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Frequency and Features of Root Canal Treatment among the Patients Visiting a Tertiary Care Center: A Retrospective Study

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ABSTRACT

Introduction: Root canal treatment is a routine endodontic procedure that preserves teeth affected by pulpal or periapical disease. Assessing its prevalence and quality provides insight into patient needs and outcomes.

Objective: To evaluate the prevalence and characteristics of root canal treatment among patients at a tertiary care dental center.

Methods: A retrospective cross-sectional study was conducted at the Department of Oral Medicine and Radiology of Kathmandu University School of Medical Sciences, Dhulikhel Hospital, Kavre, Nepal. A total of 513 panoramic radiographs of adults (January 2022- January 2023) were reviewed. Data on number and distribution of root canal treated teeth, according to gender, age, jaw, tooth type, quality of obturation, and periapical pathology, were analyzed. Ethical approval was obtained.

Results: A total of 387 root canal treated teeth were identified. Root canal treatment was slightly more common in females (51.3%) and most frequent in patients aged 20- 30 years. Maxillary teeth accounted for 55.04% of treated teeth, with the maxillary first molar (14.99%) and central incisor (11.37%) being most common. In the mandible, the first molar (21.18%) was most frequently treated. While most obturations were adequate, underfilling (18.34%), overfilling (2.06%), and periapical radiolucency (10.07%) were observed.

Conclusion: Root canal treatment was more common in younger individuals, predominantly involving molars. Although most treatments were of acceptable quality, deficiencies and periapical pathology were also noted which emphasizes the need for precise treatment and long-term follow-up.

Keywords: Endodontic treatment; periapical radiolucency; radiographs.

INTRODUCTION

Dental caries is the most prevalent oral disease, affecting individuals of all ages, and remains a major global public health concern. The World Health Organization (WHO), estimates that 2.3 billion people globally suffer from caries in permanent teeth.[1]

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In Nepal, adult caries prevalence ranges from 33% to 83%.[2,3] Despite being preventable, caries often goes untreated due to dental ignorance, lack of awareness, limited access to dental services, poverty, and the absence of routine dental checkups.[4]

If untreated, dental caries can progress to pulpal and periapical pathologies, requiring endodontic treatment, or root canal therapy. This procedure involves removing infected pulpal tissue and disinfecting the root canal system to prevent periradicular disease.[5] It helps preserve the tooth in a functional state.[6]

However, there is limited research in Nepal on the frequency of root canal treatments and related factors such as periapical radiolucency, underfilling, and overfilling.[7] Epidemiological data in this area are essential for understanding treatment patterns, guiding clinical practice, and informing oral health policies. This study aims to determine the frequency and distribution of root canal treatment at a tertiary center assessing orthopantomograms (OPGs). The findings are expected to contribute to the development of evidence-based strategies for improving oral health outcomes.

METHODS

This retrospective cross-sectional study was conducted at Department of Oral Medicine and Radiology, Kathmandu University School of Medical Sciences (KUSMS), Dhulikhel Hospital, Kavre, Nepal. A total of 513 panoramic radiographs of patients aged over 20 years, comprising both genders, were retrieved from the radiographic archives of the Department of Oral Medicine and Radiology between January 2022 and January 2023. Each radiograph was evaluated for the number of teeth present, the number of root canal–treated teeth, the status of treated teeth (underfilled or overfilled), and the presence of periapical radiolucency. Ethical approval for the study was obtained from the Institutional Review Committee of Kathmandu University School of Medical Sciences (Ref. 174/24). The sample size was calculated using the formula: $n = Z^2 p q/e^2$ where, n is the sample size, e is the desired level of precision (i.e. the margin of error), p is the (estimated) proportion of the population which has the attribute in question and q is 1 – p. Prevalence taken as 66 % of underfilled restoration as reported by Porto et al.,[8] Z= 1.96 at 95% confidence interval, p= 66%, q= 34% e = 5%, n= 345. Thus, the desired sample size is 345.

All panoramic images were acquired using a Dentium Rainbow CBCT machine (Dentium Co., Korea) with a maximum potential of 120 kVp and 150 mA. For standardization, the imaging parameters were set at 100 kVp peak voltage, 12 mA tube current, a field of view of 16 × 18 cm, voxel size of 300 µm, and a scan time of 20 seconds. The images were evaluated on a computer monitor under controlled viewing conditions, with ambient light minimized by closing all curtains.

