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Root morphology of maxillary 1st premolar teeth in orthodontic extraction cases presenting in a tertiary care hospital: Taxilla Cantt.

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ABSTRACT... Objective: To observe pattern and variation of root morphology of maxillary 1st premolar teeth in orthodontic extraction cases among local population. **Study Design:** Prospective Observational study. **Setting:** Dental College-HITEC Institute of Medical Sciences-Taxilla Cantt. **Period:** 1st January 2017 to 31st December 2019. **Material & Methods:** A total of 160 patients and 320 maxillary 1st premolars were studied clinically for gross root morphology after orthodontic tooth extraction, variation of gross root morphology was studied among extracted teeth, frequency distribution was observed on basis of gender and both quadrants in each patient, a critical analysis is also made about variation of root morphology among various populations across the world. **Result:** Out of 160 patients, 49 were males and 111 were females. 151 patients had bilateral similar root morphology, out of 320 clinically examined teeth 206 had two roots, and 123 teeth had fused root morphology, 83 teeth had two bifurcated (separate) roots while 114 teeth were single rooted. **Conclusion:** Maxillary 1st premolar is unique in terms of wide variation in root morphology which is evident among various population studies. Two roots with fused root morphology is most prevalent in Pakistani population.

Key words: Atraumatic, Extraction Technique, Maxillary 1st Premolar, Orthodontic Tooth Extraction, Periotome, Root Morphology.

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INTRODUCTION

One of the first orthodontists to indicate permanent tooth extractions for correction of malocclusions was Charles Tweed, who found that only 20% of his clinical cases treated without extractions were successful.¹ It is clearly evident that extractions are inevitable in most of orthodontic treatment cases.

Maxillary 1st premolars are most common tooth to extract for orthodontic treatment purpose because of their position and compatible size with most types of discrepancies in cases that require the retraction of anterior teeth.¹

Consistent coronal description of this tooth is well explained in literature, but variation in root morphology is evident among various populations, with a higher incidence, which makes this tooth quite distinctive.²

Its variation of root morphology has been a topic of interest, it has been studied among various Asian populations, like East-Asian (Chinese)³, South-Asian (Nepalese)⁴, South-East Asian (Singaporean)⁵ and West-Asian (Saudi Arabia and Jordanian)^{6,7} along with Africans and Europeans. No study has yet been put forward among Pakistani population.

Roots may easily get fractured if early luxation is too vigorous.⁸ A maxillary universal forceps is typically used for these teeth to be extracted. Initially, the forceps is seated and pushed apically, Careful buccal-palatal movement, allowing time for the bone to expand under firm pressure, is repeated until the alveolar bone is expanded, the tooth is mobile, and the periodontal attachment loosened.⁹

Although an atraumatic extraction technique like

use of physics forceps or periostomes can also be advocated.¹⁰

Gross root morphology of maxillary 1st premolar and its variation among our local population should be clearly understood and appreciated by oral surgeons, who are extracting these teeth for orthodontic treatment and planning.

Rationale and Aim of this study is to assess root form of maxillary 1st premolar tooth among our indigenous Pakistani population which will help oral surgeons to avoid any uneventful extraction scenario like root fracture which may lead to "surgical extraction", which is not desired when extraction is for orthodontic purpose.

A thorough knowledge of gross root morphology of local population and a careful extraction technique is thus required in view of its variable root morphology to employ an atraumatic extraction with avoidance of root break or bone loss with maximum socket preservation.

METHODOLOGY

The study design is prospective (descriptive), which is conducted at Oral & Maxillofacial Surgery Department of Dental College-HITEC Institute of Medical Sciences. All the patients presented in Orthodontics Department of Dental College-HITEC Institute of Medical Sciences from 1st January 2017 to 31st December 2019, which met with inclusion criteria are included in the study.

A total of 160 patients (males and females) were included and $160 + 160 = 320$ teeth were observed in terms of gross root morphology. Extraction was performed under local anesthesia, each patient had bilateral extraction from both right and left maxillary quadrant. Data was collected from Oral & Maxillofacial Surgery Department, which included only the patients referred from Orthodontic Department of same hospital. All subjects of this study were candidates of maxillary 1st premolar extraction bilaterally, between the ages of 12 years to 25 years. Patients who were not orthodontic treatment extraction cases, referred from other settings, extractions other than 1st pre-molar maxilla, cleft lip & palate, patients with syndrome

condition, and teeth that were grossly carious are not included in this study. Informed consent was taken from each patient for inclusion in this study, every patient was well versed with rationale of extraction. Study was conducted after approval from ethical review board (ERB), held on 22nd December 2016, with IRB letter number F.2/2020/ERB/DC/HITEC-IMS.

