAP seems to arise mainly from dental neglect and insufficient prior care, reflecting structural barriers to oral health access. These results are consistent with Steinvik et al. (2025), who found that lower educational attainment was linked to poorer outcomes across all oral health measures, including higher caries experience, generalized gingivitis, and worse self-reported oral health in a population-based sample of young adults [47]. In contrast, among patients with higher education, AAP appears more often associated with root canal treatment failure, suggesting that while education may promote health-seeking behavior and improve access to care, it does not eliminate the risk of biological or procedural complications. This aligns with the established understanding that post-

DOI : 10.62610/RJOR.2026.2.18.20

treatment apical periodontitis is mainly driven by persistent intraradicular infection, extraradicular biofilms, and procedural issues such as inadequate debridement, insufficient obturation, and compromised coronal seal integrity, all of which act independently of socioeconomic or educational background [48,49]. Overall, these findings highlight education as a key social determinant of oral health and point to the need for targeted public health measures—programs that improve access and awareness among lower-educated individuals, and those that optimize endodontic protocols and ensure appropriate follow-up for previously treated teeth across all groups.

Correlation analysis revealed three significant associations among age, total teeth present, and apical periodontitis burden. Older patients tended to have fewer teeth, consistent with cumulative tooth loss over a lifetime of dental disease [50,51]. Age was also positively associated with a greater number of teeth affected by apical periodontitis, reflecting disease accumulation and delayed treatment-seeking [52]. Furthermore, patients with fewer total teeth had a greater periapical disease burden, suggesting that tooth loss and apical periodontitis often occur together, likely sharing a background of neglected oral health or limited access to care.

In this study, maxillary teeth were most frequently affected (50.8%), consistent with other reports [54,54]. The most affected tooth was the mandibular first molar (M1 mand), in agreement with previous research [55,56,57]. The relatively high frequency of apical periodontitis in M1 may be explained by its early eruption and increased exposure to carious processes, also influenced by its distinctive morphology [58,59].

Here, apical periodontitis was more often found in teeth without endodontic treatment (60.2%), contrary to other studies reporting higher prevalence in treated teeth. The high proportion of untreated teeth with apical periodontitis likely reflects delayed treatment-seeking, prolonged self-medication, and limited access to timely care, allowing infections to progress unchecked to periapical tissues. This contrasts with studies in general or recall populations, where previously treated teeth are more common and post-treatment apical periodontitis is therefore more prevalent [60,61].

The negative correlation between age and initial PAI score in this study contrasts with Roma et al. (2022), who found in an experimental rat model that apical periodontitis lesions were significantly larger in older animals than in younger ones. This suggests that bone and immune changes linked to aging, including impaired neutrophil and macrophage function, increased proinflammatory cytokines, and reduced bone repair capacity, may act as disease modifiers that accelerate periapical destruction, possibly explaining why older patients here accumulated greater apical burden over time [62].
The results show a consistent and statistically significant relationship between the initial PAI score and endodontic treatment outcomes at both 12 and 24 months, indicating that the severity of periapical disease at treatment initiation strongly predicts healing prognosis.

The initial PAI score was a significant predictor of outcomes at both 12 and 24 months ($p < 0.001$), with completely healed cases showing lower baseline scores than those with stabilization, remission, or worsening. This is biologically plausible, as larger and more chronic lesions contain more complex bacterial biofilms and a well-established inflammatory environment that may persist despite proper treatment [63,64]. Analysis of final PAI scores confirmed these results: healed cases had the lowest final PAI values (median = 1) at both follow-ups, while worsening cases reached the highest (median = 5), and remission cases were intermediate, showing partial resolution. These findings are consistent with Ng et al. (2008), who identified preoperative periapical status as one of the strongest predictors of endodontic success, and with L.-L. Kirkevang et al., who found that higher preoperative PAI scores were independently linked to reduced healing probability [65,66]. Together, these results stress the importance of early diagnosis and timely intervention before lesions advance, as well as the usefulness of serial PAI assessment as an objective tool for guiding clinical decisions during follow-up.

