

PREVALENCE OF PERIRADICULAR RADIOLOCENCIES AND ITS ASSOCIATION WITH THE QUALITY OF ROOT CANAL TREATMENT AND CORONAL RESTORATIONS IN AN ADULT NEPALI POPULATION

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ABSTRACT

Although root canal treatment is carried out to eliminate the existing microorganism and create favorable environment for healing and prevent reinfection, the occurrence of post treatment disease poses a significant challenge in general population. Cross sectional studies from different countries shows that there is varying degree of prevalence of periradicular radiolucencies (PR) in root filled teeth. Since no such prevalence studies have been done in Nepal, we are unaware of the existing problem in our population. Thus, aim of this study was to investigate the prevalence of periradicular radiolucencies and its association with the quality of root canal treatment and coronal restorations in an adult Nepali population. Among 350 patients, 40.8% (389) presented with PR. Significantly better outcome was seen in teeth with adequate qualities of root filled teeth and coronal restoration. The prevalence of PR in Nepali population was seen relatively high and the considerable efforts to improve the length control during the procedure followed by proper restoration, to lessen the development of PR cannot be over emphasized.

KEYWORDS

Nepali population, periradicular radiolucency, root canal treatment, treatment quality

Received on: August 15, 2022

Accepted for publication: August 31, 2022

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DOI: <https://doi.org/10.3126/nmcj.v24i3.48620>

INTRODUCTION

The aim of the root canal treatment is to eliminate the microorganism and necrotic pulp and create favorable environment to provide adequate healing and prevent reinfection, thereby retaining the tooth in normal function.^{1,2} But the healing does not go as planned due to multiple factors resulting to post treatment endodontic disease which is often revealed upon radiographic examination.³ The high prevalence of Periradicular Radiolucency (PR) varying from 1.2-15.1% overall and 41.3% PR rates in root filled teeth have been reported by recent updated systematic review and meta-analysis of cross sectional studies in between 2012-2020.⁴

Although longitudinal studies evaluate the quality and prognosis of root canal treatment and proved to be superior are frequently done in dental schools or in controlled scenario of specialists' clinic.⁵⁻⁸ This may not reflect the real-world scenario where lot of the root canal fillings are carried out by general dental practitioner and the quality cannot be assessed by longitudinal studies.⁹ So, to assess the status of disease or the treatment outcome in a population cross sectional studies has been the assessment method of choice.¹⁰

This type of survey based on patients receiving dental treatment from general practitioners would provide a more accurate image of the burden of disease in general population and along with it the quality of treatment provided at the community level can also be assessed.

There are many cross-sectional population-based studies assessing the periradicular status conducted in Europe and America.¹¹⁻²² There are few studies performed in Asian countries that have been published.²³⁻²⁶ To the best of our knowledge, none of the study assessing the periradicular status have been conducted in Nepal. For this purpose, data were obtained from 8 districts of Nepal (Biratnagar, Chitwan, Butwal, Kathmandu, Lalitpur, Bhaktapur, Pokhara and Dang). The aim of this country wide cross-sectional study was to determine the prevalence of PR and its association with the quality of root canal treatment and coronal restorations in Nepali population.

MATERIALS AND METHODS

Study sample: The sample consisted of 350 subjects aged 18 years and above of whom the Orthopantomogram (OPG) X-rays were taken for consultation and /or treatment purposes

in 8 different dental care centers (namely, Biratnagar, Chitwan, Butwal, Kathmandu, Lalitpur, Bhaktapur, Pokhara and Dang) during the period from September 2020 to August 2021. Subjects having less than 8 remaining teeth were excluded. The Ethical clearance was obtained from Nepal Medical College-Institutional Review Committee on August 2020.

Radiographic examination: All the participants had OPG taken in their respective diagnostic centers. The digital images were examined using Photoshop 6.0 software (Adobe Systems, CA, USA) at a 1:1 .50 OPGs were used for calibration between two examiners and were not included in the study.

Radiographic evaluation: Periapical Index (PAI)²⁷ was used to evaluate the presence or absence of PR in each sample teeth (n=10149), using the scale ranging from 1-5.

