SHORT COMMUNICATION

Eruption of third molars: Relationship to inclination of adjacent molars

Jackie Badawi Fayad, DDS, MS,[a,b,c] Julia Cohen Levy, DDS, MS,[a,b,c] Chadi Yazbeck, MD, MS,[d] Robert Cavezian, MD,[a] and Emmanuel-Alain Cabanis, MD, PhD[a]

Paris, France

The purpose of this study was to determine the relationship between the sagittal inclination of the first and second maxillary molars and the eruption of the third molars. The sample consisted of 2 groups. The subjects in the first group (n = 28) had complete normal dentitions including third molars; those in the second group (n = 32) had impacted right and left third molars. The sagittal inclinations to the palatal plane of the first and second maxillary molars were measured on computed tomography sagittal images obtained with multiplanar reconstructions. The Mann-Whitney *U* test was used to compare mean angular values between the 2 groups. Spearman correlation coefficients were calculated to assess the relationship with age. A multivariate analysis was used to evaluate the relationship between the eruption of the third molars and the sagittal inclination of the first molar, the second molar, sex, and age. Maxillary first and second molars were more mesially inclined in the first group, particularly in the younger subjects (16-25 years). This inclination increased with age. The logistic regression showed that the sagittal inclination of the first molar is a predictor of the eruption of the third molar. This finding suggests that a more mesially inclined maxillary dentition is likely to be associated with third molar eruption. The absence of data on space requirements in the maxillary arch and interarch relationships warrants further exploration in an orthodontic population. (Am J Orthod Dentofacial Orthop 2004;125:200-2)

The third molars are the teeth that are most often congenitally missing. If present, they might follow an abortive eruption path and become impacted. Impacted third molars are developmental pathologic medical deformities characteristic of a modern civilization. They account for 98% of all impacted teeth.[1,2] Eruption times of third molars are variable, ranging from age 16 to 24 years.[3]

Many authors have studied third molar impaction in the mandible, but there are few studies of maxillary third molars.[4-7] In general, their impaction is related to available space, defined by the distance between pterygoid vertical and the distal border of the first molar crown as measured on dental panoramic tomography or lateral cephalogram.[4,8,9] However, a recent study has called into question the clinical significance of this available space as a predictor for eruption and impaction.[10]

[a]Centre Hospitalier National d'Ophtalmologie des Quinze-Vingts, Department of Neuroradiology, Paris, France.

[b]University of Paris 7, Department of Orthodontics.

[c]University of Paris 5, DEA "Biomorphologie quantitative, variabilité de la forme humaine," Department of Anatomy.

[d]Inserm U 472, Department of Public Health, Paris, France.

Reprint requests to: Dr Jackie Badawi Fayad, 222 Avenue de Versailles, Paris 75016, France; e-mail, jackiebf@hotmail.com.

Submitted, September 2003; revised and accepted, October 2003.

0889-5406/$30.00

doi:10.1016/j.ajodo.2003.10.010

The purpose of this study was to determine the relationship between the maxillary molars' sagittal inclination and the eruption of third molars with computed tomography (CT) scanograms.

MATERIAL AND METHODS

In this study, we used CT scans to measure the sagittal inclination of the maxillary first (M1) and second (M2) molars in 2 groups of subjects, all with complete normal permanent dentitions without anomalies of number, shape, volume, or position. These subjects were recruited from the Department of Neuroradiology at the Centre Hospitalier National d'Ophtalmologie des Quinze-Vingts in Paris, where they were referred for CT scanning of their maxillary sinuses. The sample size was 60 subjects (30 men, 30 women). The subjects in the first group (n = 28; mean age, 33.35 years; range, 16-50) had complete normal dentitions with erupting or erupted third molars. The subjects in the second group (n = 32; mean age, 27.61 years; range, 16-50) had impacted right and left third molars; the criterion used for impaction was a complete root formation with the highest part of the third molar (M3) beneath the cervical line of M2. People with crowded dentitions, unilateral impaction of the third molars, absent or extracted teeth, tumoral or infectious lesions in the molar region, and prosthetic molar

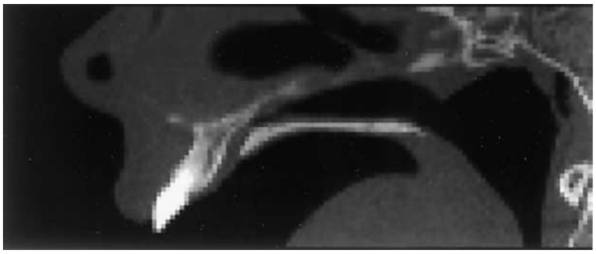

Fig 1. Sagittal reconstruction showing palatal plane.

