Prevalence of periapical lesions in non-endodontically and endodontically treated in an urban Iraqi adult subpopulation: A retrospective CBCT analysis

Ahmed H. Ali, Anas F. Mahdi, Noor H. Fadhil and Duaa Shihab

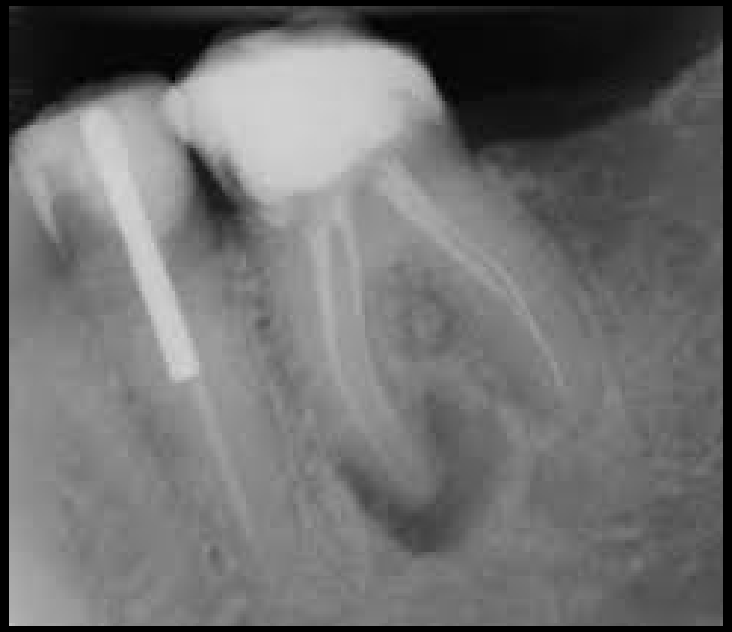
Department of Aesthetic and Restorative Dentistry, College of Dentistry, University of Baghdad, Baghdad, Iraq.

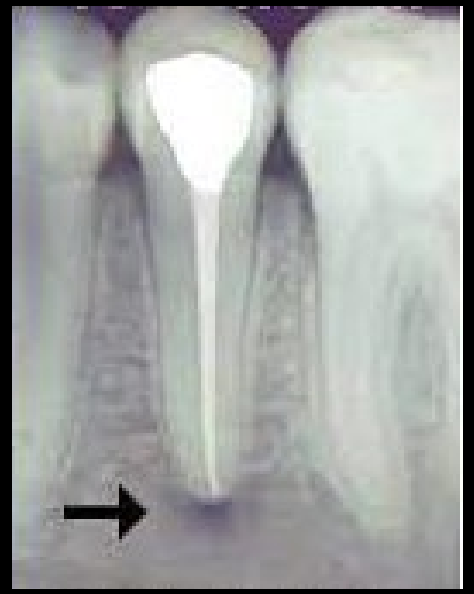
Structure of the presentation

- Introduction
- Aims of the study
- Materials and methods
- Results and discussion
- Conclusions

Objectives and outcome of root canal treatment

- A root canal filling must completely seal a root canal system otherwise we will have a proliferation and growth of bacteria inside the root canal system and infection of periapical area (apical periodontitis) (European Society of Endodontology, 2006).





Objectives and outcome of root canal treatment

- The favorable outcome of root canal treatment has been reported to be high, however, in reality, only 35%-60% of root canal-treated teeth demonstrate normal apical periodontal condition in radiographic cross-sectional studies.

INTERNATIONAL ENDODONTIC JOURNAL

**Prevalence of apical peri
association with previous
root canal filling length a
restoration – a cross-sect**

J. Meirinhos[1], J. N. R. Martins[1], B. Pereira
A. Monroe[2] & A. Ginjeira[1]

[1]Department of Endodontics, Faculdade de Medicina Dentária,
San Diego, CA, USA

Clinical Oral Investigations
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ORIGINAL ARTICLE

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Quality of root canal fillings and prevalence of apical radiolucencies in a German population: a CBCT analysis

Sebastian Bürklein[1] · Edgar Schäfer[1] · Hans-Peter Jöhren[2] · David Donnermeyer[3]

Received: 28 March 2019 / Accepted: 20 June 2019

Abstract

Objectives The aim of this study was to determine the frequency and quality of root canal fillings (RCF) and the prevalence of apical radiolucency (AR) in a German population.