The five categories are as follows:

1. Normal periapical structures or normal apical periodontium,
2. Small changes in periapical bone structure or bone structural changes indicating, but not pathognomonic for apical periodontitis,
3. Changes in periapical bone structure with some mineral loss or bone structural changes with some mineral loss, characteristic of apical periodontitis,
4. Demineralization of periapical bone with well-defined radiolucent area or well-defined radiolucency,

Demineralization of periapical bone with exacerbating features or radiolucency with radiating expansions of bone structural changes.

Healthy teeth are indicated by Scores 1 or 2 whereas scores 3 to 5 indicated the presence of PR. For multi rooted teeth, the root with the highest PAI score was recorded. Teeth were categorized as root canal treated if they had been obturated with a radio-opaque material in the pulp chamber and/or in one or more of the root canals.

The criteria described by Tavares *et al*,¹³ were used for the evaluation of the quality of root canal filling and coronal restorations, which states:

Root canal procedure is either Adequate (All canals obturated. No voids present. Root canal fillings end from 0-2 mm short of the radiographic apex) or Inadequate (Root canal fillings end more than 2 mm short of the

radiographic apex or grossly overfilled. Root canal fillings with voids, inadequate density, unfilled canals, and/or poor compaction). Coronal restoration is adequate (Any permanent restoration that appeared intact on a two-dimensional radiograph) or Inadequate (Any permanent restoration with detectable radiographic signs of overhangs, open margins or recurrent caries, or presence of temporary coronal restoration. This group also included teeth with no coronal restorations, permanent or temporary).

Statistical analysis: The data was entered, edited and coded in Microsoft Excel version 16.45 The data was exported and analysed with the help of Statistical Package for Social Sciences (SPSS) version 17. Data was analysed statistically by Chi square test with significant level set at 5% ($P \leq 0.05$) and the reliability was determined using odds ratio.

RESULTS

Total study participants were 350, male 169 (48.3%) and female 181 (51.7%) of whom 953 teeth were evaluated. The age of the study

Table 1: Distribution of Periradicular Radiolucencies among the study participants

No of PR/ Patient	n (%)
0	129 (36.9)
1	127 (36.3)
2	58 (16.6)
3 and above	36 (10.2)
Total	350 (100)

PR: Periapical Radiolucency

Table 2: Distribution of PR according to type of teeth in Maxilla and Mandible (n=953)

Teeth	Total n (%)			
	Maxilla Present	Maxilla Absent	Mandible Present	Mandible Absent
Anteriors	35 (24)	111 (76)	24 (29.3)	58 (70.7)
Premolars	43 (32.1)	91 (67.9)	29 (25)	87 (75)
Molars	99 (51)	95 (49)	159 (56.6)	122 (43.4)

Table 3: Association of PR with quality of coronal restoration and root filled teeth among study participants (O.R)

Quality of dental treatment		PR		P-value	O.R
		Present n (%)	Absent n (%)		
Coronal Restoration	Adequate N=685	216 (31.5)	469 (68.5)	<0.001*	0.25
	Inadequate N=268	173 (64.6)	95 (35.4)		
Root filled teeth	Adequate N=522	100 (19.2)	422 (80.8)	<0.001*	0.12
	Inadequate N=431	289 (67.1)	142 (32.9)		

O.R: Odds Ratio, Chi square test, P-value<0.05 statistically significant

Table 4: Distribution of PR, root filled teeth and coronal restoration

Quality of dental treatment		n (%)	Periapical radiolucency n (%)
Adequate coronal restoration (N=685)	Adequate root filled teeth	438 (63.9)	66 (15.1)
	Inadequate root filled teeth	247 (36.1)	150 (60.7)
Inadequate coronal restoration (N=268)	Adequate root filled teeth	84 (31.3)	34 (40.5)
	Inadequate root filled teeth	184 (68.7)	139 (75.5)

participants ranged from 18 to 88 years with mean age 43.9 ± 17.2 years. Out of the 350 study participants, 221 (63.1%) had at least 1 PR. The number of PR per patient varied from 1 to 7. A higher proportion of study participants had 1 PR (36.3%) followed by 2 PR (16.6%) (Table 1). Periapical radiolucency (PR) was seen in 389 (40.8%) of the 953 teeth evaluated. Out of 10149 untreated teeth, 256 (2.5%) of the teeth were found to have PR. Presence of PR was more in Mandibular and maxillary molars (56.6% and 51%) respectively (Table 2).

