Original Article

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Radiographic evaluation of preoperative periapical status in teeth with apical abscess

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Abstract

Background: The presence of preoperative periapical lesion is a significant prognostic factor that influences the outcome of endodontic treatment. Radiographic evaluation of periapical status is important for diagnosis, treatment, and prognosis of periapical lesion.

Objectives: To radiographically compare and evaluate the preoperative periapical status using periapical index (PAI) in teeth with acute and chronic apical abscess.

Methods: An analytical cross-sectional study was conducted in Chitwan Medical College, between 2022 February to 2022 May using nonprobability convenience sampling technique. Forty-eight periapical radiographs with a diagnosis of apical abscess {24 acute apical abscess (AAA) = Group 1; 24 chronic apical abscess (CAA) = Group 2)} were included for evaluation. Four observers (Three endodontists and one oral radiologist) evaluated the periapical status on radiographs and scored them according to PAI scoring system. Statistical analysis was done using the Mann-Whitney U test and SPSS v.22.

Results: The most common PAI score for teeth in Group 1 was three (13, 54.20%) with mean PAI score = 3.21 and in Group 2 the score was four (13, 54.20%) with mean PAI score = 3.79. Analysis of PAI scores found significant differences ($p = 0.009$, $p < 0.05$) between groups. The distribution of PAI varied according to apical diagnosis ($p < 0.05$). Intraobserver and Interobserver agreement values demonstrated good self-agreement and interobserver agreement.

Conclusion: Teeth with CAA were more likely to have higher PAI scores and therefore, periapical radiograph and PAI scoring system can be used effectively for the evaluation of preoperative periapical status in teeth with apical abscess.

Key words: Acute apical abscess; Chronic apical abscess; Periapical index; Periapical lesion; Periapical radiographs; Periapical status.

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INTRODUCTION

Periapical lesions (PL) frequently present as apical periodontitis, periapical abscess, periapical granuloma and cysts.[1] Early detection and assessment of PL are significant for diagnosis treatment planning, and prognosis.[2] A periapical abscess has similar features to other PL, which creates difficulty in differentiating them.[1]

Periapical radiographs (PR) play an important role from diagnosis and treatment planning to evaluation of prognosis and treatment outcomes in teeth with PL

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including periapical abscess.[2-5] The presence and extent of preoperative PL is an important prognostic factor that influences the outcome of endodontic treatment.[6] Teeth with preoperative PL have less chances of complete healing and hence the probability of success is lower and the prognosis is poor.[6-8]

Radiographic evaluation of periapical status of apical tissues is therefore, important for diagnosis, treatment planning, and prognosis of PL.[4, 9, 10] The periapical index (PAI) was developed by Ørstavik et al. in 1986 for the radiographic evaluation of the periapical status.[5] Therefore, the aim of this study was to radiographically compare and evaluate the preoperative periapical status using PAI in teeth with acute and chronic apical abscess.

METHODOLOGY

This analytical cross-sectional study was conducted in the department of Conservative Dentistry and Endodontics, School of Dental Sciences, Chitwan Medical College, Nepal, between 2022 February and 2022 May. This study was reviewed and approved by the Institutional Review Committee of Chitwan Medical College (Ref. CMC-IRC/078/079–089). The purpose of the study was explained to the patients willing to participate in the study and written informed consent was obtained. The data collected included patient's age, gender, tooth type, clinical diagnosis (pulpal and periapical diagnosis), and the PAI score.

The minimum sample size for each group was determined to be 24 and calculated as follows: $n = 2(Z_\alpha+Z_\beta)^2\ s^2/d^2$; where, Z_α = 1.96 at 95% confidence level; Z_β= 0.84 at 80% power; d = mean difference between groups = 1; s = variability, standard deviation = 1.22. Hence, $n = 2\{(1.96+0.84)^2 \times (1.22)^2\} / 1^2 = 23.34 \approx 24$ per group.