Material and methods Five hundred randomly selected full-size CBCT images (Planmeca ProMax 3D, FOV = 8 × 8 cm, voxel size 160 µm or 200 µm) were obtained from German patients (40.6% = ♂; 59.4% = ♀; mean age = 50.21 ± 12.45 years). A total of 8254 teeth were examined for pathology (AR, widened periodontal ligament). The relationship between AR and existing RCF and the quality of RCF were documented. Frequency and correlations between the left and right sides and gender distribution were analyzed statistically using the chi-square test.

Results The overall prevalence of AR was 3.8%, whereas for teeth with RCF, it was 42.5%. Patients had approximately 1.4 root canal–filled teeth (8.2% of all teeth). RCF terminated more than 2 mm short of the radiological apex in 31.2%, 5.1% reached beyond the apex, 8.1% were associated with extruded sealer, and 5.3% presented untreated root canals. Odds ratio of having an AR was highest in teeth with RCF beyond the apex (OR = 27.0) followed by RCF <2 mm short of the apex (OR = 4.4), untreated root canals (OR = 2.9), and inhomogeneity of RCF (OR = 1.2). Extrusion of sealer was least associated with AR. Molars were most frequently associated with AR ($P < 0.05$). Root canal–filled teeth showed significantly more AR in men compared with women ($P < 0.05$).

Conclusions About 42.5% of root canal–filled teeth were associated with AR, and in about one-third of these teeth, the RCF terminated more than 2 mm short of the apex.

Clinical relevance Each step in root canal therapy influences treatment outcome and prevalence of periapical radiolucencies. Determination of the working length is still one of the key points to achieve predictable periapical healing, and homogenous root canal filling reaching the foramen major seems to be essential.

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and type of coronal
ortions was used to
h subgroups, and an

odds ratio was determined in order to analyse the association between treatment status and periapical lesions. A $P < 0.05$ was considered significant.

Results At a tooth level, the overall prevalence of periapical lesions in the sample was 10.4%. Maxillary teeth were associated with a significantly larger percentage of lesions (13.1%), whilst maxillary first

The prevalence of periapical lesions was significantly larger in root filled teeth (55.5%), short root canal fillings (72.7%) and in teeth restored with crowns (46.1%). At a root level, the mesiobuccal roots of

(46.1%). At a root level, the mesiobuccal roots of both maxillary first molars had a tendency for a larger percentage of periapical lesions.

Conclusion History of root canal treatment, root canal filling length and type of coronal restoration influenced the presence of periapical lesions. Molars were more commonly associated with periapical lesions on root filled teeth, particularly those with short root fillings and those with crowns.

Keywords: apical periodontitis, cone-beam computed tomography, cross section study, diagnostic imaging, endodontically treated teeth, outcome measure.

Received 4 July 2019; accepted 19 November 2019

Prevalence of AP over a decade!!

Meta-Analysis > J Endod. 2020 Oct;46(10):1371-1386.e8. doi: 10.1016/j.joen.2020.07.007.
Epub 2020 Jul 14.

Prevalence of Apical Periodontitis and Conventional Nonsurgical Root Canal Treatment in General Adult Population: An Updated Systematic Review and Meta-analysis of Cross-sectional Studies Published between 2012 and 2020

Conclusions: There is an increased AP prevalence in the adult general population compared with data from 2012 (6.3% versus 5.4%) in both endodontically treated (41.3% versus 35.9%) and untreated teeth (3.5% versus 2.1%). In addition, AP developed less frequently in female patients with endodontically treated teeth and in teeth with inadequate compared with adequate restorative and endodontic treatment.

- Many other epidemiological studies assessed the prevalence of AP within different populations across the globe, The data of these studies represent the actual outcome of root canal treatments in the overall population and many of them found a significant association between periradicular health/pathosis and the presence/quality of root canal filling (1,2).

