Three-rooted first permanent mandibular molars in a Hong Kong Chinese population: a computed tomographic study

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ABSTRACT  Objective. This study was undertaken to determine the frequency of three-rooted permanent first mandibular molar teeth in a southern Chinese (Hong Kong) population by computed tomography. Methods. Spiral computed tomographic images of the mandibles of Chinese patients, taken at the Oral Radiology Unit, Prince Philip Dental Hospital in Hong Kong during the year 2006, were retrieved and re-examined. All first permanent molars were re-evaluated in the axial section from the pulpal floor to the apices of the roots to determine the number of roots. In teeth with three roots, the position of the third root was recorded. Results. Images of 117 patients (67 females and 50 males; mean [range] age, 34 [12-70] years) were studied, and involved a total of 203 first mandibular molars; they were unilateral in 31 patients, and bilateral in 86. Among these, 44 (22%) three-rooted molars were found in 31 patients. Of the 26 patients with molars present bilaterally, 13 (50%) had bilateral three-rooted molars, and 11 (85%) had a unilateral three-rooted molar on the right side. The third root was a disto-lingual root in the remainder. Conclusion. The frequency of three-rooted first molars was high in this study and may be due to the use of computed tomographic images rather than extracted teeth or radiographs. Because of their clinical and anthropological importance, it is important to be aware of lower first permanent mandibular molars with three roots in the southern Chinese (Hong Kong) population.

Key words: Asian continental ancestry group; Hong Kong; Tomography, spiral computed; Tooth root/abnormalities

Introduction

The study of the root anatomy of teeth has an endodontic as well as an anthropological significance. Mandibular first permanent molars usually have two roots placed mesially and distally and three root canals, but a variation in number of roots as well as canal morphology is not uncommon. The number of roots in mandibular first permanent molars in various races differs significantly. These variations appear to be genetically determined 1, and so are important in identifying racial origins of populations. The third root usually appears as a thin strand in the disto-lingual position. Three-rooted mandibular first molars occur in less than 5% of White persons 2-4, Africans 5, Eurasians and Indians 5,6 but in Chinese 1,7,8, South-East Asians 2-9,10, Japanese 11, Eskimos 12,13, and native Americans 14 (Mongoloids), its frequency is higher and varies between 5 and 32%.

This study was undertaken to explore the frequency of three-rooted permanent first mandibular molars in a sample of computed tomographic (CT) images of teeth in a southern Chinese population in Hong Kong.

Methods and materials

Spiral CT images of the mandibles of Chinese patients taken at the Oral Radiology Unit, Prince Philip Dental Hospital in Hong Kong during the year 2006 were retrieved and re-examined. Computed tomographic images with pathology (such as tumors associated with first molars) were excluded as well as the images of heavily restored or root-filled first molars. Most of the
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Patients had been referred for the assessment of implant placement or impacted teeth. The CT images were obtained using a helical single slice CT Hispeed scanner (FX/1 CT; General Electric, Milwaukee [WI], US). The exposure settings were between 120-140 kV and 150 mA with an image resolution of 512 x 512 pixels. All images of permanent mandibular first molars were re-evaluated in the axial section from the pulpal floor to the apices to explore the number of roots. The age and the sex of each patient were recorded. In teeth with three roots, the position of the third root was recorded.

Results

Computed tomographic images of 156 patients were retrieved; images of 39 patients were excluded from the study due to pathology, heavy restorations or root fillings of first molars. In the remaining 117 patients, 31 patients had only one first mandibular molar so altogether 203 first mandibular molars were studied. The latter involved 67 (57%) females and 50 (43%) males. The mean (range) age of these patients was 34 (12-70) years. The frequency of three-rooted first molars was 22% (Table 1). There were 31 patients with three-rooted first mandibular molars (Figure 1); five had only one molar present and 26 had both. Among these 31 patients, 13 (50%) had bilateral (Figure 2) and the rest had only a unilateral three-rooted molar. Eleven (85%) of 13 patients with a unilateral three-rooted molar were on the right side (Table 2). The third root was present as a disto-lingual root in all other the cases.

Discussion

The reported frequency of three-rooted mandibular first molars is high among the Mongoloids as apposed to the Caucasians and Negroids. It is highest among Eskimos. Although many studies have been carried out to explore the prevalence of three-rooted first molars, they have differed in methodology. Some have used extracted teeth whilst others used radiographs. In this study, for the first time, CT images were used and demonstrated that the prevalence of three-rooted first permanent mandibular molars in Hong Kong Chinese population was high and fell within the ranges noted in other Mongoloid populations. Moreover, it is the highest value reported so far among the Asians, which may well be due to the use of CT rather than reliance on extracted teeth or conventional radiographs, both of which may well underestimate. It is higher than the 15% values reported for Chinese populations in Hong Kong by Walker in 1988 and Walker and Quackenbush in 1985 but is close to the figure for Chinese reported by Yew and Chan (21.5%) in 1993. In our study as well as

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<th>Table 1 Distribution of patients examined in relation to the presence of three-rooted first mandibular molar according to gender</th>
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<td>Male</td>
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<td>No. (%) of patients receiving computed tomography</td>
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<td>No. (%) of patients with three-rooted first molars</td>
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Figure 1 Axial computed tomographic scans with three-rooted permanent lower right first molar
in almost all other studies, the additional root was found distally and lingually and a buccally placed third root was only reported by Sperber and Moreau. In more than 90% of cases, the third root is clearly evident in radiographs, but in some instances it may not be evident because of its slender dimensions. The presence of a third root is considered a genetic trait rather than a developmental anomaly.