The statistically significant negative correlation between age and PAI score change suggests that

DOI : 10.62610/RJOR.2026.2.18.20

older patients tend to show less radiographic improvement over time compared to younger ones, as seen in a study by X Wang et al., where lower healing rates were observed in elderly patients (58.%) compared to younger individuals (87.1%) [67]. Although the correlation strength was low, its clinical relevance remains important.
This is biologically plausible, since aging is associated with a gradual decline in immune function that may impair the ability to resolve periapical inflammation and regenerate alveolar bone after endodontic treatment [68].

No significant differences in periapical healing were observed between teeth treated in one, two, or three visits, a result also confirmed by other studies [69,70,71]. On the other hand, in a systematic review and meta-analysis by C Sathorn and co., there appeared to be a difference between single and multiple visits, with single-visit teeth showing a 6.3% higher healing rate, though the difference was not statistically significant [72].
After 2 years of follow-up, healing was observed in 89.9% of endodontically treated teeth. Even though the teeth that had periapical healing were functional throughout our follow-up, the evolution may be uncertain and should be followed over a longer period of time.

Limitations
This study has several limitations. First, its retrospective observational design may introduce selection bias and limit control over confounding variables that could affect endodontic healing (e.g., oral hygiene, occlusal factors, trauma, and patient adherence). Second, the study was conducted in a single center, which may restrict the generalizability of the findings to other populations and clinical contexts. Third, radiographic outcomes were assessed using the Periapical Index (PAI), a semi-quantitative method that can be influenced by measurement variability and does not fully capture the timing of clinical symptom resolution. Furthermore, although follow-up was performed at 12 and 24 months, excluding patients without complete follow-up may have introduced attrition bias. Finally, potential treatment and tooth-related heterogeneity (complexity, root anatomy, and procedural variations) and the lack of adjustment for all biologic and behavioral factors may have influenced the observed associations between patient or dental characteristics and healing outcomes.

Conclusion
In conclusion, endodontic treatment of acute apical periodontitis resulted in high radiographic healing rates, especially at 24 months. The severity of the initial disease state, reflected by lower baseline PAI scores, was strongly linked to favorable outcomes and steady improvement over time, while persistent or worsening PAI indicated poor healing. Moreover, patient age negatively affected PAI evolution, suggesting a reduced healing response in older individuals. Finally, smoking and systemic comorbidities were associated with a greater number of teeth affected at baseline, emphasizing the importance of considering both patient-related and disease-related factors when predicting treatment success.

References

1. Nair PN. Pathogenesis of apical periodontitis and the causes of endodontic failures. Crit Rev Oral Biol Med. 2004 Nov 1;15(6):348-81. doi: 10.1177/154411130401500604. PMID: 15574679.

2. Siqueira JF Jr, Rôças IN. Present status and future directions: Microbiology of endodontic infections. Int Endod J. 2022 May;55 Suppl 3:512-530. doi: 10.1111/iej.13677. Epub 2022 Jan 13. PMID: 34958494.
3. Ricucci D, Siqueira JF Jr. Fate of the tissue in lateral canals and apical ramifications in response to pathologic conditions and treatment procedures. J Endod. 2010 Jan;36(1):1-15. doi: 10.1016/j.joen.2009.09.038. PMID: 20003929.
4. Sidaravicius, B., Aleksejuniene, J. and Eriksen, H.M. (1999), Endodontic treatment and prevalence of apical periodontitis in an adult population of Vilnius, Lithuania. Dental Traumatology, 15: 210-215. https://doi.org/10.1111/j.1600-9657.1999.tb00776.x