1- Bürklein S, Schäfer E, Jöhren HP, Donnermeyer D. Quality of root canal fillings and prevalence of apical radiolucencies in a German population: a CBCT analysis. Clin Oral Investig. 2020;24:1217-27.

2- Van der Veken D, Curvers F, Fieuws S, Lambrechts P. Prevalence of apical periodontitis and root filled teeth in a Belgian subpopulation found on CBCT images. Int Endod J. 2017;50:317-29.

Why it is important to assess the prevalence of apical periodontitis?

- Assessing the prevalence of AP and risk factors in a population may help to predict the future need for the dental treatment of that population.
- Also to monitor the performance of the dental profession by re-assessing the situation in the future.

- There were links between the presence of AP and systemic low-grade inflammation and health impairment (1-2).

REVIEW ARTICLE

Apical Periodontitis Is Associated with Elevated Concentrations of Inflammatory Mediators in Peripheral Blood: A Systematic Review and Meta-analysis

Athina Christina Georgiou, DDS, Wim Crielaard, MSc, PhD,* Iakovos Armenis, MD, PhD,†‡ Ralph de Vries, MSc,§ and Suzette V. van der Waal, DDS, PhD*‖*

ABSTRACT

Introduction: Apical periodontitis (AP), except for the local known consequences, may also be a systemic burden. Circulating inflammatory mediators that are released to sustain the AP lesion can in theory harm other bodily tissues. The aim of this systematic review was to summarize the existing evidence on the influence of AP on the peripheral blood levels of inflammatory mediators and markers of systemic stress. **Methods:** A search of MEDLINE-PubMed, Embase, and Cochrane was conducted up to and including February 2019 to identify studies in 5 different languages. The Newcastle-Ottawa Scale was used for quality assessment of the included studies. **Results:** Twelve of the 20 included studies were case-control studies, and 8 were intervention studies. The data of all the included studies were analyzed descriptively, whereas the data of 11 studies were available for meta-analyses. The study designs were heterogeneous. Nevertheless, the meta-analyses revealed statistically significant differences in C-reactive protein, interleukin 6, and asymmetric dimethylarginine levels between AP subjects and controls in peripheral blood. In addition, the concentration of C3 complement fragment in peripheral blood was significantly lower after the treatment and resolution of AP than before. **Conclusions:** The existing literature indicates that AP adds on to systemic inflammation by elevating C-reactive protein, interleukin 6, asymmetric dimethylarginine, and C3 levels. In order to overcome the issue of large variation between study designs, future studies should have clear inclusion criteria, preferably larger cohorts, adequate follow-up of all subjects, and a thorough presentation of the data to enable further exploration of the possible burden of AP on general human health. Nevertheless, there is now stronger evidence that AP contributes to low-grade systemic inflammation. *(J Endod 2019;45:1279–1295.)*

1- Khalighinejad N, Aminoshariae MR, Aminoshariae A, Kulild JC, Mickel A, Fouad AF. Association between systemic diseases and apical periodontitis. J Endod.. 2016;42:1427-34.

2- Georgiou AC, Crielaard W, Armenis I, de Vries R, van der Waal SV. Apical periodontitis is associated with elevated concentrations of inflammatory mediators in peripheral blood: a systematic review and meta-analysis. J Endod. 2019;45:1279-95. e3.

- A previous report using CBCT in Suleimani population in Suleimani city found that AP was present in 50% of RCT teeth and about 2% in non-RCT teeth which consider to be low.

Original Article

Prevalence of Apical Periodontitis by Cone Beam Computed Tomography: A Cross Sectional Study

Mohammed T. Baban[1], Ranjdar M. Talabani[2], Mardin O. Rashid[3], Darwn S. Abdulateef[2], Sarhang S. Gul[4], , Bamo N. Abdulkareem[5], Rishwan O. Salih[6]*

Abstract

Objectives: This study aimed to assess the prevalence of apical periodontics (AP) from a sample of the Iraqi adult population using cone-beam computed tomography (CBCT) images.

