Root Form and Morphology of Human Permanent Maxillary First Premolars of an Indo-Dravidian Population Based in Southern India: An In Vitro Study

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Aim: The aim of this study was to analyze root form and morphology of human maxillary first permanent premolars of an Indo-Dravidian population from southern India. Materials and Methods: Eight hundred and twenty-two maxillary first permanent premolars were cleansed and stored appropriately. Morphology and root form analysed, segregated into Groups (Gps): Gp I, Gp II, and Gp III, and later divided into subgroups (SGs) based on specific criteria. Gp I was divided into two SGs: SG A (minimal or absence of grooving in the root) (n = 252) and SG B (clear and defined longitudinal groove in the root) (n = 104), and Gp II was divided into SG C (roots dividing in coronal one-third) (n = 154), SG D (roots dividing in the middle one-third) (n = 158), and SG E (roots dividing in the apical one third) (n = 138). Gp III consisted of only one SG F (teeth with three roots) (n = 16). The groups were analyzed separately, their external root form and morphology were recorded. Root form was analyzed, and results were tabulated. This study was compared with other studies and statistically analyzed. Results: Gp II was common with an incidence of 54.74%. Gp I was the next most common with an incidence of 43.3%. Gp III was the least common with an incidence of 1.94%. The number and distribution of roots was also computed. Six types of root form were identified (Type [Ty] A = 30.65%, Ty B = 12.65%, Ty C = 18.73%, Ty D = 19.22%, Ty E = 16.78%, and Ty F = 1.94%). Conclusion: Awareness and assessment of root form, number preoperatively with regard to specific populations before initiation will pave way for successful outcome of therapy.

Keywords: Indo-Dravidian population, longitudinal grooves, maxillary first premolar, root type classification, south Indian population

INTRODUCTION

Differences of form and morphology of maxillary first permanent premolar have been reported as specific to races and populations.[1] Location of all canals is of utmost importance, as untreated canals can lead to failures.[2] The only tooth to have all eight types of canal configuration was maxillary first permanent premolar.[3,4] Missed canals and untreated roots have been reported with an incidence of 42% in teeth, which required retreatment.[5] Approximately, 9.68% failures could be attributed to perforations of root, and 58.66% to

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incomplete obturation of root canal.[6] Single-, two-, and three-root variations have been reported in permanent maxillary first premolars.[7] The aim of this study was to identify incident root forms and morphology of human maxillary first permanent premolar tooth of an Indo-Dravidian population in southern India.

**Materials and Methods**

Eight hundred and twenty-two extracted human maxillary first permanent premolar teeth were cleansed and observed under magnification for intact occlusal and root morphology. Selected teeth were placed in a solution of 3% sodium hypochlorite for 48 h, and the solution was changed every 6 h. Subsequently, they were washed with 0.5% sodium thiosulfate solution and stored in a 0.1% thymol solution at 4°C. The samples were analyzed for number of roots, and separated into Groups (Gps): Gp I, II, and III. Gp I is single rooted (n = 356), Gp II is two rooted (n = 450), and Gp III is three rooted (n = 16). The observations with regard to the number of roots were recorded. They were divided into subgroups (SGs) based on specific criteria. Gp I was divided into two SGs, namely SG A (minimal or absence of grooving in the root) (n = 252) and SG B (clear and defined longitudinal groove in the root) (n = 104). Gp II was divided into SG C (roots dividing in coronal one-third) (n = 154), SG D (roots dividing in the middle one-third) (n = 158), and SG-E (roots dividing in the apical one-third) (n = 138). Gp III consisted of only one SG F (teeth with three roots) (n = 16). The groups were analyzed separately; their external root form and morphology were recorded.

**Results**

Gp II was common with an incidence of 54.74%. Gp I was the next most common, with an incidence of 43.3%. Gp III was the least common with an incidence of 1.94% [Table 1]. The number and distribution of roots was also computed [Figure 1]. No statistically significant difference was found between this study where two-rooted form was the most common and other studies with regard to the number of roots (P > 0.05) [Graph 1]. Six different root forms were identified based on the criteria for SGs [Figure 2] (Type [Ty] A = 30.65% [Figure 3A], Ty B = 12.65% [Figure 3B], Ty C = 18.73% [Figure 3C], Ty D = 19.22% [Figure 3D], Ty E = 16.78% [Figure 3E], and Ty F = 1.94%) [Figure 3F].