The nature of this additional root is variable, and can be present as a full-length root or a short conical projection (which is always smaller than the disto-buccal). It may present unilaterally but often is bilateral. We observed an equal prevalence of unilateral and bilateral three-rooted lower first molars. This observation differs from the findings of Yew and Chan in 1993 for Chinese, and Walker and Quackenbush in 1985 for Hong Kong Chinese population, both of whom reported a high bilateral distribution (67% and 61% respectively). Our study sample was small, consisting of only 203 first molars, and 26 patients with bilateral three-rooted molars. Hence it may be inappropriate to stress this difference in distribution. Interestingly in our study as well as in that of Walker and Quackenbush, unilateral three-rooted first molars were mainly noted on the right side (85%).

Studies thus far have all used extracted teeth or radiographs of teeth to identify three-rooted lower first molars, for which reason their reported frequency may have been underestimated. Teeth with slender roots can easily be missed in radiographs or being fractured on extracted teeth. Although there are no reported studies to identify the prevalence of three-rooted lower first permanent molars, CT has been used in many other dental morphological studies. There are clinical and in vitro studies on extracted teeth dealing with root canal anatomy, specially in relation to C-shaped canals in lower second permanent molars. Accuracy of CT images is well documented. Thus, in this study, the CT images gave a detailed and accurate picture of molar teeth, which was likely to have been more reliable than the other methods.

The presence of a third disto-lingual small third root in mandibular first molars means that there must be two distal root canals. This results in high rates of mandibular first molars with four roots canals and more than two-thirds of cases with four root canals are three-rooted ones in which the fourth canal arises from the third root. The disto-lingual canal in first molars with three roots has a type 1 configuration; it may arise from the pulp chamber with a lingual direction and may have a buccal orientation at the apex. The difficulty in identification of this narrow disto-lingual canal can be a cause of treatment failure in endodontics. Extraction of three-rooted first molars may be difficult with a possibility of fracture of a thin third root. During endodontic treatment, it is important to be aware of the presence of third roots.

Anthropologically, the presence of a three-rooted lower permanent first molar is significant. It is more commonly noted in Mongoloids than Caucasians and Negroids. Northern and southern divisions among
Mongoloids are well documented using anthropological, dental, osteological, and genetic markers. Using dental morphology as a feature, two distinct patterns namely sinodont and sundadont have been identified. The sinodont pattern, with more complex dental morphology, is observed in northern Chinese. Whereas, the sundadont pattern is characterized by simpler dental anatomical features, and is observed in the southern Chinese and South-East Asians. There is a clear division between sundadont and sinodont dentitions, with respect to the morphology as a feature, two distinct patterns namely dental, osteological, and genetic markers. Using dental South-East Asians of CT imaging rather than extracted teeth or radiographs.

In conclusion, the frequency of three-rooted first molars in this study was high and may be due to the use of CT imaging rather than extracted teeth or radiographs. It is important to be aware of the presence of a third root in lower first permanent mandibular molars among the southern Chinese of Hong Kong, because of its clinical and anthropological importance. Spiral CT images can be used to provide suitable visualization for studying the anatomy of teeth, particularly in difficult or retreatment cases, but the higher radiation risk associated with spiral CT imaging should also be considered.

References

6. Sperber GH, Moreau JL. Study of the number of roots and canals in Mongoloids are well documented using anthropological, dental, osteological, and genetic markers. Using dental morphology as a feature, two distinct patterns namely sinodont and sundadont have been identified. The sinodont pattern, with more complex dental morphology, is observed in northern Chinese. Whereas, the sundadont pattern is characterized by simpler dental anatomical features, and is observed in the southern Chinese and South-East Asians. There is a clear division between sundadont and sinodont dentitions, with respect to the frequency of three-rooted lower permanent first molars with the latter having a higher frequency. Observations in our study are in keeping with the above findings. The three-rooted lower first molar tooth is considered characteristic of anatomically modern humans.

In conclusion, the frequency of three-rooted first molars in this study was high and may be due to the use of CT imaging rather than extracted teeth or radiographs. It is important to be aware of the presence of a third root in lower first permanent mandibular molars among the southern Chinese of Hong Kong, because of its clinical and anthropological importance. Spiral CT images can be used to provide suitable visualization for studying the anatomy of teeth, particularly in difficult or retreatment cases, but the higher radiation risk associated with spiral CT imaging should also be considered.

References