Methods: Two hundred and fifty-one CBCT images (116 male and 135 female) were obtained, 6738 teeth were examined of these patients who attended for dental treatment from January 2017 to June 2018 in the B&R private dental clinic in Sulaimani, Kurdistan Region/Iraq. Apical periodontitis was divided according to tooth types (anatomical) in both upper and lower jaw, root canal treatment (RCT) and non-root canal treatment (Non-RCT), affected root by AP, and quality of RCT. Pearson's chi-square test was used to determine the level of significance ($p<0.05$).

Results: Apical periodontitis was found in 294 teeth from 6738 examined teeth; of these, 59.9% of AP incidence was linked to RCT. The percentage of periapical lesions was not significantly different between male and female patients. Among RCT teeth, maxillary teeth were most susceptible to AP (61.92%) than mandibular teeth (38.07%). The mesiobuccal root of upper first molar and mesial root of lower first molar were most commonly affected with AP (12.4%). The most-reported defects were underfilling, followed by a missed

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Aims of the study

This cross-sectional study aimed to assess the prevalence of AP in teeth of an adult Iraqi subpopulation and its association with the absence/presence of RCF, its radiographic quality, and coronal restoration adequacy using CBCT images.


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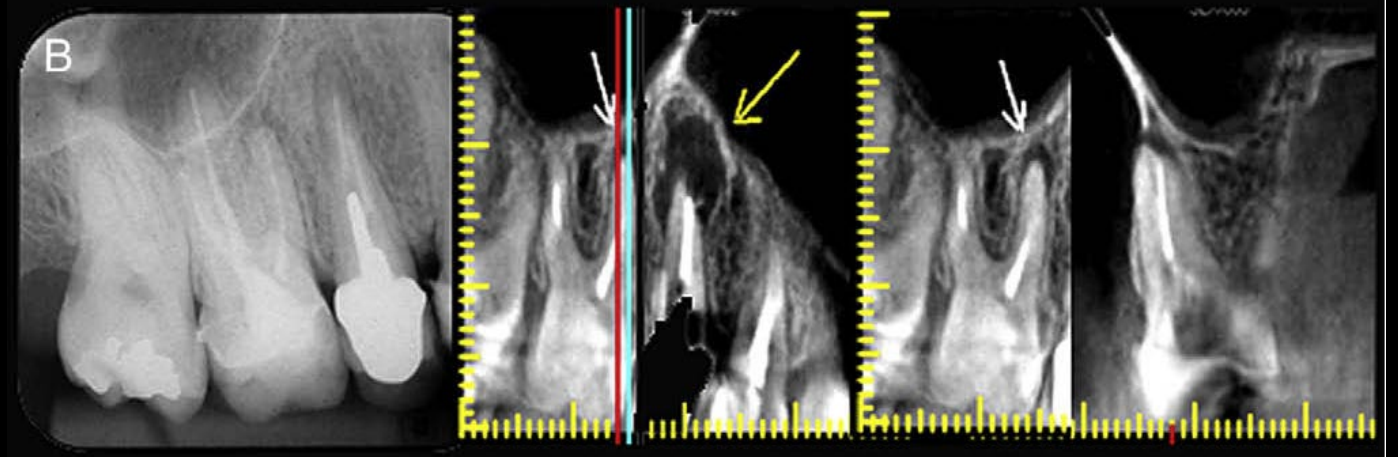
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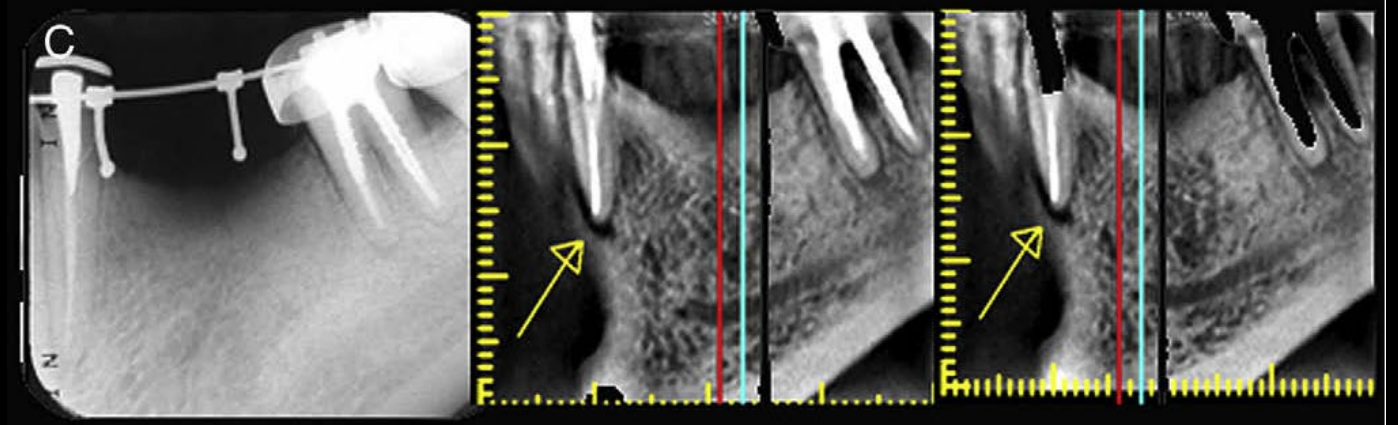
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Materials and Methods