**Discussion**

Racial differences and genetically determined variations in form and morphology of root have been recognized. The permanent human maxillary first premolar poses difficulties and challenges during endodontic management. It cannot withstand excessive

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**Table 1: Incidence of root form**

| Root form | Incidence |
|-----------|-----------|
| Single root | 43.3% |
| Two roots | 54.74% |
| Three roots | 1.94% |

**Figure 1: Root types distribution**

**Graph 1: Studies—two-root incidence**
instrumentation, and also the technique should be modified based on preoperative morphologic assessment. There is a considerable variation in shape, number, apical curvature, and grooves of roots.

Longitudinal depressions have been observed with an incidence of 72.4% on mesial surface of the root and 52.7% on the distal surface. Mesial surface depressions were found to be deeper than distal surface depressions. An “S”-shaped variation of the shape of the root has also been reported.\(^9\)

Maxillary permanent premolars most often have one or two roots, but in some cases, three roots do occur. Variations due to ethnicity and populations have been noted with the single root being dominant in certain populations.\(^7\) The incidence of single root has been reported in a range of 10%–76.6% [Graph 2]. In this study, single-rooted pattern was the second most common, and two types of root form were identified, namely Ty A and B based on the presence of developmental grooves on roots. Studies on the Chinese

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**Figure 2**: Root form classification

| TYPE  | Description                      |
|-------|----------------------------------|
| A     | Minimal or groove absent         |
| B     | Defined longitudinal groove       |
| C     | Furcation at coronal third       |
| D     | Furcation at middle third        |
| E     | Furcation at apical third        |
| F     | Three root form                  |

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**Figure 3**: (A) Type A—root form. (B) Type B—root form. (C) Type C—root form. (D) Type D—root form. (E) Type E—root form. (F) Type F—root form
population have reported single root as being more common. A maxillary first premolar with decreased length and single roots being more common was reported in the Nepalese population. In Mongoloid populations, single-rooted maxillary first premolars have been found to be more prevalent. East Greenland Eskimos and Aleut Eskimos had an incidence of single root as high as 87%–95%. Sixty percent were considered to be truly single rooted in a study on the southern Chinese population. The incidence of a single root was also higher in the Brazilian population.

Incidence of two roots has been reported to be in the range of 33%–85% [Graph 1]. The incidence of two-root form was most common in this study. The two-rooted pattern presented with a buccal and a palatal root. Three-root form types were identified based on the level of furcation (Ty C, D, and E). Singaporean population considered a Mongoloid stock had an 50.6% incidence of two root form. The author also observed that bifurcation of maxillary first premolar occurred at apical, middle, and coronal thirds of root.

The incidence of three roots has been reported to be in the range of 0.8%–9.2% [Graph 3]. The three-rooted variations are directly attributable to the ethnicity of the population being studied. They are more frequently found in European and Native American populations. The incidence of maxillary first permanent premolars with three-root form has been found more frequently in Caucasian populations compared to that in Mongoloid populations. Incidence of two- and three-root form variations of maxillary first permanent premolars has been found with increased incidence in patients with

Graph 2: Studies—single-root incidence

Graph 3: Studies—three-root incidence
Turner syndrome. External morphology of three-rooted maxillary first premolars varies considerably. Various reasons have been proposed for the formation of the extra root, namely the altered division during tooth development, heredity, tooth bud dichotomy, and dental lamina behavior during the formation of the root. The incidence of three roots was the least common in this study on an Indo-Dravidian population from southern India at 1.94%.

Numerous clinical case reports discuss incidence of variant morphology and suggest methods for effective management. The common variant form of the root reported in case reports is three roots with three canals. Developmental anomalies are very rare in maxillary first premolars. These teeth have often been described as radiculous or ridiculous by the researchers. Modification of access, use of magnification, preoperative assessment, operator experience, and use of special radiology techniques have been suggested to effectively identify and treat these variant premolars. A guideline for easy identification of maxillary permanent premolars with a third root on preoperative radiograph with parallel view has been suggested. When mesiodistal width of center of root on radiograph appears equal to or greater than mesiodistal width of crown, there is a likely chance of a third root being present. Knowledge of incidence of variations among different population groups provides valuable information to the clinician and also has anthropological significance (Table 2).

Contralateral maxillary premolars also show a tendency for symmetry in root morphology. On the basis of the number of morphological variations inherently reported for this tooth, it would be prudent to incorporate sufficient modification of instrumentation process based on the morphology of tooth, which has to be looked into detail before the initiation of therapy. Also, the ethnicity should be factored during preoperative assessment.

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Conflicts of interest
There are no conflicts of interest.

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