Original Article

Tooth-Size Reduction Associated with Occurrence of Palatal Displacement of Canines

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Abstract: This study investigates mesiodistal crown size of the maxillary and mandibular incisors of patients with palatally displaced canines (PDC). Pretreatment dental casts of orthodontic patients with PDC of 1 or both maxillary canines (N = 31; M10:F21) were collected. This PDC sample was matched according to age and sex with pretreatment dental casts from unaffected orthodontic patients. For the PDC and matched control samples, maximum mesiodistal crown diameters were recorded for the 4 incisors on the left side only. The results showed that, on average, the mesiodistal crown diameters for the maxillary and mandibular incisors measured smaller in the PDC sample than in the control sample. These findings of statistically significant tooth-size reductions associated with PDC occurrence indicate a generalized pattern of reduced tooth size as a characteristic associated with the PDC anomaly. Further, the presence of generalized tooth-size reduction in cases with palatally displaced canines helps explain why most orthodontic treatment plans for PDC patients are of the nonextraction type. (*Angle Orthod* 2000;70:126–128.)

Key Words: Tooth eruption, ectopic; Canine, impacted; Tooth size; Odontometry

INTRODUCTION

The maxillary canine is the most frequently impacted tooth in the permanent dentition, excluding the third molars.[1–3] In populations of European origin, 70 to 85% of cases of maxillary canine impaction are characterized by the canine being ectopically displaced palatal to the dental arch.[4–7] The reported prevalence of the palatally displaced canine (PDC) ranges from 0.8 to 2.8%.[1–3] Palatally displaced canines occur twice as frequently in females than in males.[7] Bilateral occurrence of PDC has been reported in a range of 19 to 45%.[7]

Some investigators have linked reductions in the number and size of certain teeth with the occurrence of the PDC phenomenon.[8–14] Statistically significant increases in agenesis of third molars and mandibular second premolars occur in association with PDC.[12] Tooth-size reductions associated with PDC have been studied only for the maxillary lateral incisor, which often is noted in its peg-shaped phenotype in cases of PDC.[8–13] To our knowledge, no quantitative tooth-size study has been published on subjects with the PDC malposition.

We investigate the mesiodistal crown size of the maxillary and mandibular incisors of PDC patients to observe relationships between tooth size and the PDC anomaly.

MATERIALS AND METHODS

Pretreatment dental casts of 31 nonsyndromic orthodontic patients (M10:F21) with palatal displacement of 1 or both canines were evaluated. This PDC sample was selected according to a clear diagnosis of palatal ectopic displacement of the anomalous canines, based on panoral, periapical, and occlusal radiographs, and clinical history. All PDC subjects self-identified as Caucasians and were from northeastern United States. The range of ages for the PDC patient sample was from 11 to 17 years with a mean of 13.6 years and a median of 14.0 years. The control reference sample consisted of pretreatment dental casts of 31 non-PDC orthodontic patients matched with the PDC subjects according to age (rounded to the whole year) and sex. Information on racial self-identity of the control subjects was not available.

For the PDC subjects (N = 31) and for the matched control sample (N = 31), maximum mesiodistal (MD) crown diameters were recorded in millimeters for the 4 incisors (FDI/ISO tooth numbers employed) on 1 side only (left), on the basis of strong right-left metrical concordance between homologous human teeth.[15,16] The following measurements to the nearest 0.01 mm were taken from the pre-

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Table 1. Maximum Mesiodistal Crown Diameters for Four Incisors (Left Side) in the Palatally Displaced Canines (PDC) Sample vs. Controls

Variable	Sample	N	Mean, mm	SD, mm	*t*-test	*P*
MD21	PDC	31	8.40	0.52	3.120	0.004
	control	31	8.87	0.66		
MD22	PDC	31	6.47	0.63	2.998	0.004
	control	31	6.92	0.72		
MD31	PDC	31	5.29	0.34	1.612	0.112
	control	31	5.45	0.43		Nonsignificant
MD32	PDC	31	5.68	0.36	3.265	0.002
	control	31	6.03	0.47		

treatment dental casts using a specially tipped odontometric dial caliper:

1. MD21 = maximum MD crown diameter, maxillary left central incisor
2. MD22 = maximum MD crown diameter, maxillary left lateral incisor
3. MD31 = maximum MD crown diameter, mandibular left central incisor
4. MD32 = maximum MD crown diameter, mandibular left lateral incisor.

