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Case Report

Dentistry Section

Single Rooted Permanent Premolars and Molars - A Rare Clinical Presentation Confirmed using Cone Beam Computed Tomography

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ABSTRACT

The morphology of the root and root canal system plays a significant role in the treatment outcome of endodontic procedures. The necessity of clear and high contrast images for tissues like bone and teeth has made the usage of newer imaging techniques inevitable. This is a rare case report wherein, the permanent posterior dentition of both arches was single rooted. While sporadic cases of single rooted teeth have been reported, it is rare for all the premolars and molars to show such variation. This rare clinical observation has been enhanced by Cone Beam Computed Tomography (CBCT), which provides a clear image with added benefits of 3D (Three Dimensional) image reconstruction, low dosage and rapid scan time.

Keywords: Dysmorphological roots, Homeobox genes, Imaging techniques, Morphodifferentiation, Nonsyndromic hypodontia

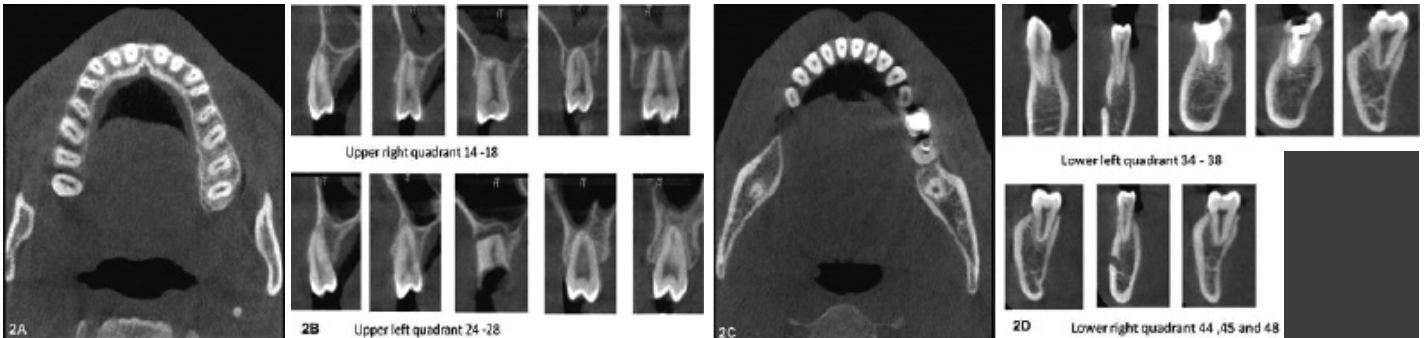
CASE REPORT

A 27-year-old male patient reported to a private dental clinic in Chennai, with pain in relation to his lower left posterior region of the jaw, 6 months back. Intra oral examination revealed grossly decayed and temporarily restored left mandibular first and second molars (36,37), dental caries in relation to left upper first molar (26) and missing right lower first and second molars (46,47). Based on clinical and radiographic evaluation, a complete treatment plan was devised for all the findings, which included root canal treatment for 36 and 37. After taking the consent from the patient, a routine pre-operative Intra Oral Periapical Radiograph (IOPA) of the involved teeth was taken. The routine IOPA revealed presence of single roots in relation to the decayed molars. A subsequent evaluation with a panoramic radiograph unraveled the fact that the posterior dentition in both the arches had teeth exhibiting single roots and variable canal morphology [Table/Fig-1a].

The teeth were anaesthetized and isolated with rubber dam. During endodontic access cavity preparation, we encountered a single canal with singular orifice. Canal instrumentation was done using rotary protaper files. Following apical patency, an apex locator (AFA - Apex finder Analytical Technology) was used for estimation of root length. We were able to corroborate our finding of single root canal with an IOPA after insertion of a protaper Guttapercha point (GP) - master cone size 30 [Table/Fig-1b]. The canal was enlarged up to size F3 and obturated with F3 GP after irrigation with normal saline. The canal was then restored with an intermediate restorative material and sealed with zinc oxide eugenol cement. Postoperative OPG revealed obturated single canals in relation to 36 and 37 [Table/Fig-1c]. Patient was advised to report for follow up sessions to enable permanent restoration for the involved teeth and for treatment of decayed 26.