DOI : 10.62610/RJOR.2026.2.18.20

5. Tibúrcio Machado, Camilla & Michelon, C & Zanatta, Fabricio & Gomes, Maximiliano & Marin, J & Bier, Carlos. (2020). The global prevalence of apical periodontitis: a systematic review and meta-analysis. International Endodontic Journal. 54. 10.1111/IEJ.13467.
6. Alhomrany R, Jally FA, Al-Jari A, Al-Zamanan M, Al-Laajam N, Almakrami A. Current prevalence and risk factors of apical periodontitis in healthy Saudi adults attending dental school at Najran University: a cross-sectional study using cone beam computed tomography. Saudi Dent J. 2025 Oct 15;37(7-9):56. doi: 10.1007/s44445-025-00060-9. PMID: 41091335; PMCID: PMC12528622.
7. Madhavi A, Sujatha MM, Mazhar M, Pabba K, Lavanya G, Gupta A. Evaluating the Influence of Acute and Chronic Orofacial Pains on the Overall Comprehensive Quality of Life. Cureus. 2024 Jul 1;16(7):e63625. doi: 10.7759/cureus.63625. PMID: 39092385; PMCID: PMC11292984.
8. Fu D, Shu X, Zhou G, Ji M, Liao G, Zou L. Connection between oral health and chronic diseases. MedComm (2020). 2025 Jan 14;6(1):e70052. doi: 10.1002/mco2.70052. PMID: 39811802; PMCID: PMC11731113.
9. American Association of Endodontists. AAE Consensus Conference Recommended Diagnostic Terminology. J Endod. 2009;35(12):1634.
10. Nair PNR. Pathogenesis of apical periodontitis and the causes of endodontic failures. Crit Rev Oral Biol Med. 2004;15(6):348-381.
11. Cohen S, Hargreaves KM, Berman LH. Cohen's Pathways of the Pulp. 11th ed. St. Louis, MO: Mosby Elsevier; 2016.
12. Blake A, Tuttle T, McKinney R. Apical Periodontitis. [Updated 2023 Jul 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK589656
13. Sedani S, Kriplani S, Thakare A, Patel A. The Hidden World Within: Microbial Dynamics in Root Canal Systems. Cureus. 2024 May 18;16(5):e60577. doi: 10.7759/cureus.60577. PMID: 38894761; PMCID: PMC11184535.
14. Ørstavik, Dag. (2019). Apical Periodontitis: Microbial Infection and Host Responses. 10.1002/9781119272014.ch1.
15. Blake A, Tuttle T, McKinney R. Apical Periodontitis. [Updated 2023 Jul 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan-. Available from: https://www.ncbi.nlm.nih.gov/sites/books/NBK589656/
16. American Association of Endodontists. AAE Consensus Conference Recommended Diagnostic Terminology. J Endod. 2009;35(12):1634.
17. Patel S, Durack C, Abella F, Shemesh H, Roig M, Lemberg K. European Society of Endodontology position statement: the use of CBCT in endodontics. Int Endod J. 2014;47(6):502-504.
18. Ørstavik, Dag et al. "The periapical index: a scoring system for radiographic assessment of apical periodontitis." *Endodontics & dental traumatology* 2 1 (1986): 20-34 .
19. European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. Int Endod J. 2006;39(12):921-930.
20. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - part 2. Influence of clinical factors. Int Endod J. 2008;41(1):6-31
21. Haapasalo, Markus & Endal, Unni & Zandi, Homan & Coil, Jeffrey. (2005). Eradication of endodontic infection by instrumentation and irrigant solutions. Endodontic Topics. 10. 77 - 102. 10.1111/j.1601-1546.2005.00135.x.
22. Mehta D, Coleman A, Lessani M. Success and failure of endodontic treatment: predictability, complications, challenges and maintenance. Br Dent J. 2025 Apr;238(7):527-535. doi: 10.1038/s41415-025-8453-5. Epub 2025 Apr 11. PMID: 40217035; PMCID: PMC11991907.
23. Duncan HF, Nagendrababu V, El-Karim IA, Dummer PMH. Outcome measures to assess the effectiveness of endodontic treatment for pulpitis and apical periodontitis for use in the development of European Society of Endodontology (ESE) S3 level clinical practice guidelines: a protocol. Int Endod J. 2021 May;54(5):646-654. doi: 10.1111/iej.13501. Epub 2021 Mar 15. PMID: 33630330.