There was a statistically significant association of the PR with quality of coronal restoration (P -value < 0.001). The occurrence of PR was 75% less likely in cases of adequate coronal restoration than in inadequate coronal restoration (Odds Ratio 0.25). Statistically significant association was seen between the PR and quality of root filled teeth (P -value < 0.001).

were mostly due to under filling ($n=412$) and PR was present in 66.3% of cases. But in case of over filled teeth PR was seen to be more commonly associated (84.2%). Association of PR when seen with density of root filling it was more common in non-homogenous type of root filling (70.2%) (Table 5).

DISCUSSION

Recent systemic review and meta-analysis suggests apical periodontitis, appearing as PR, contributes to systemic low-grade inflammation, which can increase the risk of other pathology thereby causing impairment of systemic health.²⁸⁻³¹ Since it has been shown as a common problem worldwide it is reasonable to investigate epidemiology of PR in Nepali population.

Table 5: Distribution of Periradicular Radiolucencies in the inadequate root filled teeth

Quality of dental treatment		n (%)	Periapical radiolucency n (%)
Defective obturation (N=431)	Under obturation	412 (95.6)	273 (66.3)
	Over obturation	19 (4.4)	16 (84.2)
Density of obturation (N=431)	Homogeneous	169 (39.2)	105 (62.1)
	Non homogeneous	262 (60.8)	184 (70.2)

Table 6: Prevalence of PR, root canal treatment (RCT) and treated and untreated teeth with PR in a weighted world population in comparison to current study

Study	Sample size	Total no. of all teeth with PR (%)	Total no. of all teeth with RCT (%)	No. of treated teeth with PR (%)	No. of untreated teeth with PR (%)
Weighted world population (Jakovljevic et al 2020)	200041	6.3	7.4	41.3	3.5
Nepali Population (current Study)	10149	3.8	9.3	40.8	2.5

PR was 88% less likely to occur in cases of adequate root filled teeth than in inadequate root filled teeth (Odds Ratio 0.12) (Table 3).

PR in 60.7% of cases was seen in inadequately root filled teeth with adequate coronal restoration and in 75.5% of cases where there was inadequate coronal restoration and inadequate root filling (Table 4).

When inadequately root filled teeth were analyzed in terms of quality of root filling it was found that inadequately root filled teeth

This is the first cross sectional study to see the prevalence of periradicular radiolucencies and its association with the quality of root canal treatment and coronal restorations in an adult Nepali population.

With very less of government recruitment of dentist's, dental patients largely rely on the treatment from private sector and mostly by general dental practitioner. The number of Specialist in endodontics is low and centered in the major cities of Kathmandu Valley. To

get the information from different geographic region of Nepal, 8 centers, where OPG could be carried out were selected as many cities in Nepal still do not have this facility. Due to lower level of dental health care provided extraction might still be the prevailing treatment of choice in those places, with less facility, instead of endodontic treatment.

This study evaluated 10149 teeth representing 350 adult subjects radiographically. The sample size was calculated based on the similar study done in Indian urban population.²⁵

The cross-sectional studies although provides observational data at one point in time has a limitation of biases of interpretation because data are restricted to information available at that point in time. But at the same time, it is less prone to bias by opinion of investigator as in longitudinal studies. The large number of cases can be collected and data being easier to obtain is one of the greatest advantages of cross-sectional studies.^{13,25}

PAI scoring system is the most acceptable method to determine the periapical status in the epidemiological studies. This system has pre-defined sets of criteria that are measurable, mutually exclusive, valid, reproducible and communicable.^{17,32} Since full mouth series of periapical radiographs are not a regular practice in our country, OPG was the choice for this study. OPG is simple, fast to be used even patients with limited mouth opening. It has high specificity (86%) and sensitivity (96%) in detection of periapical radiolucency.³³