Study design

A cross- sectional study

Materials and Methods

Sample size calculation

The sample size was calculated to be 385 based on error margin of 5% and the Iraqi population is about 40 million people.

Materials and Methods

CBCT scans

385 CBCT scans were gained from a pool of archived data from the dental radiographic departments of both governmental and private health institutions. They were for patients between 18-45 years old who had previously been referred from dental or maxillofacial clinics for reasons not related to this study, in the years from 2016 to 2021.

Technical settings and parameters were in the following range: FOV (8×9 to 16×17 mm2), voxel size (0.125 to 0.200 mm3), slice thickness (0.15 to 1 mm), exposure time (15 to 10.08 s), tube voltage (80 to 105 Kvp), and tube current (3.2 to 10 mA).

Materials and Methods

Exclusion and inclusion criteria

The assessment was performed at tooth level, all teeth were included in the assessment except for teeth undergone orthodontic treatments, retained roots, retained primary teeth, fractured root, pathologic lesions of non-dental origin, combined endo perio-lesions, impacted teeth and not fully erupted teeth.

The teeth were grouped according to the presence/absence of apical radiolucency, which was defined as any lateral or apical radiolucency (that exceeds double the width of the adjacent normal periodontal ligament) associated with the apical part of the root.

Evaluation criteria of RCT and coronal restoration

Classify the RCF into adequate or inadequate

Adequate: All canals obturated with a homogenous root filling material with no voids present and the RCF ending not more than 2 mm short from the radiographic apex.

Inadequate: RCFs that are shorter than the radiographic apex by more than 2 mm or the filling material (including sealer) extend/pushed irregularly beyond the radiographic apex. RCF with, voids, unfilled canals, separated instruments, perforations, and ledges.

In multirooted teeth, root with an apical radiolucency and inadequate RCF was considered within this group.

Evaluation criteria of coronal restoration

Classify the coronal restoration into adequate or inadequate

Adequate: include intact permanent restoration and crowns.

Inadequate: include lost restoration, overhang, recurrent caries, open margin, and a temporary restoration.

Materials and Methods

Statistical analysis

Chi-square to assess associations of different variables and the prevalence of AP. Kappa was used to assess intra-consensus reliability. Logistic regression was used to predict risk factors associated with AP. The significant level was set at $p<0.05$.

Results

Intra-consensus agreement

Cohen Kappa for intra-consensus reliability was (0.9) for AP and (0.82) for RCT and coronal restoration quality, respectively.

Results

Table 1: Prevalence of AP among subjects and teeth in the study.

Periapical Status	No. of subjects n (%) Total=385	No. of teeth n (%) Total =9250	No. of endodontically untreated teeth n (%) Total= 8911	No. of root canal treated teeth n (%) Total=339
With AP	309 (80.2%)	1854 (20%)	1582 (17.7)[a]	272 (80.2)[a]
No AP	76 (19.8%)	7396 (80%)	7329 (82.3)	67 (19.8)

AP = apical periodontitis, identical superscript small letters represent significant differences between relevant groups.