Panoramic radiographs with clear and interpretable images were included in the study, while those with projection or image acquisition errors, motion blur, artifacts, or gross asymmetry that rendered them non-interpretable were excluded. All teeth, except third molars, were assessed. Teeth were categorized as root-filled teeth (RFT) if they demonstrated radiopaque material within the root canals. The periapical status of these teeth was evaluated using the Periapical Index (PAI) scoring system. [9] The quality of endodontic treatment was assessed as: root canal filling 0-2 mm short of radiographic apex (adequate); root canal filling >2mm short of the radiographic apex (inadequate); root canal filling extruded beyond the radiographic apex (inadequate).[10] All the measurements were done in the default viewer software of Dentium, Rainbow™ Image Viewer.

Collected data were entered manually into Microsoft Excel and subsequently analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequency and percentage, were calculated.

RESULTS

A total of 513 orthopantomograms (OPGs) that met the inclusion criteria were analyzed, of which 372 contained at least one root-filled tooth. Among the study population, 51.3% were female and 48.7% were male (Table 1). In total, 10,369 teeth were assessed on digital panoramic radiographs, and the overall prevalence of endodontic treatment was 387 teeth (3.73%).

Table 1: Distribution of patients according to gender.

Variables	Frequency/ Percentage n (%)
Male	181(48.7)
Female	191(51.3)
Total	372(100)

The age-wise distribution of patients receiving endodontic treatment is shown in Table 2. The highest prevalence was observed in the 20–30 years age group (38.2%), whereas only 3.2% of root canal treatments were recorded in patients above 60 years.

Table 2: Prevalence of Age-wise distribution of patients receiving endodontic treatment.

Age Group	Frequency/ Percentage n (%)
20-30	142(38.2)
31-40	80(21.5)
41-50	70(18.8)
51-60	68(18.3)
>60	12(3.2)
Total	372(100)

The distribution of root canal treated teeth according to tooth type is presented in Table 3. Root canal treatments were more common in the maxilla 213 (55.04%), compared to the mandible 174 (44.96%). In the maxilla, the most frequently treated teeth were the first molar, 58 (14.99%), central incisor, 44 (11.37%), and second molar, 28 (7.24%). In the mandible, the first molar, 82 (21.18%) was the most frequently treated tooth, followed by the second molar, 40 (10.34%). The mandibular lateral incisor, 6 (1.55%) and first premolar, 7 (1.81%) showed the lowest prevalence of root canal treatment.

Table 3: Prevalence of Root Canal Treated teeth in the Maxilla and Mandible.

Tooth	Maxilla n (%)	Mandible n (%)
Central Incisor	44(11.37)	11(2.84)
Lateral Incisor	24(6.20)	6(1.55)

Canines	17(4.39)	8(2.07)
First Premolar	19(4.91)	7(1.81)
Second Premolar	23(5.94)	20(5.17)
First Molar	58(14.99)	82(21.18)
Second Molar	28(7.24)	40(10.34)
Total	213(55.04)	174(44.96)

The quality of endodontic treatment and presence of periapical lesions are summarized in Table 4. Adequate obturation was observed in 308 teeth (79.60%). Inadequate treatments included short obturation in 71 teeth (18.34%) and over-obturation in 8 teeth (2.06%). Periapical lesions were detected in 39 teeth (10.07%).

Table 4: Features of endodontic treatment

Quality of Endodontic Treatment	n (%)
Adequate obturation	308(79.60%)
Short obturation (Inadequate)	71(18.34%)
Over obturation (Inadequate)	8(2.06%)
Periapical Lesion	39(10.07%)

DISCUSSION

This study aimed to assess the frequency and features of root canal treatment using digital panoramic radiographs among patients visiting a tertiary care center in Nepal. Such information is limited in the Nepalese context. Panoramic radiographs were chosen as they provide acceptable diagnostic quality with lower radiation exposure than full-mouth periapical series.[11]

In the present analysis, 3.73% of all examined teeth were endodontically treated. This prevalence lies within the wide range (1.3%–22.8%) reported in earlier studies.[12] The variation in prevalence across studies can be attributed to differences in study design, diagnostic criteria, and population characteristics. Regarding gender, 51.3% of patients with root canal–treated teeth were female. This is consistent with findings by Hollanda et al., Jain et al., and Kaur et al., who also noted a higher prevalence among women.[13–15] Women's greater health awareness, emphasis on aesthetics, and willingness to seek dental care may explain this pattern.[13,14] However, contrasting results by Wayman et al. and Al-Omari et al. indicated male predominance, suggesting that cultural and socioeconomic contexts influence treatment uptake.[16,17]