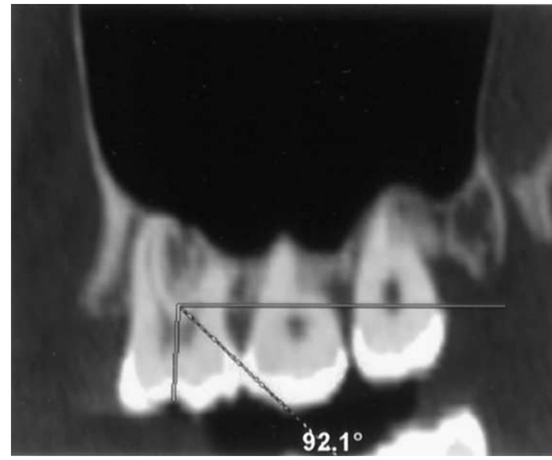

Fig 2. Example of sagittal inclination of first molar in first group.

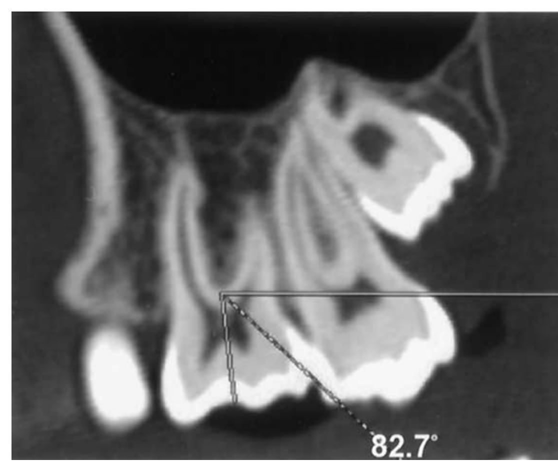

Fig 3. Example of sagittal inclination of first molar in second group.

reconstructions were excluded. All these criteria were defined on two-dimensional (2-D) multiplanar reconstructions.

Computed tomography scans were obtained with the helical technique with LightSpeed 16.X (General Electric Medical Systems, Waukesha, Wis). Slice thickness was .625 mm with a .3-mm interval. The reference plane was the palatal plane, defined on the scout view by the nasal surface of the palatal process of the maxilla (Fig 1).

One operator on the workstation performed image analysis using 2-D multiplanar reconstructions. The sagittal inclinations of M1 and M2 were measured by the posteroinferior angle formed by the molar axis (intercuspid groove-bifurcation) and the palatal plane, represented by a horizontal line.

Mean and standard deviation were computed for each group. The Mann-Whitney *U* test was used to compare mean angular values between the 2 groups, and coefficients of correlation (Spearman) were calculated to assess the relationship with age. A multivariate analysis was applied to examine the relationship between the eruption of the third molars and the sagittal inclination of M1, M2, sex, and age.

Intraoperator reliability was assessed by repeated angular measurements of the same subjects. Ten subjects were randomly selected from the entire sample, and multiplanar reconstructions and measurements were repeated twice within a month. High intraclass correlation coefficients indicated a good reproducibility of the angular measurements on serial CTs ($r = 0.98$ for M1 and $r = 0.94$ for M2; $P < .0001$).

RESULTS

Right and left M1 and M2 were more mesially inclined in the group with erupting or erupted third molars than in the second group. There was no difference between right and left ($P < .0001$). A similar analysis for the younger subjects (16-25 years) also showed a statistically significant difference.

Spearman correlation coefficients (r) were calculated to assess the relationship of the sagittal inclination of M1 and M2 with age ($r = 0.65$ for M1 and $r = 0.78$ for M2; $P < .0001$). The relationship of the sagittal inclination of M1 and M2 with sex was also assessed: there was no sexual dimorphism ($P > .05$).

The effects of age, sex, and the sagittal inclinations of M1 and M2 on the eruption of third molars were evaluated with multivariate analysis. A model of logistic regression was constructed. Upon adjusting for age, sex, and the inclination of M2, we concluded that the inclination of M1 was a predictor of the eruption of M3; odds ratio = 2.70, 95% confidence interval = 1.33-5.55. In spite of the high correlation between M1 and M2 (r = 0.90; $P < .0001$), the M1 × M2 interaction was not significant, but the difference between their sagittal inclinations was highly significant ($P < .0001$).

DISCUSSION

It has been suggested that the size of the maxillary eruption space is a valid predictor for whether the third molars will erupt. However, a recent study has questioned the clinical significance of this available space as a predictor for eruption and impaction.[10]

The present study analyzed, with CT scans, the sagittal inclination of M1 and M2 in 2 groups of subjects with erupted and impacted third molars. The sagittal inclination of M1 and M2 was greater in the subjects with erupted M3 than in those with impacted M3 and particularly in the younger subjects. This might lead us to conclude that M1 and M2 are more mesially inclined before full eruption of M3. In addition, the model of logistic regression confirmed that a more upright position of M1 in the sagittal plane is a predictor of the eruption of M3. An example from each group is shown in Figures 2 and 3.