The sampling method used was nonprobability convenience sampling method consisting of inclusion criteria patients with an apical abscess diagnosed based on clinical and radiographic examination. After exclusion and sample size calculation, a total of 48 patients with a diagnosis of apical abscess {24 acute apical abscess (AAA) = Group 1; 24 chronic apical abscess (CAA) = Group 2)} were selected for analysis. Thus, a total of 48 digital periapical radiographs (DPRs) of 48 teeth, according to the selection criteria were included for radiographic evaluation in this study.

Clinical examination and tests included a detailed intraoral examination, cold testing, an electric pulp testing (EPT), percussion testing, mobility testing, periodontal depth probing, and evaluation of swelling and intraoral sinus tract. A gutta-percha point was used to trace the pathway of the sinus tract and a radiograph was taken to determine the involved tooth. Pulpal and apical diagnoses were made after clinical and radiographic examination by an endodontist not involved in the radiographic evaluation. The diagnosis was based on the diagnostic terminology of the American Association of Endodontists.[11] The patients were then divided into two groups based on apical diagnosis as follows: acute apical abscesses = Group 1; chronic apical abscess = Group 2.

Radiographs from patients with the following inclusion criteria were selected for the study: patient older than 20 years, tooth with fully formed roots, tooth with a pulpal diagnosis of pulp necrosis and apical diagnosis of apical abscess. Patients with significant systemic disease, pregnant patients, and teeth with abnormal mobility, periodontal pockets and previous root canal treatment, were excluded from the study. Similarly, second and third molars were also excluded.

All the DPRs were taken with the same digital radiographic imaging system (CS 2100 Carestream, Carestream Health Inc. NY, USA). The DPR were obtained using a digital X-ray sensor (RVG 5200 Sensor Size 1, Carestream Dental LLC, Atlanta, USA) with the following exposure settings: an exposure time of 0.32s to 0.63s depending on the tooth evaluated, at 60 kV and 7 mA with a sensor-focus distance of 20 cm using the paralleling technique. All the digital radiographic images thus obtained, were coded and randomised before radiographic evaluation. The digital radiographic images were evaluated independently by four calibrated and blinded observers (three experienced endodontists and one oral radiologist) unaware of the clinical (pulpal and apical) diagnosis. Radiographic evaluation was done by using the radiovisiography (RVG) imaging software, CS Imaging Software 7.0.3.4 (Carestream Health Inc. 2014) on a 19.5-inch full HD computer monitor (V206HQL, Acer) with a resolution of 1600 x 900 pixels at 60 Hz.

Each observer independently evaluated the periapical status of the selected teeth on the digital radiographic images and scored them by using the PAI scoring system as follows; Score 1 = normal periapical structures; Score 2 = small changes in the bone structure; Score 3 = changes in bone structure with some mineral loss; Score 4 = periodontitis with a well-defined radiolucent area; and Score 5 = severe periodontitis with exacerbating features. The root with the highest PAI score was selected to represent the PAI score in multirooted teeth. The observers were allowed to use image enhancement tools in the software during radiographic analysis without any time restriction. The radiographic evaluation was repeated at an interval of one month. The observers were blinded to previous scores, and to each other during the second evaluation. The observers were not allowed to refer to the first evaluation score and were also not allowed to discuss with each other. A consensus PAI score was made by discussion between the observers on images with disagreements after the second independent scoring session and was considered as the final PAI score for statistical analysis. The observers were calibrated by evaluating 20 digital radiographic images that were not included in the study, before evaluating the sample radiographs.

The data were evaluated using the Mann-Whitney U test and the Chi-square test at 5% level of significance. Data analysis included simple proportions and cross-tabulation of PAI score. Comparison of PAI score was made between the two diagnostic groups. The Mann-Whitney U test was used for statistical analysis to evaluate the differences in PAI scores between the groups. Mann-Whitney U test was done to examine the null hypothesis that the distribution of PAI score does not vary between the two groups of apical diagnosis. Distribution of genders between the groups were analysed using Chi-square tests.

