Effect of Academic-Environmental Stress on Apical Periodontitis of Non-Endodontic Teeth

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Abstract

Background: The periapical area of a tooth was diagnosed using radiography; many types of risk factors can affect the health of the apical area which is the stress during life. **Objective:** To analyze the prevalence of academic-environmental stress and apical periodontitis in non-endodontic teeth of dental students using cone-beam computed tomography (CBCT) X-ray, and to demonstrate the association between stress and the prevalence of apical periodontitis. **Materials and Methods:** Cross-sectional study was done on the 103 recruited dental students aged 22–24 years during the final examination year of study in dentistry college. The academic-environmental stress scale was used to measure the level of stress in each student. The CBCT X-ray was taken for each student. The apical area was measured only for non-root canal-treated teeth using the CBCT periapical radiography index. Chi-square (χ^2) test was used to show the percentages of stress and the relationship between apical periodontitis and stress in students. **Results:** 53 students (51.5%) had a stressed state, whereas 50 students (48.5%) had a non-stressful state. The prevalence of apical periodontitis was greater among stressed than that of non-stressed students in non-endodontic teeth. Statistically, there was a significant relationship between academic-environmental stress and apical periodontitis in non-endodontic teeth. **Conclusion:** There was a negative effect of examination stress on the apical healthy of teeth that can be increased with the presence of any additional factors such as problems of life.

Keywords: Cone-beam computed tomography, stress, students, three-dimensional imaging apical periodontitis

Introduction

Apical periodontitis (AP) is a periradicular inflammatory lesion of the tooth. It is a host defense response against microbial infection that originates from untreated necrotic dental pulp or improper root canal treatment (RCT).[1] The RCT aims to seal the root canal space, reduce root infection to a minimal level, and achieve the absence of post-treatment apical periodontitis.[2]

Epidemiologically, AP is widely spread in the adult population. One study concluded that about half of population had at least one of their teeth affected with AP.[3]

Chronic inflammation of the periapical tissues frequently develops without the patient experiencing symptoms, and, therefore, examination of images is still fundamental for its detection.[4]

Upon successfully treating AP by root canal therapy, it is essential to monitor the outcome through radiological assessment. The unfavorable outcome of root canal treatment can be determined by the persistence, or the new appearance, of periapical radiolucency, while the reestablishment or the appearance of a normal periodontal ligament space is a highly desirable outcome.[5]

Radiographs are essential in the diagnosis, planning, and execution of the endodontic treatment, as well as for

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following up on the success of therapy. Until recent years, periapical radiography (PA) and orthopantomography (OPG) were the main radiographic investigations used in root canal treatment. Nowadays, cone-beam computed tomography (CBCT) is more frequently used for endodontic treatment, which is largely due to the limitations of conventional two-dimensional radiographic techniques. It has demonstrated advantages in evaluating complex dental lesions, malformed teeth, and differentiation of periapical lesions, fractures of the root, and their resorption. In addition, CBCT gives a detailed three-dimensional assessment of the region of interest that allows a detailed evaluation of a tooth and its surrounding anatomy. However, the higher radiation dose of the CBCT limited its use. Thus, CBCT should be limited to indicated patients.[6]

Recently published literature reported increased stress during medical training.[7] Emotional distress in medical students harms them, which may affect their functioning in the classroom and during clinical practice. Further, they may have a stress-induced disorder, affecting their performance.[8]

The university changes the daily life of a person. College may increase emotional stress by leaving the family home and having a new place with a new environment. Also, performing academic demands may increase the stress on students, which may affect their academic success and may lower it, which has an additional effect besides their physical and emotional welfare. In addition to the above, students may face some difficulties, changes in behavior, problems in memory, social withdrawal, worry, and some self-defeating thoughts.[9]

The present study aimed (a) to assess the levels of academic-environmental stress among dental undergraduate students (fifth stage), (b) to show the prevalence of AP in all teeth of students using CBCT images, (c) to show a relationship between stress and the prevalence of AP in non-endodontic teeth only. In this study, a null hypothesis was assumed that there is no relationship between stress and the prevalence of apical periodontitis.