- The number of teeth with RCT was 339/9250 (4%) distributed over 73 subjects.
- Root canal-treated teeth in females were195 teeth and 144 teeth in males (57.5% vs 42.5%) ($p>0.05$).
- The presence of AP was significantly higher in teeth with RCF than in untreated teeth (80.2% vs 17.7%) ($p<0.05$)

Table 2: Prevalence of AP and missed canals in root canal treated teeth according to the tooth type.

Tooth type	No. of teeth with RCT	No. of teeth with RCT and AP	Prevalence of AP (%)	No. of teeth with missed canals n (%)
Upper central	35	27	77.1	-
Lower central	3	1	33.3	-
Upper lateral	18	11	61.1	-
Lower lateral	0	0	0.0	-
Upper canine	9	6	66.7	-
Lower canine	0	0	0.0	-
Upper first premolar	48	40	83.3	-
Lower first premolar	14	10	71.4	-
Upper second premolar	44	32	72.7	2 (4.5)
Lower second premolar	34	21	61.8	-
Upper first molar	42	40	95.2	23 (54.7)
Lower first molar	37	35	94.6	6 (16.2)
Upper second molar	27	23	85.2	8 (29.6)
Lower second molar	28	26	92.9	5 (17.8)
Total	339	272	80.2	44 (12.9)

RCT= root canal treatment, AP =apical periodontitis.

The prevalence of AP in root canal-treated teeth with missed canals (93.2%) was higher than that in the root canal-treated teeth with no missing canal (78.3%) ($p<0.05$).

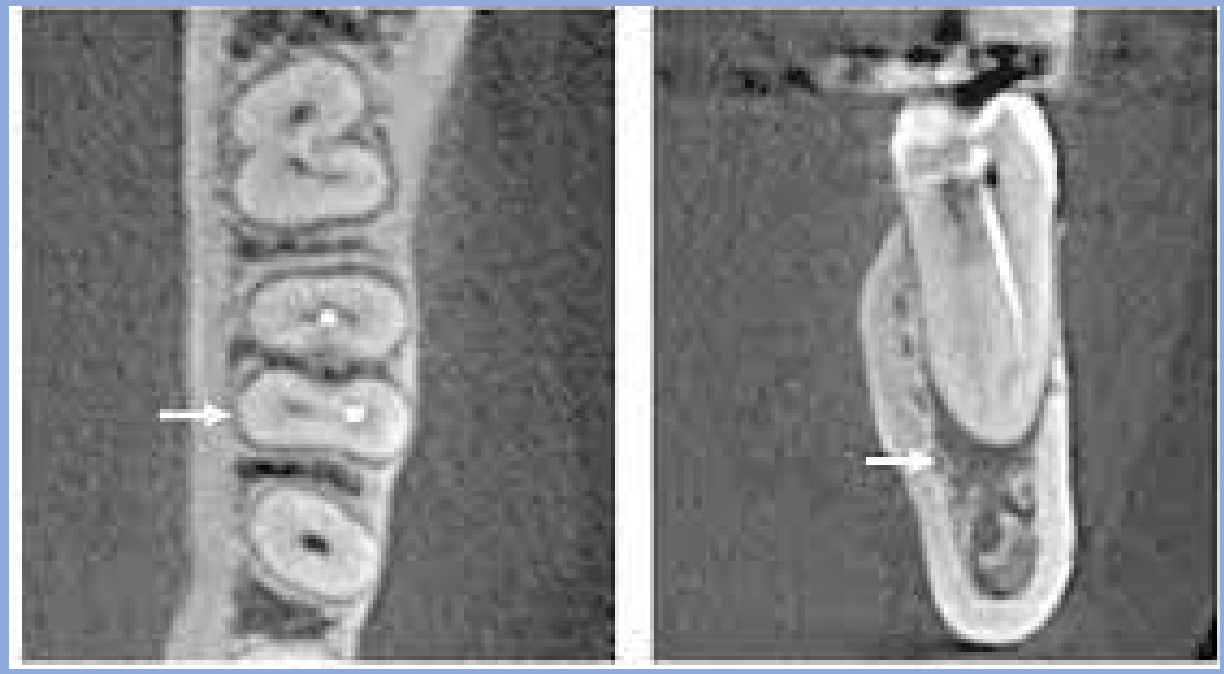

Table 3: Prevalence of AP in endodontically treated teeth according to the adequacy/inadequacy of RCF and coronal restoration.

