

Morphometric Measurements of Root Anatomic Areas of Maxillary First Premolar Teeth in a Representative Nepalese Population

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ABSTRACT

Background

The prognosis of furcation involved maxillary first premolar is typically guarded to poor. The presence of concavities in the root trunk and the positioning of the roots in the buccal and palatal regions of the teeth are responsible for its challenges during instrumentation and control plaque. We aimed to assess the presence of concavities on the root surface as well as morphometric measurement of the root trunk dimensions in the maxillary first premolar teeth in Nepalese population.

Methods

A cross-sectional quantitative study was conducted in the Department of Periodontics and Oral Implantology, College of Medical Sciences (CoMS). Extracted Maxillary first premolar teeth were evaluated for the number of roots, morphometric measurement of the root trunk, root divergence, and root length. The presence of concavities was recorded on the mesial and distal root surface at cervical, middle, and apical thirds of the root.

Results

The overall mean root trunk length was less on the mesial aspect than on the distal aspect (6.39 ± 2.54 and 8.08 ± 3.48 respectively). The prevalence of root surface concavity on the cervical third at the mesial aspect (90%) was found to be higher than in the distal aspect (15%).

Conclusions

Owing to the higher prevalence of root surface concavity on the cervical third of mesial aspect, use of mini-bladed curettes is recommended for the effective root surface debridement of the periodontally involved maxillary first premolar tooth. Patients with periodontally involved maxillary first premolar should be advised to use interdental brushes rather than dental floss.

Keywords: furcation trunk; periodontitis; plaque control; root concavities.

INTRODUCTION

Maxillary first premolar have a complex root anatomy having inimitable anatomical features comprising bifurcated roots, narrow furcation entrance, deep mesial concavities, and multiple canals.¹ The topography of such multirooted tooth prevents appropriate instrumentation access which in turn allows pathogenic microbial flora to persist and renders them inaccessible for

periodontal therapy.² Effective management of the furcation area necessitates a better understanding of the furcation and root surface anatomy.² There is paucity of literature assessing the root surface concavities and morphometric measurements of the furcation area of the maxillary first premolar teeth in Nepalese population. This study aimed to assess the presence of concavities on the root surface as well as morphometric measurement of the root trunk

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dimensions in the maxillary first premolar teeth in Nepalese population.

METHODS

A cross-sectional quantitative study was conducted in the Department of Periodontics and Oral Implantology, College of Medical Sciences (CoMS), Bharatpur. Specimen were obtained from the Department of Oral & Maxillofacial Surgery, CoMS, Bharatpur during the period of 2nd Oct 2023 – 19th Feb 2024 after obtaining ethical clearance from Institutional Review Committee of CoMS (COMSTH-IRC/2023-118). Sample size of 138 was calculated using the formula, $n = \{(Z_{\alpha/2} Z_{\beta})^2 \times 2 \times SD1 \times SD2\} / d^2$. Where, $Z_{\alpha/2}$: Standard normal Z value for a significance level $\alpha = 0.05$ which is 0.96, Z_{β} : Standard normal Z value for the power of 80% which is 0.54, SD: Standard deviation = 2.8, 2.7³, d: Difference in mean = 0.3. Tooth indicated for extraction, provided the tooth structure is sound were included in the study. Maxillary first premolar teeth either from right or left side were included. Any maxillary first premolar with evidence of caries, restorations, or extraction damage

surface concavities. Identification of maxillary first premolar was confirmed by characteristic coronal morphological features. It was distinguished from the second premolar which lacks such characteristic features of identification. The measurements were taken using digital vernier caliper. Teeth were evaluated for the number of roots, morphometric measurement of the root trunk, root divergence, and root length. The presence of concavities was observed on the proximal aspect (mesial and distal) root surface at three different thirds of the root (cervical, middle and apical).

RESULTS

Out of the 138 maxillary first premolars studied, 47 (34.06%) were found to have single root, 42 (30.43%) double root, 26 (18.84%) fused root, 22 (15.94%) were fused at distal aspect and only 1 (0.72%) three roots. The overall mean root trunk length was less on the mesial aspect than the distal aspect (6.39 ± 2.54 and 8.08 ± 3.48 respectively). The root divergence was 4.35 ± 1.38 in the double rooted premolars. The buccal root length was greatest on the buccal aspect

Table 1. Morphometric measurements of samples studied.

Root form	Frequency (%)	Root trunk length- mesial	Root trunk length- Distal	Root divergence	Root length- Buccal	Root length - Palatal
Single root	47 (34.06)	-	-	-	13.81 ± 1.36	13.72 ± 1.29
Double root	42 (30.43)	6.59 ± 2.48	6.85 ± 2.56	4.35 ± 1.38	12.66 ± 1.46	12.18 ± 1.36
Fused	26 (18.84)			2.3 ± 0.7	13.3 ± 1.4	13.0 ± 1.2
Fused at distal only	22 (15.94)	6.48 ± 2.02	10.85 ± 2.4	3.15 ± 1.28	13.65 ± 1.32	13.25 ± 1.39
Three roots	1 (0.72)	8.61	14.88	1.33	13.92	15.6
Overall Mean \pm SD	138 (100)	6.39 ± 2.54	8.08 ± 3.48	3.43 ± 1.50	13.34 ± 1.45	13.06 ± 1.45

beyond the CEJ were excluded.³ After the teeth had been extracted, it was placed in a container containing 10% formalin. The teeth were cleaned form external remnants and the morphometric measurements were recorded⁴ and assessed for the presence of root

expect in three rooted premolars (Table 1). The observation of concavity revealed that the concavity on the mesial aspect of tooth was greatest in number on the cervical third (124, 89.86%) and on the distal aspect concavity was present on the middle

Table 2. Frequency (%) of concavity observed in the samples studied.