Materials and Methods

This study is a cross-sectional study. According to the rules of the Declaration of Helsinki, a study was done after achieving an approval from the committee of ethical research at Al-Rafidain University College (ref. number. 8 on June 25, 2022).

At first, the students recruited in the study were 256, and then 153 were excluded after applying exclusion criteria (systemic disease, smoking, drinking alcohol, a student with present or previous orthodontic treatment, pregnant).

The final sample size was 103 students aged 22–24 years who were selected from fifth-stage dental students who agreed to the participate in this research, after signing a written consent letter. The sample size was determined according to previous studies done by Lemagner *et al.*[10] and Bane *et al.*,[11] which used 100 persons to determine the prevalence of apical periodontitis among students using CBCT. The sample was collected in June 2022 during the final exam of the dental school.

Each student was asked to fill out the following questionnaire that consists of the following parts:

A) Name of student.
B) Academic stress: It consists of five questions, and the scores for each question were (yes: 1, no: 0).
   1. Do you suffer from the breadth of science curricula? (yes, no).
   2. Do you suffer from a lot of exams? (yes, no).
   3. Is there a desire to compete with your peers? (yes, no).
   4. Are you afraid of failing your studies? (yes, no).
   5. Do you not have enough breaks during study for recreation? (yes, no).
C) Environmental stress: It consists of 7 questions, and the scores for each question were (yes: 1, no: 0).
   1. Family problem (yes, no).
   2. Financial problem (yes, no).
   3. Do you live alone outside of your family? (yes, no).
   4. Do you have problems travelling between the college and your place of residence? (yes, no).
   5. Is the father or mother outside the medical community? (yes, no).
   6. Do you haven't the ability to manage your time? (yes, no).
   7. Is your diet not balanced? (yes, no).

The summation of the academic-environmental stress scale (AESS) was given a clue if the student was in a stress state or not stress as follows:

- 0–6: no stress.
- 7–12: stress.

After that, a CBCT X-ray was taken for each student. The digital images of CBCT were examined thoroughly by two well-trained examiners that have experience in CBCT measurements.[12] The following teeth were excluded from the study, which includes (third molars, impacted teeth, immature apex, residual roots, and endodontic teeth). The endodontic teeth were excluded from this study due to the sample was taken from young dental students that have few numbers of teeth with endodontic treatment in addition to high education levels about dentistry and root canal treatment.

The apical area was measured only for non-root canal-treated teeth (NRCT):

1. Fitted NRCT: they include:
   - sound teeth without carious lesions or

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- teeth with fitted restoration.

2. Non-fitted NRCT: they include:

- teeth with a carious lesion or
- teeth with unfitted restoration or
- teeth with restoration, but with the presence of secondary caries.

The periapical quality was measured using Cone-beam Computed Tomography periapical index (CBCTPA index), the CBCT gave three dimensions views (sagittal, axial, and coronal), and we took the worst one for measurement of an apical index, where[13]:

- Healthy: score 0; less than 0.5 mm
- AP: scores 1–4, scores D, E; ≥0.5 mm.

Statistical analysis

Version 21.0 of the computer program IBM® SPSS® Statistics (USA) was used, where Chi-Square (χ^2) test was used to show:

- Percentages of academic-environmental stress among dental undergraduate students.
- Percentages of examined non-endodontic and endodontic teeth.
- Percentages of AP in non-endodontic teeth only.
- Relationship between AP and academic-environmental stress.

The *P*-value in this study was:

- $P > 0.05$ non-significant (NS).
- $P \leq 0.05$ significant (S).

Results

One hundred three students were included in this study; 53 (51.5%) appeared in a stressful state, and 50 (48.5%) students appeared in a non-stressful form.