Extracted maxillary 1st premolars were divided into four groups according to root morphology
Group I: single rooted
Group II: two rooted (fused)
Group III: two rooted (separate)
Group IV: three rooted

These above mentioned groups were compared in terms of frequency distribution and percentage among both quadrants in each patient, on basis of right and left quadrant among all patients, gender distribution was also noted.

SPSS version 26 was used for statistical data analysis, descriptive analysis of variables (root morphology groups and gender distribution) is calculated, level of significance was kept as $P=0.05$. Chi-square test was applied to observe variation of root morphology among both genders.

RESULTS

A total of 160 patients were included in study and 320 teeth were examined for root morphology after extraction.

Out of 160 patients, 49 were male and 111 were females which is 30.6% and 69.4% respectively with mean age of 17.3 years (Table-I)

Table-II explains Root morphology in Right quadrant, as 35.6 %, 38.1% and 26.3% for group I (single root), group II (two roots-fused) and group III (two roots-separated) respectively.

Similarly Table-III explains Root morphology in Left quadrant, as 35.6%, 38.8% and 25.6% for group I (single root), group II (two roots-fused) and group III (two roots-separated) respectively. Table-IV explains percentage and frequency of

Group I, II and III among males and females. Males presented with group I= 25 teeth, group II=42 teeth, group III= 31 teeth with 25.5%, 42.8% and 31.6 % respectively. Female patients had distribution of tooth morphology as group I = 89, group II were 80 and group III= 53 with 40.1%, 36.1% and 23.8% respectively. P value 0.067 is statistically not significant, thus difference of root morphology variation is not significant among genders.

Out of all 320 examined teeth, 114 teeth (35.6 %) were group I, 122 teeth (38.1%) were group II, 84 teeth (26.3%) were group III, while no tooth lied in group IV category. Thus two root morphology was most prevalent with group II + group III (38.1+26.3%) =64.4%, along with the fact that two root- fused form (group III) highest among all variations.

Bilateral root morphology was similar in 151 patients with exception in 9 patients. 3 male and 6 female patients showed morphology variation among right and left quadrant

Male patients showed group II in 20 patients bilaterally, group III in 15 patients bilaterally, group I in 11 patients bilaterally, while 3 patients had variation among right and left quadrant, with

left side group I in all 3 patients and right side variation of group II in 2 patients and group III in 1 patient.

111 total females were studied with 222 teeth in both quadrants, gross morphology was same bilaterally except of 6 patients which presented with right side group II and left side group III in 2 patients, right side group I and left side group II in 3 patients and 1 patient presented with right side group III with left side group II root morphology.

Age	Mean (SD)
	17.3 (3.71)
Gender	N (%)
Female	111 (69.4)
Male	49 (30.6)

Table-I. Socio demographic characteristics.

	Frequency	Percent
group I	57	35.6
group II	61	38.1
group III	42	26.3
Total	160	100.0

Table-II. Right quadrant root morphology.

	Frequency	Percent
group I	57	35.6
group II	62	38.8
group III	41	25.6
Total	160	100.0

Table-III. Left quadrant root morphology.

Classification of Roots	Female	Male	Total
Single root (Group I)	89 teeth (40.1%)	25 teeth (25.5%)	114(35.6%)
Two roots –fused(Group II)	80 teeth (36.1%)	42 teeth (42.8%)	122(38.1%)
Two roots –separate(Group III)	53 teeth (23.8%)	31 teeth (31.6%)	84(26.3%)
P value	0.067		320(100%)

Table-IV. Percentage of roots in the first maxillary premolar by Gender.

