FREQUENCY AND PATTERN OF ROOT RESORPTION ON RADIOGRAPHIC INSPECTION SAIDU COLLEGE OF DENTISTRY, SWAT – A CROSS-SECTIONAL STUDY

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ABSTRACT

OBJECTIVES

This study aimed to determine the frequency and pattern of root resorption through radiographic evaluation at Saidu College of Dentistry, Swat.

METHODOLOGY

A cross-sectional survey was conducted at Saidu College of Dentistry, Swat, on 204 cases using the non-probability consecutive sampling method. Patients aged 14 and older, of both genders, and Pakistani nationals were included, provided they had complete radiographs and demographic data. Cases with unclear radiographs, systemic bone disorders, or prior root canal treatment were excluded. Root resorption was categorized into apical (ARR), internal inflammatory (IIRR), and external (ERR) based on radiographic findings. Chi-square/Fisher exact tests applied to stratify root resorption patterns by age and gender at a significance level of $p<0.05$.

RESULTS

The mean age was 25.63 ± 6.22 years, with 103 (50.49%). Root resorption was present in 29 (14.22%) cases, with ARR being the most frequent (19, 9.31%), followed by ERR (6, 2.94%) and IIRR (4, 1.96%). Males had a higher prevalence of resorption (17, 58.62%) than females (12, 41.38%), though this was not statistically significant ($p=0.29$). ARR was significantly more common in males (15, 78.95%), whereas ERR was exclusively observed in females (6, 100%). IIRR was equally distributed between genders (2, 50% each) and was found exclusively in younger individuals (4, 100%). Age group differences were not statistically significant ($p=0.53$), but ARR (13, 68.42%) and ERR (5, 83.33%) were more common in the 14–30 years group.

CONCLUSION

Root resorption was observed in quite a high number, with apical resorption being the most common, followed by external and internal inflammatory resorption.

KEYWORDS: *Root Resorption, Gender, External Root Resorption, Radiographic Evaluation*

INTRODUCTION

Root resorption is a condition where the dental structure decreases in length or thickness due to the loss of dentin and cementum.[1] While it is a normal process during the shedding of primary teeth, it becomes a concern when it affects permanent teeth.[2] This occurs due to various factors, such as inflammation, trauma, orthodontic treatment, systemic diseases, or prolonged pressure on the teeth.[3] Root resorption can weaken the tooth and compromise its stability if left untreated. Persistent periapical infections, pulp necrosis, and endodontic disorders initiate resorptive processes by releasing inflammatory mediators, including cytokines, prostaglandins, and tumor necrosis factor-alpha (TNF-α).[4] Traumatic dental injuries, such as luxation or avulsion, can compromise the integrity of the periodontal ligament, resulting in progressive resorption.[5] Excessive or prolonged orthodontic forces may precipitate external root resorption, particularly at the apical region.[6] Additionally, systemic conditions such as hyperparathyroidism, Paget's disease, and metabolic disorders affecting bone remodeling can further exacerbate resorptive phenomena.[7] Root resorption is generally categorized into external and internal types, each with distinct etiologies and clinical implications. External root resorption originates from the root's outer surface and encompasses several subtypes, including apical, cervical, and inflammatory external resorption. Apical external resorption is frequently observed in orthodontic patients, whereas external cervical resorption typically arises from traumatic injury or bacterial infiltration.[8] Inflammatory external resorption is commonly associated with chronic periapical infections, leading to progressive structural loss. In contrast, internal root resorption

begins within the canal, often triggered by pulpal inflammation or necrosis. This process is typically asymptomatic and is usually identified incidentally through radiographic evaluation.[9] The diagnosis of root resorption primarily depends on radiographic evaluation. Intraoral periapical radiographs (IOPAR) are the conventional imaging method for detecting resorptive lesions; however, their two-dimensional nature limits the ability to assess the extent of tissue damage accurately.[10] In contrast, cone-beam computed tomography (CBCT) has emerged as a more advanced diagnostic tool, offering superior accuracy through detailed cross-sectional imaging and allowing for a more comprehensive evaluation of the affected teeth.[11] Root resorption is a common clinical finding, yet little is known about how often it occurs or how its patterns vary across different age groups and genders in our population. This study aims to examine the frequency and types of root resorption through radiographic analysis, shedding light on its clinical significance and the reliability of current diagnostic methods. Notably, no local research has been conducted on this topic, emphasizing the need for region-specific information. This study aimed to determine the frequency and pattern of root resorption on radiographic inspection.