The study showed the total number of excluded root canal-treated teeth was 70, while the total number of examined non-root canal-treated teeth was 2774 (fitted and non-fitted). The total number of fitted non-endodontic teeth was (2223), and (551) for non-fitted teeth. Generally, the total rate of apical periodontitis in stressed students was greater than that of non-stressed students in both fitted and non-fitted non-root canal-treated teeth, where the rate of apical periodontitis in fitted teeth was 20.9% in stressed students and 18.0% for non-stressed students, also the rate of apical periodontitis in non-fitted teeth was 65.8% in stressed students and 25.7% in non-stressed students. While the rate of healthy apical area in fitted teeth was 79.1% in stressed students and 82.0% in non-stressed students, also the rate of healthy apical area in non-fitted teeth was 34.2%% in stressed students and 74.3% in non-stressed students [Table 1, Figures 1 and 2].

The Chi-square test revealed a statistically significant relationship between apical periodontitis and academic-environmental stress, with a *P*-value of 0.050 for fitted non-root canal-treated teeth and 0.000 for non-fitted teeth [Table 2].

Discussion

In general, short-term stress (minutes to hours) enhances the body's immune response, including innate and adaptive immune responses. This enhancement includes changes in macrophage, lymphocyte, neutrophil, and dendric cell trafficking, maturation, and function, together with local and systemic effect in the body (cytokines production). In contrast, the long-term stress (chronic) suppresses innate and adaptive immune responses, by altering cytokines balance, causing low-grade inflammation, and affecting the function of immunoprotective cells.[14]

Table 1: Statistical description of the examined NRCT teeth

NRCT and stress status			No. (%)			
			CBCTPA index		Total fitted or non-fitted teeth	Total examined NRCT teeth
			H	AP		
Fitted NRCT	Stress state	Stress	908	240	1148	2774
			79.1%	20.9%	100.0%	
		Non-stress	881	194	1075	
			82.0%	18.0%	100.0%	
	Total		1789	434	2223	
			80.5%	19.5%	100.0%	
Non-fitted NRCT	Stress state	Stress	94	181	275	
			34.2%	65.8%	100.0%	
		Non-stress	205	71	276	
			74.3%	25.7%	100.0%	
	Total		299	252	551	
			54.3%	45.7%	100.0%	

NRCT: non-root canal-treated teeth, PA: periapical area, H: healthy, AP: apical periodontitis, CBCTPA index: cone-beam computed tomography periapical index

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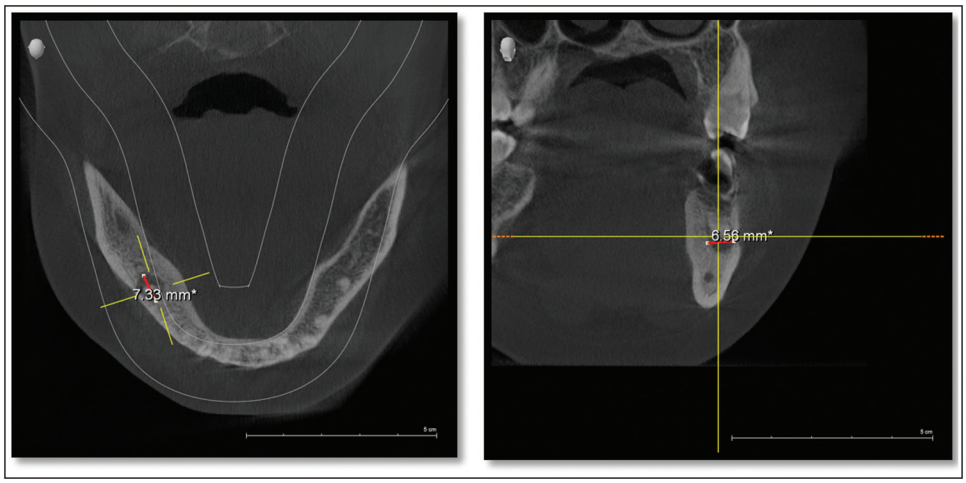

Figure 1: CBCT of maxillary first molar with apical periodontitis (left: axial view, right: coronal view)

Figure 2: CBCT of maxillary first molar with a healthy apical area (sagittal view)

The periodontal disease showed a positive correlation with chronic stress, as it increases the cortisol level, which may hurt periodontium; therefore, chronic stress is considered a risk factor for apical periodontitis.[15]

No available study has assessed the effect of chronic stress on the incidence of apical periodontitis; therefore, this study was done to determine the effect of academic and environmental stresses on the apical area of the teeth among undergraduate dental students during the final exam in dental school.