Author (year)	Country	No. of Teeth	One Root %	Two Roots %	Three Roots%
Lipski et al. (2005) ¹²	Poland	142	15.5 %	75.3 %	9.2%
Loh (1998) ⁵	Singapore	957	49.4 %	50.6 %	0%
Chaparro et al. (1999) ¹⁵	Spain	150	40.0 %	56.7 %	3.3%
Awawdeh et al. (2008) ⁷	Jordan	600	30.8 %	68.4 %	0.8%
Atieh (2008) ⁶	Saudi Arabia	246	17.9 %	80.9 %	1.2%
Ozcan et al. (2012) ¹⁴	Turkey	653	45.2 %	53.7 %	1.1%
Rwenyonyi et al. (2011) ¹³	Uganda	202	26.7 %	73.3 %	0%
Koçani, Ferit, et al. (2014).	Kosovo	221	21.7 %	70.14 %	8.14%
Senan, Elham M., et al. (2018) ¹¹	Yemen	250	54.8 %	44.4 %	0.8%
Tian YY et al(2012) ³	China	300	66%	33%	1%
Kafle Dashrhat; et al. (2015) ⁴	Neepal	100	58%	41%	1%
Present study	Pakistan	320	35.6%	64.4%	0

Table-V. Variation of Maxillary 1st Premolar root morphology among various populations worldwide.

DISCUSSION

Various populations when studied for gross root morphology of maxillary premolar teeth showed wide variation among maxillary 1st premolar teeth^{11,12}, but 2nd premolar teeth has consistent morphology in most populations. Table-V explains variation of maxillary 1st premolar root morphology among various populations worldwide. In our study, maxillary 1st premolar teeth were studied only. This study revealed that two root form is more prevalent than single root form, along with the fact that fused root morphology is even more prevalent, this fact is similar with population of Jordan where 68.4% population has two roots out of this 63.2% have fused while 5.2% has bifurcated root morphology, on the other hand 73.3% of Uganda¹³ population has two root form in maxillary 1st premolar tooth with only 16.9% are fused roots and remaining is bifurcated root morphology. Poland, Saudi Arabia, Kosovo, Turkish¹⁴ and Spain¹⁵ also has population with prevalence of two root form. Three roots were not observed in any of patient in this study which is similar to Uganda and Singaporean population. Three roots are evident among various other populations but in a very less proportion, thus its clinical significance should always be considered as a rare possibility.

X Liu et al in 2019 studied Chinese population and revealed single root in max 1st premolar as high as 72.2%, whereas Tian YY et al in 2012 revealed 66% prevalence of single root morphology, these results show variation from other Asian populations like Saudi Arabia, Pakistan, Singapore, Jordan and Turkey, where two root forms are more prevalent. Yemeni and Nepalese also have single root morphology more prevalent, same as Chinese population. These result shows a wide variation of root morphology of this tooth across the continents as well among Asian population.

H.S Loh in 1998 studied 957 maxillary 1st premolars, among Singaporean population, results revealed two roots with fused morphology as high as 32.1 %, results are close to Pakistani population as 38.2 %, in his study two roots were as high as 50.6% and single root morphology was found in 49.4% patients.

Maxillary 1st premolar is considered as a difficult tooth in terms of endodontic treatment also, due to its variation in number of roots, canal configuration, the direction and longitudinal depressions of the roots, and various pulp cavity configurations. Its gross root morphology is important to be understood along with prevalence of various root forms for oral surgeons, because it is most common tooth be extracted in orthodontic treatment plan, and atraumatic tooth extraction is almost always required in orthodontic extractions.

In our department of oral & maxillofacial surgery all the orthodontic extraction teeth were delivered atraumatically via extraction forceps, only 4 teeth had broken roots during extraction, all these 4 teeth had two roots which were bifurcated, thin and flared thus bifurcated root form carries risk of broken roots during extraction, patients were informed about broken tooth root, 1 tooth root was left in situ with consultation and informed consent of patient and orthodontic department, due to the reason of close proximity to maxillary sinus and smaller size of root remnant, above mentioned decision was made, other 3 tooth roots were removed surgically via removing inter radicular bone only, thus buccal and palatal cortices were remained intact.

There are no possible limitations in this study, although other studies used various tools to study root and canal morphology like plain radiographs, use of CBCT along with clinical examination of gross root morphology¹⁵, but rationale of this study was to observe gross root morphology for orthodontic extraction purpose only, thus clinical examination was enough to gather required information.

CONCLUSION






There is increased propensity of two roots with fused root morphology in Pakistani population. Root morphology of maxillary 1st premolar tooth shows wide variation among various ethnicities.

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