DOI : 10.62610/RJOR.2026.2.18.20

24. Barakat, R.; Almohareb, R.; Alsawah, G.; Busuhail, H.; Alshihri, S.A.; Alrashid, G.T.; Alotaibi, G.Y.; Hebbal, M. Factors Influencing the Long-Term Survival and Success of Endodontically Treated and Retreated Teeth: An Ambispective Study at an Educational Hospital. *J. Clin. Med.* 2025, *14*, 7826. https://doi.org/10.3390/jcm14217826
25. Artaza, L., Campello, A. F., Soimu, G., Alves, F. R., Rôças, I. N., & Siqueira, J. F. (2024). Outcome of Nonsurgical Root Canal Treatment of Teeth With Large Apical Periodontitis Lesions: A Retrospective Study. *Journal of Endodontics*, *50*(10), 1403-1411. https://doi.org/10.1016/j.joen.2024.08.003
26. Martins, I.S., de Vasconcelos, N.P., Afonso, A.S. *et al.* The role of smoking as a risk indicator for apical periodontitis and endodontic status: a cross-sectional study of a portuguese adult sample. *Odontology* (2026). https://doi.org/10.1007/s10266-026-01330-6
27. Liu, Xinyue & He, Guiying & Qiu, Zhengjie & Chen, Feng & Wang, Jiapeng & Huang, Zheng & Zhang, Pengtao & Zhang, Jian & Zhong, Liangjun & Ding, Cheng & Chen, Xing. (2023). Diabetes Mellitus Increases the Risk of Apical Periodontitis in Endodontically-Treated Teeth: A Meta-Analysis from 15 Studies. Journal of Endodontics. 49. 10.1016/j.joen.2023.07.016.
28. Luo H, Wu Q, Bell RA, Wright W, Quandt SA, Basu R, Moss ME. Rural-Urban Differences in Dental Service Utilization and Dental Service Procedures Received Among US Adults: Results From the 2016 Medical Expenditure Panel Survey. J Rural Health. 2021 Jun;37(3):655-666. doi: 10.1111/jrh.12500. Epub 2020 Jul 22. PMID: 32697007; PMCID: PMC7855605.
29. Daniel, R.S., Udgiri, R., Karadi, R. *et al.* Assessment of oral health practices and their impact on oral health status and quality of life: a cross-sectional study in rural North Karnataka. *Discov Public Health* 22, 455 (2025). https://doi.org/10.1186/s12982-025-00797-y
30. Katebi K, Eslami H, Jabbari S. Prevalence and causes of self-medication for oral health problems: a systematic review and meta-analysis. BMC Oral Health. 2024 Sep 19;24(1):1115. doi: 10.1186/s12903-024-04900-8. PMID: 39300478; PMCID: PMC11414189.
31. Singaraju JK, Natarajan K, Darsi A, Mandava SS, Singaraju GS, Singaraju KB. Knowledge, Practice, and Awareness of Self-Medication among Dental Outpatients: A Cross-Sectional Institutional Study. J Pharm Bioallied Sci. 2025 Dec;17(Suppl 4):S2885-S2890. doi: 10.4103/jpbs.jpbs_1147_25. Epub 2025 Dec 17. PMID: 41522983; PMCID: PMC12788419.
32. Noorul Aneesa.N, Arvina Rajasekar, Dhanraj Ganapathy. (2021). Impact of Socioeconomic Status on Periodontal Health. *Annals of the Romanian Society for Cell Biology*, 15582–15591. Retrieved from http://www.annalsofrscb.ro/index.php/journal/article/view/5189
33. Frisk, Fredrik & Hakeberg, Magnus. (2009). Socio-economic risk indicators for apical periodontitis. Acta Odontologica Scandinavica. 64. 123-128. 10.1080/00016350500469680.
34. Buligon MP, Marin JA, Wolle CFB, Liedke GS, Sfreddo CS, Bier CAS, Moreira CHC, Morgental RD. Apical periodontitis and associated factors in a rural population of southern Brazil: a multilevel analysis. Clin Oral Investig. 2023 Jun;27(6):2887-2897. doi: 10.1007/s00784-023-04886-7. Epub 2023 Feb 6. PMID: 36746818.
35. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012 Jul 7;380(9836):37-43. doi: 10.1016/S0140-6736(12)60240-2. Epub 2012 May 10. PMID: 22579043.
36. Segura-Egea JJ, Castellanos-Cosano L, Machuca G, et al. Diabetes mellitus, periapical inflammation and endodontic treatment outcome. *Med Oral Patol Oral Cir Bucal.* 2016;21(4):e387–e393.
37. Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of non-surgical root canal treatment. *Int Endod J.* 2011;44(7):583–609.
38. La Rosa GRM, Lorenzo-Pouso AI, Caponio VCA and Puci MV (2025) Apical periodontitis in inflammatory bowel disease: a meta-analysis at patient and tooth level. Front. Dent. Med 6:1553914. doi: 10.3389/fdmed.2025.1553914
39. Halboub E, Al-Maswary A, Mashyakhy M, Al-Qadhi G, Al-Maweri SA, Ba-Hattab R, Abdulrab S. The Potential Association Between Inflammatory Bowel Diseases and Apical Periodontitis: A Systematic Review and Meta-Analysis. Eur Endod J. 2024 Jan 1;9(1):8-17. doi: 10.14744/eej.2023.74507. Epub 2023 Nov 16. PMID: 37968968; PMCID: PMC10777093.