Tooth-size data from the patients with PDC were compared with data from the control sample. Student's *t*-test was employed to test differences between the mean values of the measurements MD21, MD22, MD31, and MD32 found for the PDC subjects and those for the 31 subjects in the age- and sex-matched control sample. The null hypothesis to be tested was that the mesiodistal tooth size of the incisors in PDC patients does not differ from that found in a typical orthodontic population.

Intraexaminer reliability was assessed using a double-determination method. The dental casts were measured twice by the same investigator, with 1 week separation between each set of measurements. Calculations were made for 1 variable, the maximum mesiodistal diameter of the maxillary left central incisor (MD21). The mean absolute difference between determinations was 0.20 mm, the mean signed difference was 0.034, the standard deviation of the signed difference was 0.35 mm, and the ''error of the method'' was 0.045 mm. These results were reasonably consistent with expectations. Thus, these approaches to quantifying the error of the method show good measurement reliability and reproducible methods.

RESULTS

All 4 incisor mesiodistal crown diameters on average measured smaller in the PDC sample than in the control sample (Table 1). Three of the 4 incisor-size comparisons showed differences between the means that were statistically significant. Thus, 3 of the 4 variables indicated significantly smaller teeth in the PDC cases versus the controls ($P < .01$). The fourth variable, the mandibular central incisor (MD31), which is the smallest of human teeth, confirmed this trend in the same direction, but did not show statistical significance.

DISCUSSION

The statistically significant reductions noted in this study of mesiodistal crown size for the maxillary and mandibular incisors in PDC subjects indicate a generalized pattern of smaller tooth size as a characteristic associated with the anomaly of palatal displacement of the maxillary canine. It is known that interrelationships exist between anterior tooth size and the dimension of the remaining teeth; therefore, reduced incisor tooth widths are indicative of generalized reductions in tooth size throughout the dentition.[17–19] This trend for smaller incisors with PDC is a strong indicator that the entire dentition is smaller in PDC patients.

The presence of smaller-than-average teeth in the PDC sample supports previous reports that palatal canine impactions develop in patients with dentoalveolar arch-space adequacy. Dewel[20] pointed out that canine malpositions occur most often in cases with a normal arch form and enough space. Bass[21] noted that 36% of patients with impacted canines had uncrowded arches, but all 10 patients in his study group with labially displaced canines had crowding. Eighty-five percent of PDC patients have sufficient space for eruption of the canine in the dental arch, according to Jacoby.[6] Zilberman, et al[22] showed that some crowding was seen in only 16% of patients with PDC, further lending support for the view that palatal displacement is not related to the existence of crowding.[23] Although none of these previous studies actually measured tooth size, their similar observations and statistics suggesting that PDC is not associated with maxillary crowding support our findings of tooth-size reductions associated with the PDC anomaly.

The current findings, relating the PDC malposition with the occurrence of generalized tooth-size reductions, are consistent with the growing body of evidence identifying a complex of genetically controlled dental disturbances that often occur in combination.[7–14,22] Besides tooth-size reduction and PDC, other dental anomalies in this genetic trait complex are hypodontia, infraocclusion, delayed tooth eruption, ectopic eruption of permanent first molars, and certain canine tooth transpositions. These traits share some common genetic controls, thereby being associated in occurrence, but not causally related to one another. Thus, the appearance of small permanent incisors in the early mixed dentition, especially in combination with some of these other associated dental anomalies, could serve as a useful indicator of future PDC occurrence. In these instances, clinicians should understand the reduced size of the mandibular and maxillary incisors as a *noncausal* trait associated with the PDC anomaly. Reduced tooth size may help iden-

tify candidates for interceptive treatments for PDC, such as the extraction of maxillary deciduous canines.