Periapical Status in teeth with RCF	Adequate RCF n (%)	Inadequate RCF n (%)	Adequate Coronal Restoration n (%)	Inadequate Coronal restoration n (%)
With AP	58 (63%)[a]	214 (87%)[a]	205 (79.7%)	67 (81%)
No AP	34 (37%)[b]	33 (13%)[b]	52 (20.3%)	15 (19%)
Total	92 (100%)	247 (100%)	257 (100%)	82 (100%)

RCF =root canal filling, AP =apical periodontitis. Identical superscript small letters indicate a significant difference in the same row.

In teeth with inadequate RCF, there was a higher prevalence of AP vs teeth with adequate RCF ($P<0.05$), however, there was no significant difference in the prevalence of AP in teeth with adequate vs inadequate coronal restoration ($p>0.05$)

Table 4: Binary logistic regression of risk factors of AP presence.

Risk factor	Reference	Odd ratio	CI 95%	*p*-value
Inadequate RCT	Adequate RCT	4.16	2.29-7.56	<0.05
Inadequate coronal restoration	Adequate coronal restoration	0.71	0.35-1.42	>0.05

RCT root canal treatment, CI Confidence interval.

The presence of AP was significantly associated with inadequate RCT (vs adequate RCT) (OR=4.1, CI 95% 2.29-7.56, P<0.05). On the other hand, the presence of AP was not associated with inadequate coronal restoration (vs adequate coronal restoration) (OR=-0.71, CI 95% 0.35-1.42, P>0.05)

The prevalence of AP at the subject and tooth levels were higher in this study in comparison to the previous report (52% and 5%, respectively) (16). Many epidemiological studies reported a lower prevalence of AP compared to the results of this study (4, 5, 15, 17), however, these reports utilized dental panoramic and dental periapical radiographs compared to this study which used CBCT.

4. Gulsahi K, Gulsahi A, Ungor M, Genc Y. Frequency of root-filled teeth and prevalence of apical periodontitis in an adult Turkish population. Int Endod J. 2008;41:78-85.
5. Covello F, Franco V, Schiavetti R, Clementini M, Mannocci A, Ottria L, et al. Prevalence of apical periodontitis and quality of endodontic treatment in an Italian adult population. Oral Implantol. 2010;3:9.
15. Di Filippo G, Sidhu S, Chong B. Apical periodontitis and the technical quality of root canal treatment in an adult sub-population in London. Br Dent J. 2014;216:E22-E.
16. 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;54:712-35.
17. Huumonen S, Suominen AL, Vehkalahti MM. Prevalence of apical periodontitis in root filled teeth: findings from a nationwide survey in Finland. Int Endod J. 2017;50:229-36.

On the subject level, the results of this study are comparable to the results of other CBCT studies that assessed the prevalence of AP. The AP prevalence among subjects was 78% in a study by Lemagner et al. (2015) (19). Kabak and Abbott reported an 80% prevalence of AP on the subject level in a Belarusian population (14) in comparison to 80.2% for the current results.

14. Kabak Y, Abbott PV. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. Int Endod J. 2005;38:238-45.

19. Lemagner F, Maret D, Peters OA, Arias A, Coudrais E, Georgelin-Gurgel M. Prevalence of Apical Bone Defects and Evaluation of Associated Factors Detected with Cone-beam Computed Tomographic Images. J Endod. 2015;41:1043-7.

At the tooth level, the overall prevalence of AP in all teeth in this study was 20% compared to 6.3%, 3.8%, and 10.4% in other studies (2, 6, 20) respectively.

2. Meirinhos J, Martins J, Pereira B, Baruwa A, Gouveia J, Quaresma S, et al. Prevalence of apical periodontitis and its association with previous root canal treatment, root canal filling length and type of coronal restoration–a cross-sectional study. Int Endod J. 2020;53:573-84.