METHODOLOGY

This cross-sectional survey was conducted at Saidu College of Dentistry, Swat, utilizing the available periapical and panoramic radiographs from July 1, 2024, to December 30, 2024. A non-probability consecutive sampling technique was used to include all eligible cases of radiology records. These radiographs were acquired through dental treatment as advised by various dental departments. Informed consent was previously obtained as part of the treatment process, allowing for the anonymized use of patient records for research purposes. Ethical approval was obtained from the concerned ethical committee (151/SCD/Ethical/Certificate). This study included patients aged 14 and older, of both genders, who were Pakistani nationals. Only records with complete periapical or panoramic radiographs and accurate age and gender information were considered. Cases were excluded if the radiographs were unclear or had artifacts that could affect diagnosis. Patients with conditions like hyperparathyroidism, hypoparathyroidism, or other bone disorders that could impact root structure were also excluded. Additionally, teeth that had previously undergone root canal treatment were not included, which could influence root resorption. The sample size was calculated to be 204 using OpenEpi, based on a 15.7% prevalence of root resorption.[12] With a 5% margin of error and a 95% confidence level. The operational definitions of root resorption used in this study were: Apical Root Resorption (ARR), which is characterized by the loss of root structure at the apex, detected as irregular radiolucency at the root tip on periapical radiographs/OPG; Internal Inflammatory Root Resorption (IIRR), which involves radiolucent areas within the root canal, often with well-defined borders, indicating resorption of dentin from inside the canal due to inflammation; and External Root Resorption (ERR), which is the irregular loss of the external root surface, appearing as radiolucency's along the root periphery and commonly associated with trauma, infection, or adjacent pathology.[13] Data collection involved retrieving demographic information (age and gender) from patient records, and radiographs were assessed by two independent examiners, with any discrepancies being resolved through discussion. Data analysis was performed using R software 4.3.1, and descriptive statistics were applied to determine the frequency and distribution of the different types of root resorption. Chi-square/Fisher exact test was run to stratify frequency and pattern of root Resorption by gender and age group at $p<0.05$ significant level.

RESULTS

The study included 204 patients with a mean age of 25.63 years. The gender distribution was nearly balanced, featuring 103 females (50.49%) and 101 males (49.51%). Most patients (161, 78.92%) were aged between 14 and 30, while 43 (21.08%) were in the 31–46 age group. Radiographic evaluations revealed root resorption in 29 patients (14.22%). Of these, apical resorption was the most prevalent pattern, occurring in 19 cases (9.31%), followed by external resorption in 6 cases (2.94%) and internal inflammatory resorption in 4 cases (1.96%). A more significant proportion of males (17, 58.62%) exhibited resorption compared to females (12, 41.38%), but this difference was not statistically significant ($p = 0.29$). Additionally, root resorption was more common in the older age group (7, 24.14%) than in the younger group (22, 75.86%), although this difference was also not significant ($p = 0.66$). Statistically significant gender differences were observed in apical resorption, predominantly affecting males (15, 78.95%), while external resorption was exclusive to females (n=6). Internal inflammatory resorption was evenly distributed between genders (n=2 each). Apical resorption was more frequently observed in the younger age group (n=13, 68.42%), and external and internal resorption were more prevalent in this demographic.

Table 1: Demographic Distribution of the Patients

Characteristic	N = 204
Age in years	25.63 ± 6.22
Gender	
female	103 (50.49)
male	101 (49.51)
Age Group	
14- 30	161 (78.92)
31- 46	43 (21.08)

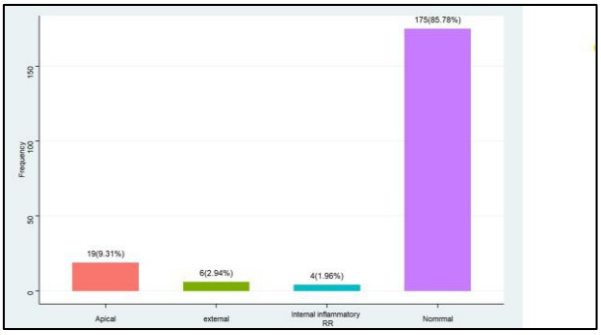

Figure 1: Pattern of Root Resorption

Table 2: Frequency of Root Resorption in Overall, among Gender and Age Groups on Radiographic Evaluation

Characteristic	Normal, N = 175	Resorbed , N = 29	P-Value
Overall	175 (85.78)	29 (14.22)	
Gender			
Female	91 (52.00)	12 (41.38)	0.29
Male	84 (48.00)	17 (58.62)	
Age Category (year)			
14- 30	139 (79.43)	22 (75.86)	0.66
31- 46	36 (20.57)	07 (24.14)	

*Chi-square test

Table 3: Pattern of Root Resorption in Overall, Among Gender and Age Groups on Radiographic Evaluation