An intraclass correlation coefficient (ICC) was used to evaluate the level of intraobserver agreement between the two observation sets. The ICC values were interpreted as follows: ICC values less than 0.5 are indicative of poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability.[12] The level of interobserver agreement was determined by Krippendorff's alpha reliability coefficient during both rounds of observations. The criteria for strength of agreement proposed by Landis and Koch[13] were used in this study: values <0.00 = poor agreement; 0.00–0.20 = slight agreement; 0.21–0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; and 0.081–1.00 = almost perfect agreement. The statistical analysis of the data was performed using the IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). The level of significance was established at p <0.05.

RESULTS

The study sample included a total of 48 patients: 16 (33.3%) males and 32 (66.7%) females with a mean age of 42.48 ± 16.62 years and an age range of 20-74 years. The average age of the patient in Group 1 was 40.38 ±16.43 years (12 males and 12 females with age range of 20-69 years). The average age of the patient in Group 2 was 44.58 ± 16.89 years (4 males and 20 females with age range of 20-74 years) (Table 1).

A total of 48 teeth were evaluated in the study. The teeth selected for evaluation comprised of six maxillary molars, six maxillary premolars, two maxillary canines, six mandibular molars, six mandibular premolars, and 12 mandibular incisors. Twenty-four were maxillary teeth and 24 were mandibular teeth. Similarly, 24 teeth were anterior and 24 teeth were posterior (Table 2). A PAI score of 4 was the most common for all teeth (Table 3).

A PAI score of 3 was the most common for all teeth (21, 43.75%) as well as teeth in Group 1 (Table 3, 4). Thirteen (54.20%) of teeth had a PAI score of 3 in Group 1 (Table 4). The most common PAI score for teeth in Group 2 was 4 (13, 54.20%). The distribution of PAI scoring reveals that more than half (13, 54.2%) of teeth in Group 2 had a score of 4. The mean PAI score for Group 1 was 3.21 ± 0.833. The mean PAI score for Group 2 was 3.79 ± 0.658. Statistical analysis indicated that the data were not consistent with the null hypothesis that the distribution of PAI did not vary according to apical diagnosis (p <0.05). Teeth with CAA were more likely to have higher PAI score. Analysis of PAI scores found significant differences (p = 0.009, p <0.05) between teeth of Group 1 and Group 2. Similarly, there was no significant difference in distribution of genders between the groups (p = 0.115, p >0.05).

Intraobserver agreement was evaluated by ICC by using the PAI scores of the first and second rounds of observation of each observer. The intraobserver agreement scores evaluated by ICC ranged from 0.841 to 0.857 demonstrating good agreement. The intraobserver values were above 0.8, confirming good reproducibility (Table 5).

Krippendorff's Alpha Reliability was used to determine interobserver agreement. The interobserver agreement value determined by Krippendorff's Alpha Reliability was 0.8706. The percent agreement between the observers was 86% and 85% (Table 6). The interobserver agreement values were in the almost perfect range of agreement (0.81–1.00) for all the four observers during both the rounds of observation. The interobserver agreement values were also above 0.8, demonstrating good reproducibility.

Table 1: Distribution of age and gender

	Group 1	Group 2	Total
Mean Age	40.38 ± 16.43	44.58 ± 16.89	42.48 ± 16.62
Age Range	20-69	20-74	20-74
Males	12 (50%)	4 (16.7%)	16 (33.3%)
Females	12 (50%)	20 (83.3%)	32 (66.7%)
Total	**24**	**24**	**48 (100%)**

Table 2: Distribution of teeth

Tooth type	Group 1	Group 2	Total
16	1	1	2
15	1	1	2
14		1	1
13			
12			
11	3	4	7
21		1	1
22	1	1	2
23	2		2
24	1	1	2
25	1		1
26	2	2	4
36	1	2	3
35		1	1
34	1		1
33			
32		2	2
31	1	1	2
41	5	2	7
42		1	1
43			
44		1	1
45	2	1	3
46	2	1	3
Total	**24 (50%)**	**24 (50%)**	**48 (100%)**