In this study, we use the AESS that was prepared, derived, and modified from other scales like the modified perceived stress scale and other questionaries from other studies.[7,9] In this study, this scale used a self-reported questionnaire

Table 2: Association between AP of NRCT teeth and AESS

Status		Value	Sig.
Fitted NRCT	Pearson χ^2	2.889[e]	0.050 (S)
	Continuity correction[b]	2.710	
	Likelihood ratio	2.895	
	Linear association	2.888	
	Number of valid cases	2223	
Non-fitted NRCT	Pearson χ^2	89.222[f]	0.000 (S)
	Continuity correction[b]	87.614	
	Likelihood ratio	91.879	
	Linear association	89.060	
	Number of valid cases	551	

AP: apical periodontitis, AESS: academic-environmental stress scale, χ^2: chi-square, S: significant, $P \leq 0.05$ Significant (S). b: Computed only for a 2x2 table. e and f: 0 cells 0.0 % have expected count less than 5

consisting of 12 questions (5 for academic stress and 7 for environmental stress). The student's answer for each question and the total summation can give an indicator if the student is in a stressed state or not. This scale is simple and not expensive and does not take a student more than 5 min to answer the questionnaire. In addition, this scale does not need saliva or blood taking to measure biomarkers, including cortisol, catecholamines, interleukin 6, and tumor necrosis factor,[15,16] because these methods are more expensive and time-consuming. Therefore, they were excluded from this study.[16,17]

The CBCT periapical index was used in this study to detect the presence of apical periodontitis rather than periapical radiography, because it has higher accuracy. It provides information in three dimensions (sagittal, axial, and coronal views), reducing the incidence of false negative results, increasing the reliability of the study, and minimizing observer interference. In addition to the above, the CBCT is more reliable and accurate in detecting periapical lesions, especially in the initial stage of disease.[13,18,19]

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Studies on animals, particularly rats, showed a positive correlation between chronic stress and apical periodontitis. They showed an increase in the rate of bone resorption, showed an increase in the level of cortisol hormone, which may impair immune function and potentiate bone resorption.[20,21]

In this study, it is found that chronic stress significantly increases the prevalence of apical periodontitis in both groups (fitted and non-fitted) of non-endodontic teeth, as chronic stress may impair immune function and increase the rate of bone resorption. In addition, it reduces leukocyte mobilization, which plays an important role in an inflammatory response and tissue healing process.[14,22] Although many factors contribute to the occurrence of a periapical lesion, such as bacterial leakage, but the presence of periapical lesions among sound teeth with stress groups more than non-stressed groups indicating that stress is a risk factor for apical periodontitis.

With non-fitted non-root canal-treated teeth, there was a greater prevalence of periapical lesions in the stressed group than in the non-stressed group. This may be related to the stress that may prevent healing and exacerbate tooth condition.[14] In addition, the presence of teeth with non-fit restoration or caries may allow the passage of bacteria that constitute one of the main causes of the periapical lesion or apical periodontitis.[14,23-25]

There is a positive correlation between stress and temporomandibular joint disorders.[26-28] Many researchers have shown that the presence of stress and anxiety will worsen the prognosis of parafunctional habits.[26,29] This will cause periodontium destruction, leading to periapical lesions, especially in young individuals, the age group taken in this study.[29,30]

This study's main limitation is the lack of sophisticated procedures (biomarkers) to detect stress among students.

Conclusion

The chronic stress developed from examinations during years of study in university and life can cause many problems in the apical area of the tooth. Any other secondary factors, such as periodontal problems, caries, and or defective restorations, can increase the rate of apical defect or lesion worsening.

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Conflicts of interest

There are no conflicts of interest.

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