Analysis by age group showed the highest prevalence (38.2%) in individuals aged 20–30 years. This aligns with the study of Farrell's et al., which also observed a peak prevalence in the 21–30 years age group.[18] In contrast, Oginni et al. reported higher prevalence in 30–39 years in Nigeria.[19] In our study, prevalence decreased markedly in patients older than 60 years (3.2%), similar to the Nigerian findings.[19] This decline may be due to tooth loss from periodontal disease, financial limitations, fear of pain, or preference for extraction.[20] On the other hand, studies reporting higher prevalence in older age groups linked this to cumulative exposure to dental caries, wear, and restorations.[21] These findings suggest that root canal treatment demand peaks in young adulthood but decreases in the elderly due to multiple contributing factors.

Arch-wise distribution in our study showed a higher frequency in maxillary teeth (55.04%) compared to mandibular teeth (44.96%). Similar observations were made by Lupi et al Al-and Negrish et al. [11,22] This may be because maxillary teeth are more visible and aesthetically important, encouraging their preservation.[14] Conversely, Kaur et al. reported a higher prevalence in mandibular teeth.[15] Differences may reflect variations in caries distribution and patient priorities in different populations.

Among tooth types, the mandibular first molar (21.18%) was most frequently treated, followed by the maxillary first molar (14.99%) and maxillary central incisor (11.37%). This finding is consistent with Jain et al. and Ridell et al.[14,23] The mandibular first molar erupts early, often before children develop proper oral hygiene practices, and its morphology makes it highly caries-prone.[17] This underscores the importance of preventive care measures such as fluoride application, pit and fissure sealants, and oral hygiene education. In contrast, mandibular lateral incisors and canines had the lowest prevalence, in agreement with Al-Negrish et al.[22]

Assessment of treatment quality revealed that 79.60% of root canal–treated teeth had adequate obturation, while 18.34% were underfilled and 2.06% overfilled. These results are better than those reported by Webb et al., where 52.7% were underfilled.[8] The adequacy rate in this study was also higher than the 46–60% range documented by Kirkevang et al., De Moor et al., and Dugas et al.[12,10,24] This favorable outcome may reflect operator skills, adherence to treatment protocols, and the use of modern endodontic instruments.

Periapical pathosis was observed in 10.07% of endodontically treated teeth. Similar to previous studies, this may be attributed to complex root canal anatomy, root curvature, or inadequate cleaning and disinfection.[11] Persistent intra-radicular or extra-radicular infection may also contribute to the persistence of periapical lesions despite treatment.[8]

The findings of this study provide valuable insight into the frequency and features of root canal treatment in a tertiary care setting in Nepal. The results highlight the higher demand for endodontic treatment in younger adults, the predominance of molar involvement, and a generally favorable technical quality of treatment. Clinically, these observations emphasize the need for preventive interventions targeted at molars from an early age, along with continuous monitoring of treatment outcomes to minimize periapical pathology.

This study has certain limitations. First, it relied solely on two-dimensional orthopantomograms (OPGs), which have lower diagnostic accuracy compared to three-dimensional imaging modalities such as cone-beam computed tomography (CBCT) or combined clinical and radiographic evaluation. Second, the time since root canal treatment was not considered, which may influence the interpretation of periapical status, as a periapical scar could be misdiagnosed as pathology. Third, the data were derived from a single tertiary care center, which may not fully represent the broader population, and the geographic limitation reduces the generalizability of the findings.

CONCLUSION

In our study, the root canal treatment was more common in younger age groups and showed female predilection. Maxillary teeth, particularly molars and incisors, were more frequently treated than mandibular anterior teeth, while mandibular molars were the most commonly treated teeth in the lower arch. Most treatments were of adequate quality, although some patients still presented with periapical pathology, emphasizing the importance of precise treatment and long-term monitoring. Future research should focus on multicenter studies with broader populations and incorporate clinical examination and advanced imaging techniques for more accurate evaluation of treatment outcomes. Efforts should also be directed toward preventive oral health strategies, early detection, and regular follow-up care to improve the overall quality and success of endodontic treatments.

Conflict of Interest: None

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