Table 3: Distribution of PAI scores and tooth types

Tooth group/types	PAI 2	PAI 3	PAI 4	PAI 5	Total, n (%)
Maxillary Incisors	1	4	4	1	10 (20.8)
Maxillary Canines	1	1			2 (4.2)
Maxillary Premolars	1	2	2	1	6 (12.5)
Maxillary Molars		4	2		6 (12.5)
Mandibular Incisors		4	6	2	12 (25)
Mandibular Canines					-
Mandibular Premolars		5	1		6 (12.5)
Mandibular Molars	1	1	3	1	6 (12.5)
Total	**4 (8.3%)**	**21 (43.7%)**	**18 (37.5%)**	**5 (10.4%)**	**48 (100)**

Table 4: Distribution of PAI scores according to apical diagnosis

Group	PAI 2	PAI 3	PAI 4	PAI 5	Total	Mean ± Std. Deviation	p-value
Group 1 (AAA)	4 (16.7%)	13 (54.2%)	5 (20.8%)	2 (8.3%)	24	3.21 ± 0.83	0.009
Group 2 (CAA)	-	8 (33.3%)	13 (54.2%)	3 (12.5%)	24	3.79 ± 0.66	

Mann-Whitney U value was 169.500**;** AAA = Acute apical abscess; CAA = Chronic apical abscess.

Table 5: Intraclass correlation coefficient values for intraobserver agreement

	Intraclass correlation coefficient values	Percent agreement (%)	95% Confidence interval Lower bound-Upper bound
Observer 1	0.841	81.2%	0.734-0.908
Observer 2	0.857	81.2%	0.758-0.917
Observer 3	0.857	81.2%	0.758-0.917
Observer 4	0.841	81.2%	0.734-0.908

Table 6: Interobserver agreement values for first and second rounds of observations

Observation round	Krippendorff's alpha reliability	Percent agreement
First round of observation	0.870	86%
Second round of observation	0.859	85%

DISCUSSION

Radiographic examination of apical abscess is essential, for the assessment of the long-term prognosis required in treatment planning.[4, 9, 14-16] Periapical radiolucency visualised in PR is the most consistent feature representing the presence, progression or, healing of PL observed during the evaluation of periapical status and therefore, forms the basis for the diagnosis of PL.[4, 10, 16-18]

A recent study showed a significant increase in the number of patients visiting the emergency department with periapical abscess.[19] Similarly, about 60% of all non-traumatic dental emergencies were related to AAA and toothaches in an earlier study.[20] An AAA has a prevalence ranging from 5% to 46%,[11, 21] whereas, the prevalence of CAA varies from 8.5% to 18%.[7] Radiographically, a periapical abscess presents as an irregular periapical radiolucency associated with the root apex along with discontinuous or absence of lamina dura and is typically associated with long-standing root-canal infection.[7]

Therefore, PR plays a significant role in the management and prognosis of PL including apical abscess.[2, 5, 22, 23] However, there are limitations of PR such as limited film size, geometric distortions, magnification, and low radiographic contrast.[4, 24] The image produced in PR is influenced by multiple factors such as magnification and distortion, which can affect radiographic interpretation resulting in underestimation.[3, 10, 18, 24, 25] Additionally, PR are two-dimensional representations of three-dimensional structures, and hence, may not represent all the clinical characteristics and biologic features of PL.[24] Since PR do not permit estimation of buccolingual extension, the extent of the PL is difficult to determine, and may be underestimated.[2, 4, 23] Therefore, radiographic evaluation of PL must be carried out with caution, as it may not reflect the lesion's actual extent.[18] A significant amount of cortical bone erosion (30-50%) is required for a PL to be visible and diagnosed in PR.[18] Hence, although present clinically, PL may not be visible radiographically.[23] Thus, the possibility of false negative diagnosis is significantly higher due to lower rates of visualisation of PL when PR are used.[24] Although, many studies have found low levels of accuracy with PR resulting in failure to detect PL, PR have an excellent efficacy in the diagnosis of advanced PL.[23] Similarly, interpretation of PR has a considerable amount of both interexaminer and intraexaminer variation.[25] However, both intra- and interobserver agreement were good in this study (Table 5, 6).