DOI : 10.62610/RJOR.2026.2.18.20

40. Luo H, Wu Q, Bell RA, Wright W, Quandt SA, Basu R, Moss ME. Rural-Urban Differences in Dental Service Utilization and Dental Service Procedures Received Among US Adults: Results From the 2016 Medical Expenditure Panel Survey. J Rural Health. 2021 Jun;37(3):655-666. doi: 10.1111/jrh.12500. Epub 2020 Jul 22. PMID: 32697007; PMCID: PMC7855605.
41. Ríos-Osorio N, Muñoz-Alvear HD, Jiménez-Castellanos FA, Quijano-Guauque S, Jiménez-Peña O, García-Perdomo HA, Caviedes-Bucheli J. Association between cigarette smoking and the prevalence of post-endodontic periapical pathology: a systematic review and meta-analysis. Restor Dent Endod. 2022 Jun 13;47(3):e27. doi: 10.5395/rde.2022.47.e27. PMID: 36090507; PMCID: PMC9436652.
42. Martins, I.S., de Vasconcelos, N.P., Afonso, A.S. *et al.* The role of smoking as a risk indicator for apical periodontitis and endodontic status: a cross-sectional study of a portuguese adult sample. *Odontology* (2026). https://doi.org/10.1007/s10266-026-01330-6
43. Delgado-Pérez VJ, Patiño-Marín N, Rueda-Ibarra V, Márquez-Rodríguez S, Casanova-Rosado AJ, Casanova-Rosado JF, Acuña-González GR, López-Gómez SA, Medina-Solís CE, Maupomé G. Epidemiological and Oral Public Health Aspects of Dental Pain: A Narrative Review. Cureus. 2024 Dec 1;16(12):e74908. doi: 10.7759/cureus.74908. PMID: 39742195; PMCID: PMC11687405.
44. Lipsky MS, Su S, Crespo CJ, Hung M. Men and Oral Health: A Review of Sex and Gender Differences. Am J Mens Health. 2021 May-Jun;15(3):15579883211016361. doi: 10.1177/15579883211016361. PMID: 33993787; PMCID: PMC8127762.
45. Galdas PM, Cheater F, Marshall P. Men and health help-seeking behaviour: literature review. J Adv Nurs. 2005 Mar;49(6):616-23. doi: 10.1111/j.1365-2648.2004.03331.x. PMID: 15737222.
46. Berlt, Maiara & Souza, Karoline & Zhang, Linjie & Bock, Patrícia & Hort, Mariana. (2025). Prevalence of self-medication for dental issues in the general population: a systematic review and meta-analysis. Discover Public Health. 22. 10.1186/s12982-025-00566-x.
47. Steinvik LM, Holde GE, Stein LM. Oral Health in Young Adults: The Impact of Socioeconomic Factors and Health Literacy. Int J Environ Res Public Health. 2025 Sep 9;22(9):1407. doi: 10.3390/ijerph22091407. PMID: 41007551; PMCID: PMC12469395.