6. Bürklein S, Schäfer E, Jöhren HP, Donnermeyer D. Quality of root canal fillings and prevalence of apical radiolucencies in a German population: a CBCT analysis. Clin Oral Investig. 2020;24:1217-27.

20. Jakovljevic A, Nikolic N, Jacimovic J, Pavlovic O, Milicic B, Beljic-Ivanovic K, et al. Prevalence of Apical Periodontitis and Conventional Nonsurgical Root Canal Treatment in General Adult Population: An Updated Systematic Review and Meta-analysis of Cross-sectional Studies Published between 2012 and 2020. J Endod. 2020;46:1371-86.

The percentage of root-filled teeth was 4% in comparison to 12.2%, 20% and 8.2% in other studies (6, 8, 14), respectively. This could be attributed to the lower awareness of the study population toward endodontic treatment. Another cause for this difference could be the average age in this study was lower than that in the other mentioned studies which had been performed in European countries.

6. Bürklein S, Schäfer E, Jöhren HP, Donnermeyer D. Quality of root canal fillings and prevalence of apical radiolucencies in a German population: a CBCT analysis. Clin Oral Investig. 2020;24:1217-27.

8. Van der Veken D, Curvers F, Fieuws S, Lambrechts P. Prevalence of apical periodontitis and root filled teeth in a Belgian subpopulation found on CBCT images. Int Endod J. 2017;50:317-29.

14. Kabak Y, Abbott PV. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. Int Endod J. 2005;38:238-45.

Our results agree with others studies which concluded that the presence of root filling in a tooth significantly increases the risk of detecting AP radiographically (6, 8, 14).

6. Bürklein S, Schäfer E, Jöhren HP, Donnermeyer D. Quality of root canal fillings and prevalence of apical radiolucencies in a German population: a CBCT analysis. Clin Oral Investig. 2020;24:1217-27.

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14. Kabak Y, Abbott PV. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. Int Endod J. 2005;38:238-45.

Also, Inadequacy of root canal filling significantly increase risk of presence of apical periodontitis in cross sectional studies

Inadequate RCT was present in 72.8% (Iraqi population)
Inadequate RCT was present in 54.5% (Belgian population)
Inadequate RCT was present in 81% (French population)
Inadequate RCT was present in 55.8% (Dutch population)
Inadequate RCT was present in 50% (Belarusian population)

- High prevalence of AP in this study indicates the need to improve the quality of dental care, especially root canal treatment, provided to the patients to reverse the present state.

- This possibly can be performed through investing more in developing the training skills for general dental practitioners or maybe by limiting root canal treatment to be provided by endodontists only.

- Also, the situation needs to be evaluated periodically in the short and long term to ensure monitoring of the outcome effect of implementing such strategies.

Conclusions

- AP was significantly higher in root canal treated teeth compared to not treated ones and inadequate root canal filling significantly increase the odds of having AP compared to adequate root canal filling making it a risk factor for developing AP.
- On the other hand, coronal restoration adequacy is not associated with the risk of presence of AP in root canal-treated teeth.
- Teeth with root canal filling and missed canals have a higher prevalence of AP compared to teeth with no missing canals.

Limitations

- Causative factors of the outcome of RCT
- Healing or expanding of AP lesion
- CBCT archived data

Recommendations

The practice by itself, without regard for the quality of outcomes, is not a sufficient condition for learning.

Need plans to improve educational outcome for the undergraduate level, and to overcome possible procedural errors by acquiring necessary knowledge and skills

Educational programs need to be modified to underline different variations associated with the treatment of different teeth.

Encouraging introduction of NiTi instrumentation in addition to new obturation techniques in root canal treatment .

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Prevalence of **periapical lesions** in non-endodontically and endodontically treated teeth in an urban Iraqi adult subpopulation: A retrospective CBCT analysis.

Ali AH, Mahdee AF, Fadhil NH, Shihab DM.

J Clin Exp Dent. 2022 Nov 1;14(11):e953-e958. doi: 10.4317/jced.59877. eCollection 2022 Nov.

Thank You