Cone beam computed tomography (CBCT) is a three-dimensional imaging method with greater diagnostic accuracy and provides clinically relevant additional information compared to PR.[3, 22-24] However, CBCT is not without limitations and has concerns regarding higher radiation dose and higher cost.[3] Following the radiation safety principles of as low as reasonably achievable (ALARA), evidence-based studies have failed to prove an improved outcome for the patient and hence, do not support routine use of CBCT in clinical practice.[3]

Similarly, to prevent unnecessary radiation exposure lacking clinical advantage (ALARA), the American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiology (AAOMR) advise against routine clinical use of CBCT and recommends the use of CBCT restricted to assessment and treatment of complex endodontic conditions, associated with complex root-canal anatomy and endodontic treatment complications.[26] According to the AAE, CBCT should only be used when conventional radiographic techniques are insufficient in providing the necessary information for the diagnosis of PL.[26]

CBCT has a relatively low specificity in the diagnosis of PL and therefore, a significant potential for false positive diagnosis of periodontal ligament space widening even in healthy teeth.[3, 22, 23] Several studies comparing the diagnostic accuracy of CBCT and PR conclude that CBCT lacks clinical applicability since a clinically relevant and valid reference standard is missing.[3, 22, 23] A reference standard is required to confirm certainty about the presence or absence of disease and to measure the accuracy (sensitivity and specificity) of imaging technologies.[16] The specificity of the EPT lies between 92% and 99%, and was used as a reference standard for the evaluation of PR in this study.[27] Moreover, the pulp tests were performed by specialist endodontists with experience in conducting and interpretation of the test.

The CBCT has higher sensitivity than PR without significant differences in specificity.[16, 22] Therefore, the presence of apical radiolucency in CBCT may lead to an overestimation of disease. In contrast, PR has a high specificity (0.98), but significantly lower sensitivity (0.55) to detect PL, hence are more likely to detect advanced lesions and underestimate disease prevalence compared to CBCT.[15] A systematic review stated that there was a lack of high-level of evidence, to establish the diagnostic performance of CBCT compared to DPR for the clinical evaluation and detection of endodontic diseases.[16] It also highlighted the limitations of the existing studies and emphasised the need for properly designed studies to establish the diagnostic efficacy of CBCT compared to PR.[16]

Various diagnostic indices such as CBCT-PAI (cone beam computed tomography-periapical index) and periapical and endodontic status scale (PESS) based on the methods of radiographic examination are used for the evaluation of periapical status of PL and each has its own limitations.[4]

The PAI scoring system was used in this study for radiographic evaluation of preoperative periapical status in teeth with apical abscess using PR (Table 4). It is a 5-point ordinal scoring scale used for radiographic assessment of PL by evaluating periapical status on radiographs. It evaluates the severity of PL, according to the increased radiolucency on radiographs ranging from healthy to severe periodontitis with exacerbating features.[5]

The most common PAI score was 3 in teeth with AAA, whereas a PAI score of 4 was most common in teeth with CAA. There was a significant difference in the distribution of PAI scores between teeth with AAA and CAA (Table 4). Teeth with CAA were found to have higher PAI scores, which could be due to the nature of the disease process. Therefore, PAI can be useful for differentiating between AAA and CAA. The Mann-Whitney U test was used in the comparison of PAI scores between the groups since the data did not show a normal distribution and the PAI scores were measured on an ordinal scale.