48. Di Filippo G, Sidhu SK, Chong BS. Apical periodontitis and the technical quality of root canal treatment in an adult sub-population in London. Br Dent J. 2014 May;216(10):E22. doi: 10.1038/sj.bdj.2014.404. PMID: 24853011.
49. Ricucci D, Campello AF, Milovidova I, Rôças IN, Siqueira JF Jr. Post-treatment Apical Periodontitis: Histobacteriologic and Histopathologic Findings. J Endod. 2026 Jun;52(6):940-952. doi: 10.1016/j.joen.2026.03.007. Epub 2026 Mar 20. PMID: 41865833.
50. Abdurrahman, F., Kusama, T., Tamada, Y. *et al.* Tooth loss, dental prosthesis use, and cause-specific mortality in older Japanese adults: a 7-year cohort study. *Sci Rep* 15, 40650 (2025). https://doi.org/10.1038/s41598-025-24357-1
51. Bolukbasi, G.; Dundar, N. Oral health in older adults: current insights and tips. *J. Gerontol. Geriatr.* 2024, *72*, 96-107. https://doi.org/10.36150/2499-6564-N700
52. Vengerfeldt V, Mändar R, Nguyen MS, Saukas S, Saag M. Apical periodontitis in southern Estonian population: prevalence and associations with quality of root canal fillings and coronal restorations. BMC Oral Health. 2017 Dec 12;17(1):147. doi: 10.1186/s12903-017-0429-7. PMID: 29233146; PMCID: PMC5727925.
53. Kirkevang LL, Vaeth M, Wenzel A. Tooth-specific risk indicators for apical periodontitis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004 Jun;97(6):739-44. doi: 10.1016/S1079210403005213. PMID: 15184857.
54. Mashyakhy M, Alkahtany M. Prevalence of apical periodontitis between root canal-treated and non-treated teeth and between genders: A cross-sectional CBCT study. Niger J Clin Pract. 2021 Nov;24(11):1656-1661. doi: 10.4103/njcp.njcp_627_20. PMID: 34782505.
55. Mashyakhy M, Alkahtany M. Prevalence of apical periodontitis between root canal-treated and non-treated teeth and between genders: A cross-sectional CBCT study. Niger J Clin Pract 2021;24:1656-61.
56. Meirinhos J, Martins JNR, Pereira B, Baruwa A, Gouveia J, Quaresma SA, Monroe A, Ginjeira A. Prevalence of apical periodontitis and its association with previous root canal treatment, root canal

DOI : 10.62610/RJOR.2026.2.18.20

filling length and type of coronal restoration - a cross-sectional study. Int Endod J. 2020 Apr;53(4):573-584. doi: 10.1111/iej.13256. Epub 2019 Dec 15. Erratum in: Int Endod J. 2020 Apr;53(4):585. PMID: 31749154.