Clinically, the results of this study may help explain the predominance of nonextraction-type treatment plans for orthodontic patients with PDC problems. A collateral study has indicated that maxillary arch width is normal, not constricted, in the PDC patient.[23] Integrating this dental-arch width adequacy with the pattern of reduced tooth size we now have associated with PDC, it becomes clear that permanent tooth extractions usually would be unnecessary to find ample dental-arch space for orthodontic correction of the palatally ectopic canine.

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REFERENCES

1. Dachi SF, Howell FV. A survey of 3,874 routine full mouth radiographs. II. A study of impacted teeth. *Oral Surg Oral Med Oral Path.* 1961;14:1165–1169.
2. Shah RM, Boyd MA, Vakil TF. Studies of permanent tooth anomalies in 7,886 Canadian individuals. II: Congenitally missing, supernumerary and peg teeth. *J Canad Dent Assoc.* 1978;44:262–264.
3. Grover PS, Norton L. The incidence of unerupted permanent teeth and related clinical cases. *Oral Surg Oral Med Oral Pathol.* 1985; 59:420–425.
4. Rohrer A. Displaced and impacted canines. *Int J Orthod Oral Surg.* 1929;15:1003–1020.
5. Nordenram A, Stromberg C. Positional variations of the impacted upper canine. *Oral Surg Oral Med Oral Pathol.* 1966;22:711–714.
6. Jacoby H. The etiology of maxillary canine impactions. A clinical and radiologic study. *Am J Orthod.* 1983;84:125–132.
7. Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. *Angle Orthod.* 1994;64:249–256.
8. Racek J, Sottner L. Heredity of canine teeth retention [in Czech]. *Cesk Stomat.* 1977;77:209–213.
9. Sottner L, Racek J. Determination of heritability of the character; model: retention of canines [in Czech]. *Cas Lék Cesk.* 1978;117: 1060–1062.
10. Racek J, Sottner L. Personal views on the heredity of retention of canine teeth [in Czech]. *Sborn Lék.* 1984;86:355–360.
11. Becker A, Smith P, Behar R. The incidence of anomalous maxillary lateral incisors in relation to palatally-displaced cuspids. *Angle Orthod.* 1981;51:24–29.
12. Peck S, Peck L, Kataja M. Prevalence of tooth agenesis and peg-shaped maxillary lateral incisor associated with palatally displaced canine (PDC) anomaly. *Am J Orthod Dentofacial Orthop.* 1996;110:441–443.
13. Baccetti T. A controlled study of associated dental anomalies. *Angle Orthod.* 1998;68:267–274. (Comment: J Dent Res. 1997; 76:728–729.)
14. Pirinen S, Arte S, Apajalahti S. Palatal displacement of canine is genetic and related to congenital absence of teeth. *J Dent Res.* 1996;75:1742–1746.
15. Garn SM, Lewis AB, Kerewsky RS. The meaning of bilateral asymmetry in the permanent dentition. *Angle Orthod.* 1966;36: 55–62.
16. Garn SM, Bailey SM. The symmetrical nature of bilateral asymmetry (delta) of deciduous and permanent teeth. *J Dent Res.* 1977; 56:1422.
17. Garn SM, Lewis AB, Kerewsky RS. Size interrelationships of the mesial and distal teeth. *J Dent Res.* 1965;44:350–354.
18. Hanihara K. Upper lateral incisor variability and the size of the remaining teeth. *J Anthropol Soc Nippon.* 1970;78:316–323.
19. Le Bot P, Salmon D. Congenital defects of the upper lateral incisors (ULI): condition and measurements of the other teeth, measurements of the superior arch, head and face. *Am J Phys Anthropol.* 1977;46:231–243.
20. Dewel BF. The upper cuspid: its development and impaction. *Angle Orthod.* 1949;19:79–90.
21. Bass TB. Observations on the misplaced upper canine tooth. *Dent Pract Dent Rec.* 1967;18:25–33.
22. Zilberman Y, Cohen B, Becker A. Familial trends in palatal canines, anomalous lateral incisors, and related phenomena. *Eur J Orthod.* 1990;12:135–139.
23. Langberg BJ, Peck S. Adequacy of maxillary dental-arch width in patients with palatally displaced canines. *Am J Orthod Dentofacial Orthop.* In press.