The PAI scoring system is the most commonly used periapical index scoring system for the assessment of PL and has been applied in both clinical and epidemiological studies for the evaluation of periapical status and outcomes of endodontic treatment.[4, 8, 9, 14, 17, 24, 28] PAI is a highly reliable with an accurate measurement method to determine the extent and severity of PL, that has repeatability, and therefore, the periapical status can be evaluated consistently and correctly.[9, 10] Many studies examining the periapical status of PL have concluded that PL can be detected using PR and the PAI scoring system.[17, 28] Therefore, Teeth with decreasing PAI scores are regarded as being healed.[28] Additionally, it is possible to compare studies by using the PAI scoring system.[10, 17] However, PAI is based on two-dimensional PR and histological findings of the periapical region of maxillary incisors only and hence, the application and reliability of PAI system in multirooted teeth is doubtful.[4, 10, 18, 25] Furthermore, since the size of the lesion, cannot be evaluated using PAI, radiographic analysis of PL using PAI might not correctly display the volumetric changes.[5, 6, 8, 18] Therefore, a reduction in the PAI score of PL does not confirm a volumetric reduction in the size of the lesion.[25]

The PL can be detected radiographically only after considerable (30%–50%) bone loss. PAI therefore, may not be able to detect PL in the early stages.[15] There is a chance of false positive and false negative evaluation due to the high level of subjectivity during evaluation of PL using PAI.[18] Although, PAI has a good interobserver agreement, the intraobserver agreement of PAI is poor; hence, the results of the evaluation of PL using PR and PAI must be accepted with caution.[9, 18] Even though, PAI is not based on clinical outcome, and the prognostic value is unknown, it is easily applicable in clinical situations for predicting the prognosis of a tooth, based on the periapical status.[4] Similarly, CBCT-PAI introduced by Estrela et al. is also associated with an overestimation of disease and overdiagnosis, while providing the size of the PL only in millimeters, with limited diagnostic and prognostic value.[3, 14, 24]

A significant intra- and interobserver variation influences the results and conclusions of radiographic studies.[9] Many studies report significant variations within and between observers in radiographic diagnosis of PL, which needs to be minimised to enhance the reliability of radiographic studies.[9, 14] Several measures including establishing a standard criterion for evaluation are recommended to minimise the effect of observer variation and for increasing the reliability of radiographic evaluations.[9, 16, 25] Using the judgments of several observers is suggested to reduce interobserver variation and increase intraobserver reproducibility.[9] Hence, studies evaluating the diagnostic performance of radiographic images are recommended to include a significant number of observers.[16]

According to some authors, observer calibration is one of the factors that influences the reliability of radiographic evaluation.[9,14] Calibration of the observers helps to reduce interobserver variation, increases agreement, and significantly improves the consistency of assessing a radiographic image.[14] Furthermore, experience of the observers and expertise are additional clinically relevant factors that impact diagnostic performance since diagnostic accuracy increases with observer experience.[15, 16] Four calibrated and experienced observers (three endodontists and one oral radiologist) were involved in the analysis of radiographic images.

Similarly, using improved quality of the radiographic image is also recommended. The DPRs were used for radiographic evaluation, which have advantages like reduction in radiation exposure, wide exposure latitude, instant image generation, and manipulation.[17] Additionally, the contrast, brightness, and sharpness of digital radiographic images can be manipulated and enhanced by using software, which further facilitates the diagnosis and evaluation of PL.[16] The DPR produces improved quality high-resolution images helpful for early detection and diagnosis of PL.[9, 16, 24] The radiographs were exposed using the long-cone paralleling technique, which provides images of good quality with minimal geometric distortion.[17]

The observers evaluated the radiographic images on the same computer monitor during both the evaluation sessions to minimise observer variation. Likewise, a one-month interval between the observation sessions was made to prevent the observers from recalling previous scores and to evaluate intraobserver agreement. During evaluation, the examiners were allowed to use image enhancement software tools of the digital radiographic viewing system for analysis. Also, the distribution of the age, gender, number and teeth types were similar in both the groups. These additional measures along with above-mentioned factors might have reduced interobserver variability and contributed to the high interobserver agreement values in the present study.