57. Khaly Bane, Diouma Ndiaye, Anta Seck, Wendpoulomdé Aimé Désiré Kaboré, Fatou Leye Benoist, Babacar Touré. Apical periodontitis epidemiology: A population-based survey of students in Dakar, Senegal. Turk Endod J. 2019; 4(2): 23-26
58. Yamunadevi A, Pratibha R, Rajmohan M, Mahendraperumal S, Ganapathy N, Srivandhana R. First Molars in Permanent Dentition and their Malformations in Various Pathologies: A Review. J Pharm Bioallied Sci. 2021 Jun;13(Suppl 1):S23-S30. doi: 10.4103/jpbs.JPBS_744_20. Epub 2021 Jun 5. PMID: 34447037; PMCID: PMC8375929.
59. Que, L., Jia, M., You, Z. *et al. Prevalence of dental caries in the first permanent molar and associated risk factors among sixth-grade students in São Tomé Island. BMC Oral Health 21, 483 (2021). https://doi.org/10.1186/s12903-021-01846-z*
60. Tibúrcio-Machado CS, Michelon C, Zanatta FB, Gomes MS, Marin JA, Bier CA. The global prevalence of apical periodontitis: a systematic review and meta-analysis. Int Endod J. 2021 May;54(5):712-735. doi: 10.1111/iej.13467. Epub 2021 Jan 22. PMID: 33378579.
61. Mashyakhy M, Alkahtany M. Prevalence of apical periodontitis between root canal-treated and non-treated teeth and between genders: A cross-sectional CBCT study. Niger J Clin Pract 2021;24:1656-61
62. Roma, Luiza & Andrade, Rosana & Brasil, Sabrina & Moreno, Adalgiza & Orsini, Marco & Ferreira, Dennis & Almeida, Bernardo & Santos, Rachel & Armada, Luciana. (2022). Effects of aging on the evolution of Apical Periodontitis lesions in rats. Research, Society and Development. 11. e424111335505. 10.33448/rsd-v11i13.35505.
63. Siqueira Jr, J. F., & Rôças, I. N. (2009). Distinctive features of the microbiota associated with different forms of apical periodontitis. *Journal of Oral Microbiology*, *1*(1). https://doi.org/10.3402/jom.v1i0.2009
64. Ricucci D, Campello AF, Milovidova I, Rôças IN, Siqueira JF Jr. Post-treatment Apical Periodontitis: Histobacteriologic and Histopathologic Findings. J Endod. 2026 Jun;52(6):940-952. doi: 10.1016/j.joen.2026.03.007. Epub 2026 Mar 20. PMID: 41865833.
65. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - part 1. Effects of study characteristics on probability of success. Int Endod J. 2007 Dec;40(12):921-39. doi: 10.1111/j.1365-2591.2007.01322.x. Epub 2007 Oct 10. PMID: 17931389.
66. Kirkevang, L.-L & Ørstavik, Dag & Wenzel, A. & Væth, M.. (2014). Prognostic value of the full-scale Periapical Index. International Endodontic Journal. 48. 10.1111/iej.12402.
67. Wang X, Wang J, Zhang G. [Analysis on curative effects of teeth with chronic apical periodontitis in elderly people]. Zhonghua Kou Qiang Yi Xue Za Zhi. 1999 Jan;34(1):16-8. Chinese. PMID: 11776526.
68. Yajia Xie , Shuang Chen , Lu Sheng , Yu Sun , Shangfeng Liu. A New Landscape of Human Dental Aging: Causes, Consequences, and Intervention Avenues. *Aging and disease*. 2023, 14(4): 1123-1144 https://doi.org/10.14336/AD.2022.1224
69. Weiger R, Rosendahl R, L€ost C. Influence of calcium hydroxide intracanal dressings on the prognosis of teeth with endodontically induced periapical lesions. Int Endod J 2000;33:219–26.
70. Trope M, Delano EO, €Orstavik D. Endodontic treatment of teeth with apical perio-dontitis: single vs. multivisit treatment. J Endod 1999;25:345–50.
71. Paredes-Vieyra J, Enriquez FJ. Success rate of single- versus two-visit root canal treatment of teeth with apical periodontitis: a randomized controlled trial. J Endod. 2012 Sep;38(9):1164-9. doi: 10.1016/j.joen.2012.05.021. Epub 2012 Jul 26. PMID: 22892729.
72. Sathorn C, Parashos P, Messer HH. Effectiveness of single- versus multiple-visit endodontic treatment of teeth with apical periodontitis: a systematic review and meta-analysis. Int Endod J. 2005 Jun;38(6):347-55. doi: 10.1111/j.1365-2591.2005.00955.x. PMID: 15910469.

DOI : 10.62610/RJOR.2026.2.18.20