Concavity	Concavity on mesial aspect of the tooth			Concavity on distal aspect of the tooth		
	Cervical third	Middle third	Apical third	Cervical third	Middle third	Apical third
Present	124 (89.86)	122 (88.41)	76 (55.07)	21 (15.22)	115 (83.33)	63 (45.65)
Absent	14 (10.14)	1 (0.72)	9 (6.52)	117 (84.78)	13 (9.42)	31 (22.46)
Root separated	0	15(10.87)	53 (38.41)	0	10 (7.25)	44 (31.88)

third (115, 83.33%). The absence of the concavities on mesial aspect and distal aspect was greatest on the middle third (1, 0.72% and 13, 9.42%; respectively) (Table 2).

DISCUSSION

The present study found 47 (34.06%) single root, 42 (30.43%) double root, 26 (18.84%) fused root, 22 (15.94%) were fused at distal aspect and only 1 (0.72%) three roots. The fused-root form without noting its internal canal morphology, was often regarded as one-root, which in fact, it was not.⁵ This study has separated and demarcated the fused and single rooted separately. The incidence of two-root and fused-root forms is common in the western nations. Populations can be distinguished from one another using morphological characteristics, such as the maxillary first premolar's root form.⁵ Pedersen noted that the dentition of the East Greenland Eskimo people had an incredibly high frequency of one-root maxillary first premolars.⁶ According to Tratman, the two-root form was very unusual in Mongoloid people.⁷ Two-root form was more common in Singaporeans (50.6%), while one-root form accounted for 49.4% of cases, according to Loh.⁵ There was no three-root form found. According to Study,⁸ 30.8% of Jordanians have one root, 63.2% have two, and 5.2% have bifid roots. The overall root divergence in the sampled population showed 3.43 ± 1.50 mm of divergence. The divergence was greatest among the double rooted premolars (4.35 ± 1.37). Study by Joseph et al.,⁹ found the mean root divergence to be 3.0 ± 1.79 . The results from the current study shows that the mean length of root trunk on distal aspect is greater than of the mesial aspect (8.08 ± 3.48 and 6.39 ± 2.54 respectively). A study conducted in India on 100 extracted premolars found that the mean length of the root trunk to be 7.9 ± 2.8 on the mesial aspect and 7.6 ± 2.7 on the distal aspect.³ When the furcation of the maxillary first premolar is involved, the prognosis is typically guarded to poor. This is because the roots are positioned in the buccal and palatal regions of the teeth, which makes it challenging to instrument during periodontal therapy and control plaque for home care measures. The furcation entrance is located on the mesial and distal portions of the tooth.⁹ Plaque and calculus find niches in the furcal concavity and the concavities on the root trunk. These areas are not accessible during root planing, hence the accretions

usually remain in place. It's also challenging to maintain these areas after therapy. These concavities need to be taken into account because they could result in a poor prognosis.⁹ According to Beube, maxillary bicuspid furcation involvement is typically a sign of significant bone loss and probing depths close to the apices of their roots. Such tooth was recommended for extraction.¹⁰ The concavity in the maxillary first premolar is characteristic to this tooth.¹¹ The findings of the present study showed that the concavity on the mesial aspect of tooth was greatest in number on the cervical third (124, 89.86%) and on the distal aspect concavity was present on the middle third (115, 83.33%). The absence of the concavities on mesial aspect and distal aspect was greatest on the middle third (1, 0.72% and 13, 9.42%; respectively). Zhao et al.¹² in his study showed the prevalence of mesial and distal root concavities as 39.3% and 100% respectively. Several studies^{10,12-14} have found root concavities to be 100%. A study¹⁵ revealed that the concavity depths of the maxillary first premolar at the coronal and middle third of proximal aspects. The study noted the concavities as well as categorized it based upon the location on the root surface. A study by Fox and Bosworth revealed that the root concavities present in maxillary first premolar was associated with attachment loss when compared with nonconcave surface.¹⁶ In addition the such concavities were also more prone to higher mean probing depth and plaque accumulation suggesting such teeth to be promoting periodontal disease.¹² Joseph et al revealed that the deeper concavities were more in mesial aspect of teeth with both bifurcated and fused roots than on the distal aspect.⁹ Booker et al showed that the concavities were also closer to the pulp and cause root sensitivity during plaque control process and were also associated with pulp death. As with earlier studies Booker et al also revealed deeper mesial concavity.¹³

CONCLUSIONS

Based on the findings of higher prevalence of root surface concavity, use of mini bladed curettes is recommended for the root surface debridement of periodontally involved maxillary first premolar tooth. Use of interdental brushes rather than dental floss should be advised to those patients for regular home care measures so as to reach root surface concavities

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