The intraobserver agreement values determined by ICC statistical analysis between the observation rounds were in good range (Table 5). All the observers demonstrated good self-agreement. Similarly, interobserver agreement values evaluated by Krippendorff's alpha statistical analysis during both rounds of interpretation, ranged from 0.86–0.96, indicating an almost perfect agreement between observers and good reproducibility (Table 6). A value higher than 0.81 is considered good reproducibility.[13] A very significant level of agreement between examiners with high interobserver agreement values (0.80–0.95 range) has also been observed in earlier studies.[4, 14, 15] The agreement of PAI scores between endodontists and oral radiologist was also high (Percent agreement >80%).

One of the limitations of PAI is the interobserver variation in the choice of PAI. Therefore, radiographs were examined twice by the examiners and the degrees of interobserver agreement were calculated in this study, to overcome this limitation.[18] Moreover, an easy to learn and apply index like PAI, contributes towards a more consistent evaluation.[14] The PL associated with anterior teeth are more easily visualised with PR. Therefore, maxillary second and third molars were, excluded due to the fact that these teeth are better viewed in orthopantomograms.[17]

The preoperative presence and extent of PL is the most significant risk factor and has a strong adverse effect on the healing and outcome of endodontic treatment.[6, 28] The Toronto study found a healing forecast of 82% in teeth with preoperative radiolucency against 93% for teeth without radiolucency.[8] Similarly, Ng et al. found the presence and size of PL and the preoperative presence of a discharging sinus tract were significant preoperative prognostic factors to affect the prognosis and health of periapical tissues after endodontic treatment resulting in poor prognosis.[6, 7]

Therefore, preoperative evaluation of periapical status is important for treatment planning and prediction of prognosis in teeth with PL. Additionally, prior prediction of the prognosis of endodontic treatment is required for clinical decision-making.[28] The assessment of periapical health also facilitates to identify treatment needs.[10] Different radiographic imaging techniques have been used to evaluate observers' ability to accurately detect PL, hence, their diagnostic accuracy varies.[25, 29] Many studies have evaluated PL and its periapical status by using PR and PAI. However, few have determined periapical status in teeth with apical abscess. Correlation between clinical and radiographic findings is essential to diagnose and differentiate PL and to determine the stage of disease progression.[2] Even though, recent advances in diagnostics help in the assessment of the periapical region to formulate better diagnosis, treatment planning and prognosis of PL, PR are the imaging modality of choice.[2, 16]

The clinical significance of this study is that although, CBCT has many advantages compared to PR, CBCT cannot always be used in routine clinical practice due to its radiation and cost factors. Additionally, a study concluded that the choice of treatment of PL does not change significantly even after including an advanced imaging modality like CBCT compared to PR.[30] Despite limitations, PR represent an important imaging method commonly used for the diagnosis, treatment, and follow-up of PL.[9, 10, 22, 23, 25] Additionally, preoperative evaluation of periapical status in teeth with apical abscess using PAI can later be utilised for the evaluation of treatment outcomes.

There were some limitations in this study, such as small sample size and lack of control teeth in study design. The methodology of this study is different compared to previous studies on periapical status, therefore, the results should be interpreted carefully. Future studies involving larger samples and re-evaluation of periapical status post-treatment by using PAI are required for conclusive results. The PAI scoring system was used in this study to radiographically evaluate and compare the periapical status on digital radiographic images in teeth with apical abscess. The differences in the distribution of PAI scores between teeth with AAA and CAA was found to be significant.

CONCLUSION

The results of this study demonstrated that teeth with CAA were more likely to have higher PAI scores and therefore, PR and PAI scoring system can be used effectively for the evaluation of preoperative periapical status in teeth with apical abscess.

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