In this study of Nepali population, 40.8% of root canal treated teeth exhibited periapical radiolucency. This is within the range reported by several studies done in various countries ranging from, 15.8-59.5%.¹¹⁻²⁶

The prevalence of PR in our study was around 2.5% which is less than the weighed world average (6.3%)⁴ of prevalence of PR. Our study shows a greater number of root canal treatment being carried out when compared to world population (9.3% vs 7.4%)⁴ which goes on to show the burden of disease and its challenge in the future in Nepali population.

The quality of endodontic treatment has shown to have strong influence on the periradicular tissue status. Statistically significant association was seen between the PR and quality of root filled teeth (P-value<0.001). PR was 88% less likely to occur in cases of adequate root filled teeth than in inadequate root filled teeth (Odds Ratio 0.12) which has also been established by other studies.^{4,10}

When the root canal filling was more than 2mm short of radiographic apex or with evidence of root filling extrusion it was considered to be inadequate. In our study, 67.1% of inadequately root filled teeth were diagnosed having PR which is similar to the varying PR rates in different population studies ranging from 34%,¹⁵ 61.7%,²⁵ 72%¹⁶ to 78%.¹⁹

Furthermore, when under filled root canal was assessed for its density, PR was seen more in non-homogenous filled root canal (70.2%). The presence of PR in inadequately root filled teeth (short and non-homogenous) is due to inability to clean the long segment of root canal and leaving enough space for proliferation of residual microorganism.³⁴

There was a statistically significant association of the PR with quality of coronal restoration (P-value <0.001). The occurrence of PR was 75% less likely in cases of adequate coronal restoration than in inadequate coronal restoration with odds Ratio of 0.25. This is in agreement with previous studies.^{17,18,22,25,35}

When there was radiographic evidence of root filling material extrusion in the periapical area, PR was noticed in 84.2% (n=16) of the cases. The reason for high incidence of PR in over filled cases may be result of the over instrumentation of infected root canal and subsequent pushing of dentinal debris to the periapical area.³⁶

Similarly, 15.1% of the teeth with adequate restoration and adequate root filling still showed PR. This can be due to limitation of this study in inability to determine whether PR is healing or progressing.³⁷ Moreover, all the OPG were examined at a single point in time and this does not take into consideration the causal factors that may affect the progression of periapical healing. Such factors include treatment timing and specific clinical procedures along with it the clinicians skills and qualifications.^{37,38} To overcome the limitation of two dimensional radiograph cone beam computed tomography (CBCT) can be utilized in assessment of PR as it provides three dimensional information and it has more sensitivity for diagnosis of hard tissue changes.³⁹

The other limitation is, sample of population in this study has been extracted from 8 different dental centers located in various district of the country and due to this it was not possible to adequately analyze the quality of treatment protocols which can affect the treatment outcome.⁴⁰

Information gathered from this type of study may help policy makers understand about the

present situation and thus formulate plans for better preventive and curative management of endodontic diseases in future. Also, from educational point of view, it can be a valuable tool in evaluation and planning of future under- and post-graduate dental education.

In conclusion, inadequate root filling appears to have a significant impact on the presence of PR. Molar teeth were commonly associated with the PR. Adequate root filling and coronal restoration shows less possibility towards developing PR. Hence the considerable efforts are required to improve the length control during the procedure followed by proper restoration, to lessen the development of PR.

ACKNOWLEDGMENT

The authors would like to thank the following dental centers for providing the OPG images: Nepal Medical College Teaching Hospital (Kathmandu), 3D Dental Solutions (Lalitpur), Bhaktapur Imaging Centre (Bhaktapur), Purwanchal Dental Imaging and Diagnostic Centre (Biratnagar), Chitwan Dental Imaging and Diagnostic centre (Chitwan), Resunga Digital Xray Centre (Butwal), Pokhara Dental imaging Centre (Pokhara) and BR Dental hospital (Dang).

Conflict of interest: None

Source of research fund: None

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