The accidental radiographic finding of single roots in 36 and 37 prompted us to perform further radiographic investigations to

[Table/Fig-1a-c]: Intraoral periapical radiograph (IOPA) and Orthopantomograph (OPG) findings. (a) OPG showing single rooted permanent posterior teeth (b) IOPA of left first and second molars (36,37) after Guttapercha cone insertion revealing presence of single roots (c) Postoperative OPG showing single rooted permanent posterior teeth after obturation of 36, 37



[Table/Fig-2a-d]: Cone Beam CT (CBCT) findings. (a) Axial section of CBCT at the level of apical 3rd of the roots of maxillary teeth showing single roots in all the posterior teeth of the maxilla (b) Serial cross sectional CBCT image showing single rooted premolars and molars in the maxilla exhibiting varying patterns of branching in their root canal system (c) Axial section of CBCT at the level of apical 3rd of the roots of mandibular teeth showing single roots in all the posterior teeth of mandible (d) Serial cross sectional CBCT image showing single rooted premolars and molars in the mandible exhibiting varying patterns of branching in their root canal system

explore the root and canal patterns of other teeth. A CBCT was done to provide confirmation of such a rare finding which could have significant clinical implications in all his future dental treatment needs.

Reconstruction of axial, coronal, sagittal, panoramic slices of thickness 200 microns at 90kv, 10mA with 10.8sec exposure and 18x20cm field of view [Table/Fig-2a-d] revealed single rooted posterior teeth in maxilla and mandible. The canal morphology was variable.