Characteristic	Apical, N=19	external, N=6	Internal inflammatory RR, N=4	Normal, N = 175	p-value
Gender					
Female	04 (21.05)	06(100.00)	02 (50.00)	91 (52.00)	
Male	15 (78.95)	0 (0.00)	02 (50.00)	84 (48.00)	
Age group (years)					
14- 30	13 (68.42)	05 (83.33)	04 (100.00)	139 (79.43)	0.53
31- 46	06 (31.58)	01 (16.67)	0 (0.00)	36 (20.57)	

*Chi-square test

DISCUSSION

Root resorption, a phenomenon frequently associated with periapical pathologies, varies significantly in prevalence, distribution, and severity across studies. In the present study, radiographic assessment identified root resorption in 14.22% of patients, with apical root resorption (ARR) being the most common (9.31%), followed by external (2.94%) and internal inflammatory root resorption (1.96%). The higher prevalence of ARR may be attributed to its frequent association with orthodontic treatment, periapical infections, or traumatic injuries, which are more commonly encountered in clinical practice.[14] Although the overall prevalence of root resorption did not significantly differ between males and females, specific patterns emerged. Apical resorption was substantially more frequent in males, whereas external resorption was exclusively observed in females. Age-wise, while resorption was more common in older individuals (31-46 years), the difference was not statistically significant. These findings contrast with previous studies that reported a higher root resorption prevalence.[15,16,17] A radiographic study on inflammatory periapical pathologies found ARR in 40.5% of cases, with periapical granuloma and cysts being the most affected (72.8%), followed by periapical abscesses (35%) and acute apical periodontitis (18.1%). Interestingly, this study also noted a male predominance (58.5%), whereas external root resorption was more frequently reported in females.[18] Conversely, a cross-sectional study in Indore analyzed orthopantomograms (OPGs) of 656 subjects with periodontitis and found that 34.5% exhibited external root resorption (ERR). Among these, males had a higher prevalence (38.6%) than females (30.6%), indicating a significant association between gender and ERR occurrence.[19] Wei et al. reported ARR in 40.5% of cases among patients with inflammatory periapical pathologies, with periapical granuloma and cysts being the most affected (72.8%), followed by periapical abscesses (35%) and acute apical periodontitis (18.1%). Interestingly, this study also noted a male predominance (58.5%), whereas external root resorption was more frequently reported in females.[15] Similarly, Nandhini et al. found that external root resorption was significantly more common in females (60%) and primarily affected posterior teeth, particularly in the 36-55 age group.[17] In contrast, Gabor et al. demonstrated a strong correlation between internal inflammatory root resorption and pulpal inflammation, with resorption detected in 50% of teeth with pulpitis and 77% of necrotic teeth.[16] The severity of internal resorption increased with disease progression, with most lesions localized in the middle third of the root canal. These findings align with the established role of inflammatory mediators, such as cytokines and prostaglandins, in stimulating odontoclastic activity, leading to root resorption.[20] Our study also found more root resorption in old ages. Cone-beam computed tomography (CBCT) has been shown to improve detection accuracy, particularly for subtle or intracanal resorptive changes, but concerns regarding radiation

exposure limit its routine use. Given these findings, a more comprehensive diagnostic approach integrating advanced imaging modalities and clinical risk assessment is necessary to improve root resorption's early detection and management.[21] This study has several strengths. Using both periapical and panoramic radiographs improved the detection of root resorption types. The sample size was calculated based on reported prevalence rates, ensuring reliable statistical power. Independent evaluation by two examiners reduced observer bias, while stratification by age and gender provided a clearer understanding of demographic patterns. However, the study also has some limitations. The cross-sectional design limits the ability to establish causal relationships between root resorption and its associated factors. The study was conducted at a single center, which may limit the generalizability of the findings to other populations. Non-probability consecutive sampling may introduce selection bias, potentially affecting the sample's representativeness. Radiographic assessment alone may underestimate the prevalence of root resorption, as mild cases might not be detectable without histological examination. The study's retrospective nature relied on pre-existing patient records, which could introduce information bias if records were incomplete or inaccurate.

LIMITATIONS

The study is limited by its cross-sectional design, preventing assessment of the progression of root resorption over time. Being a single-center study, the findings may not be generalizable to other populations. Radiographic limitations, including the lack of three-dimensional imaging like CBCT, may result in diagnostic inaccuracies. Observer bias in radiographic interpretation could also affect reliability. Additionally, the study does not include histological confirmation, and potential confounding factors such as orthodontic treatment, trauma, or systemic conditions may not be fully accounted for.

CONCLUSIONS

Root resorption was observed in many cases, with apical resorption being the most frequently encountered type, followed by external and internal inflammatory resorption. Gender differences were present, with apical resorption more common in males, while external resorption occurred only in females. Internal inflammatory resorption was evenly distributed between both genders. Age did not significantly impact overall frequency, but internal inflammatory resorption was found exclusively in younger individuals.

CONFLICT OF INTEREST: None

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