A cross-sectional model was adopted in this study. Some impacted third molars at age 16 years might follow a normal eruption after age 20. This is a limitation intrinsic to all cross-sectional studies. Moreover, the absence of data on space requirements in the maxillary arch and interarch relationships warrants further exploration of this issue in an orthodontic population.

The effect of age on the sagittal inclinations of M1 and M2 was similar to the findings reported by Harris[11] and Ferrario et al.[12] In his investigation, Harris measured mesial and buccal drift for postcanine teeth in adults between 20 and 55 years of age. He attributed drift to the presence of an occlusal force with an anterior component. Carter and McNamara[13] also ascribed adolescent and adult modifications in dental arch size to muscular forces. Presently, we cannot propose other explanations for this result.

In the present study, all angles were measured relative to the palatal plane, which is easily detected on the scout view, thus reducing measurement error. This reference plane is more reliable than the occlusal plane, used in measuring inclination of the facial axis of the clinical crowns, which is modified by treatment and age.[12,14]

All measurements were made with 2-D multiplanar reconstructions on hyper workstations. This process seems less time consuming and produces less measurement error when compared with conventional radiographs. Measurements taken from dental panoramic tomography are not reliable because of distortions and magnifications, especially in the molar and retromolar regions. Lateral cephalograms make the differentiation between right and left very difficult because of superposition.[15] The advantage of the CT scan over conventional radiography is that contemporary workstations and software used to process the CT image data are rapid, detailed, and allow 2- and 3-D visualization of the proposed sites on a 1:1 ratio (ie, life-sized).[16]

CONCLUSIONS

1. The vertical position of the first maxillary molar in the sagittal plane is a predictor of the eruption of the adjacent third molar.
2. The sagittal inclination of the maxillary molars increases with age: it could be the effect of mesial drift.

REFERENCES

1. Hattab F, Rawashdeh M, Fahmi M. Impaction status of third molars in Jordanian students. Oral Surg Oral Med Oral Pathol 1995;79:24-9.
2. Bishara S. Third molars: a dilemma! Or is it? Am J Orthod Dentofacial Orthop 1999;115:628-33.
3. Haralabakis H. Observations on the time of eruption, congenital absence and impaction of the third molar teeth. Trans Eur Orthod Soc 1957:308-9.
4. Ricketts RM, Turley P, Chaconas S, Schulhof RJ. Third molar enucleation: diagnosis and technique. J Calif Dent Assoc 1976; 4:52-7.
5. Richardson ME. Prophylactic extraction of lower third molars: setting the record straight. Am J Orthod Dentofacial Orthop 1999;115:17A-18A.
6. Richardson ME. Lower third molar space. Angle Orthod 1987; 57:155-61.
7. Björk A, Jensen E, Palling M. Mandibular growth and third molar impaction. Acta Odontol Scand 1956;14:231-72.
8. Elsey MJ, Rock WP. Influence of orthodontic treatment on development of third molars. Br J Oral Maxillofacial Surg 2000;38:350-3.
9. Ganss C, Hochban W, Kielbassa AM, Umstadt HE. Prognosis of third molar eruption. Oral Surg Oral Med Oral Pathol 1993;76: 688-93.
10. Kim T, Artun J, Behbehani F, Artese F. Prevalence of third molar impaction in orthodontic patients treated nonextraction and with extraction of 4 premolars. Am J Orthod Dentofacial Orthop 2003;123:138-45.
11. Harris EF. A longitudinal study of arch size and form in untreated arches. Am J Orthod Dentofacial Orthop 1997;111: 419-27.
12. Ferrario VF, Sforza C, Colombo A, Ciusa V, Serrao G. Three-dimensional inclination of the dental axes in healthy permanent dentitions—a cross-sectional study in a normal population. Angle Orthod 2001;71:257-64.
13. Carter GA, Mc Namara JA. Longitudinal dental arch changes in adults. Am J Orthod Dentofacial Orthop 1998;114:88-99.
14. Andrews LF. The straight-wire appliance, origin, controversy, commentary. J Clin Orthod 1976;10:99-114.
15. Freedman GS, Putman CE, Potter GD. Critical review of tomography in radiology and nuclear medicine. CRC Crit Rev Clin Radiol Nucl Med 1975;6:253-94.
16. Hirschfelder U. The spiral CT imaging technic—the initial experience for orthodontic examinations. Fortschr Kieferorthop 1992;53:247-53.