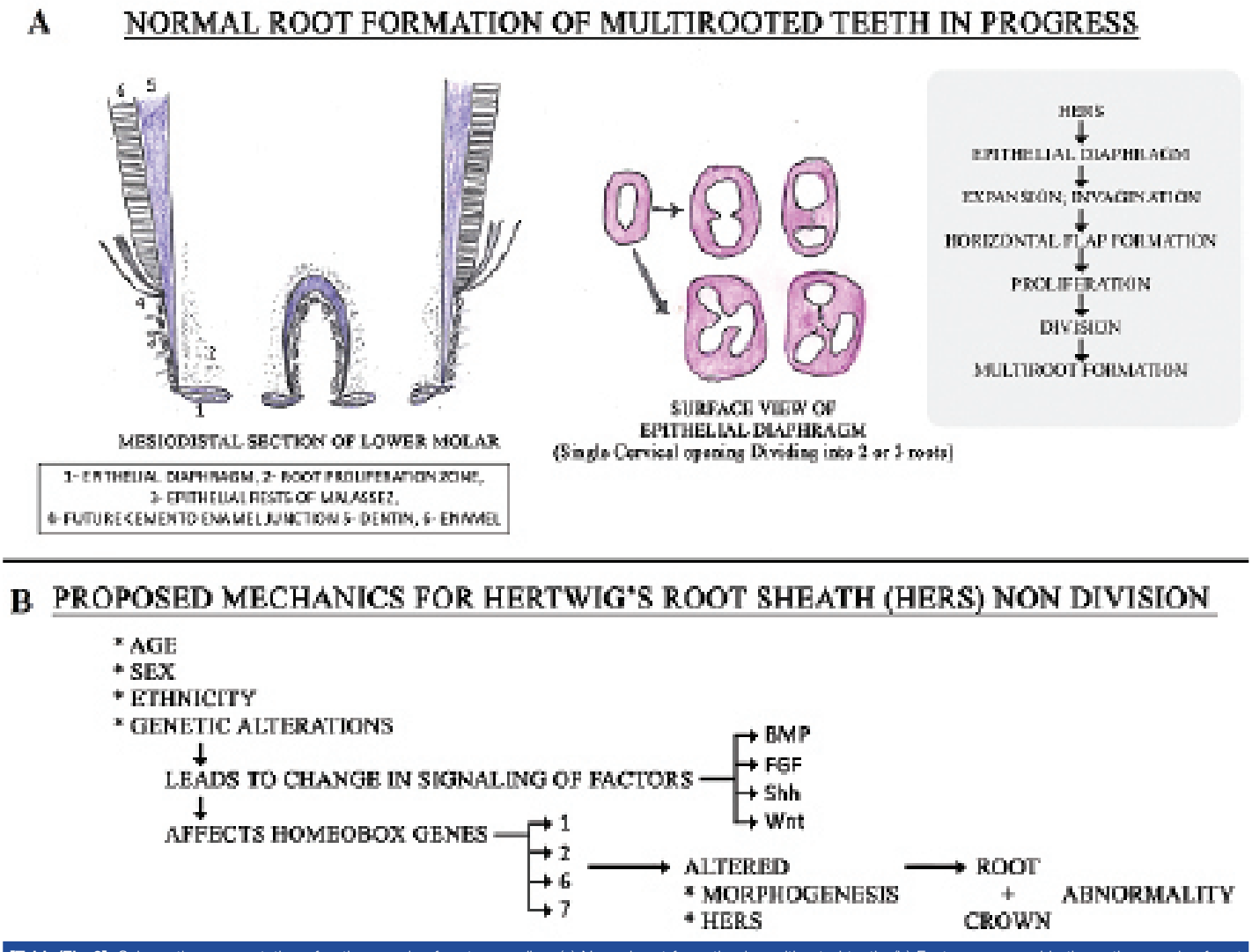
DISCUSSION

The variation in roots and their canal morphologies provide a challenge to the dentist and play an important role in the success of any endodontic procedure. While cases of sporadic teeth with altered root and canal morphology have been reported, they usually highlight an increase in the number of root canals [1,2]. The conventional use of IOPA is a common first step modality used for diagnosis and planning of treatment especially in assessing canal configuration. However, this technique is not entirely reliable due to its inherent limitations of requiring multiple angled radiographs and the lack of 3D (Three Dimensional) information [3]. The emergence of newer diagnostic methods like the CT (Computerized Tomography) has helped us to overcome these disadvantages. The inclination and the position of roots within the mandible can be clearly assessed only with a CT [4]. The Cone Beam CT (CBCT) makes use of a different principle in data gathering which makes the CBCT an ideal low dose cross sectional technique for imaging bony structures in the head and neck. The CBCT scanners employ hard and software that are comparably more compact, simple and less expensive than normal CT scanners. The main disadvantage of CBCT would be its decreased effectiveness in imaging soft tissue details, but it makes up for it by being an effective hard tissue imaging tool. This limitation can be overcome by using spiral CTs [5].

While reports of single rooted mandibular second molars with single canal morphology have been found in the literature [4], reports of all premolars and molars presenting with single roots are absolutely rare. The present report is a rare case where all the posterior permanent teeth had a single rooted morphologic presentation.

Normal Root development depends on Morphodifferentiation and Hertwig's epithelial root sheath (HERS). Morphodifferentiation is responsible for the development of the dentino enamel and cementoenamel junctions which in turn determines the shape and size of the crown and root. The roots begin to develop as soon as the enamel and dentin reach the future cementoenamel junction. Single and multi rooted teeth show a definite difference in the development of their HERS. The root sheath forms the epithelial diaphragm. The differential growth along with proliferation of epithelial diaphragm causes division of roots and determines if roots are single or multiple [Table/Fig-3] [6].

Morphologic dental defects could be localized to a single tooth, a group of teeth or involve entire dentition and are generally related to the invaginations and extrusions that occur in the odontogenic apparatus during morphodifferentiation or could be attributed to failure of the Hertwigs epithelial root sheath to invaginate in the case of root anomalies. This is observed as pyramidal or conical root forms in the first molars when they are involved [7].



[Table/Fig-3]: Schematic representation of pathogenesis of root anomalies. (a) Normal root formation in multirooted teeth. (b) Factors proposed in the pathogenesis of root anomalies [6]
BMP - Bone morphogenetic protein, FGF - Fibroblast growth factor, Shh -Sonic Hedgehog & Wnt -Wingless tumour gene

These anatomic abnormalities could be attributed to many factors such as age, sex and ethnicity. Genetic alterations of candidate genes involved in the differential growth of epithelial diaphragm might influence the pattern of root and its canal. Epithelial signaling factors that determine the generation of tooth morphology are the Bone morphogenetic Proteins (BMP), Fibroblast growth factor (FGF), Sonic hedge hog gene (Shh) and the wingless integration (Wnt). These genes affect the homeobox genes 1, 2, 6 and 7 which in turn influence molar morphogenesis indicating that complementary expression of genes affect teeth formation [3,8-10].

Around 21.8 percentage of root fusion cases presents as single roots with conical or c-shaped forms [3]. Cases of molars with single roots have been reported with a greater frequency in the primary teeth compared to that of permanent dentition with maxillary molars involved more often than mandibular molars. The first recorded case of single rooted tooth was that of primary molar by Ackerman et al., in 1973. Involvement of both the primary and secondary dentition exhibiting single roots have been reported [10,11]. Single rooted permanent second molars of both arches have also been reported by Fava et al., [12]. A study by Pansiera et al., reported 5.88% of cases in which mandibular second molars showed single root and canal morphology [3].

A similar case of single rooted permanent teeth associated with nonsyndromic hypodontia (congenitally missing teeth) has been reported in literature [10]. Hypodontia with morphological alteration of existing teeth can occur sporadically or have a familial presentation within a family pedigree. The present case however has no congenitally missing teeth or a familial presentation. Diagnostic confirmation of this rare finding with substantial clinical implication was enhanced by Cone beam CT.

CONCLUSION

Variations in the dental anatomy are commonly encountered both in the hard tissue and soft tissue. It is imperative for the dental fraternity to be aware of all these variations and to analyse its significance in terms of treatment and prognosis. Different expressions of root anomalies have to be taken into account during endodontic procedures for diagnosis and prevention of endodontic failures. This is to a great extent facilitated by advances in the field of imaging such as cone beam CT.

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