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Root Length of Lateral Incisors adjacent to Palatally-displaced Maxillary cuspids

An evaluation of 70 palatally-displaced cuspids and 106 controls finds significantly shorter lateral incisor adjacent to the palatal cuspids.

KEY WORDS: CUSPID IMPACTION, ERUPTION, IMPACTION, LATERAL INCISOR

Lateral incisor absence has been noted to be relatively frequent among cases with palatally-impacted cuspids, as reported by MILLER (1963/4) AND BASS (1967). Both point out the role of the root of the lateral incisor as a guide for the normal eruption of the maxillary cuspid, emphasizing BROADBENT'S original 1941 observation.

Both agree that the absence of a lateral incisor deprives the erupting cuspid of this normal guidance, leading to the relatively high incidence if its impaction in these cases. In an earlier report (BECKER ET AL. 1983), we have noted a 5.5% rate of congenital absence of lateral incisors in a large group of patients with palatal cuspids. This frequency is 2.4 times the incidence of 2.1% seen in the general population (EIDELMAN ET AL. 1973).

MILLER (1967) considers that even a rudimentary lateral incisor can develop a root of sufficient length to provide the guidance needed for normal eruption of the cuspid. He illustrates this contention with reference to several cases, but does not examine the frequency of occurrence of these anomalous teeth in relation to the incidence of palatal displacement of the cuspid.

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In the study which we have reported and referred to above, the incidence of anomalous lateral incisors among the palatally-displaced cuspid cases was contrary to what would have been expected on the basis of Miller. Of the cases examined, 42.2% showed small lateral incisors, including 17.2% which were frankly peg-shaped. This compares to a 1.1% incidence of peg-shaped incisors in the general population from which the cuspid sample was drawn (CHOSAK 1984).

According to GARN ET AL. (1963), teeth with small mesiodistal dimensions usually develop late. The high incidence of lateral incisors with small mesiodistal crown widths found adjacent to palatal cuspids in our earlier study supports the conclusion that palatal impaction is indeed related to late development of the lateral incisor.

It was our view that the lateral incisor was insufficiently developed at the time when its root would be most important for guidance of the normally- developing cuspid (BECKER ET AL. 1983). We also felt that the root of a small or peg-shaped lateral incisor was not as normal in length as Miller had supposed, and that perhaps this was also associated with palatal displacement of the cuspid.

Accordingly, this study was undertaken to compare the root lengths of lateral incisors adjacent to palatal cuspids with root lengths of those adjacent to normally-erupted cuspids. The manner in which mesiodistal crown width might influence these values was also investigated.

Materials and Methods

The experimental group consisted of patients who had been successfully treated orthodontically for the correction of palatally- impacted cuspids. A group of patients whose maxillary cuspids had erupted normally was selected as controls.

To satisfy the criteria for inclusion in this study, the patients of both groups were required to exhibit a dental age of more than 12 years, based on radiographic evidence of closure of the root apices of all teeth except upper cuspids, second bicuspids, and second and third molars.

All cases were represented by plaster casts of the teeth showing full eruption and alignment of the cuspids, together with either full-mouth periapical radiographs or a panoramic scan of the completed case.

The majority of the radiographs that were available for the patients in this study were panoramic views, which are known to show variable horizontal enlargement in different parts of the same film (BRUEGGEMANN 1967, LUND AND MANSON-HING 1975). However, the enlargement is more consistent in the vertical plane.

Since it was considered essential to check whether these views were comparable to periapical views, a pilot test was undertaken using 12 patients outside of this study sample. Records on this pilot group included both periapical and panoramic radiographic views of the completed roots in the upper incisor area.

Total tooth length was measured on whichever view was available. Even though differences were found between absolute measurements, the ratio between the lengths of lateral incisors and adjacent central incisors was found to be consistent (Table 1). This establishes the validity of using either view of the teeth for determining the lateral/central ratio for tooth or root length.

Diagnosis of palatal displacement of the maxillary cuspid in those subjects in the experimental group was made prior to the commencement of orthodontic treatment, according to the methods described by Seward (1963). This was confirmed visually at the time of surgery, or by the

Table 1

Mean tooth length (mm)
from periapical and panoramic films
of 12 patients

Radiographic view	No. of teeth	Lateral incisor	Central incisor	Ratio of lengths	Standard deviation	Median	Variance
Periapical	24	23.8	25.5	0.94	0.01	0.93	0.003
Panoramic	24	24.4	25.9	0.94	0.01	0.93	0.003

spontaneous palatal eruption of the tooth into the mouth.

In addition to the dental age, the sex and chronological age were also noted for each patient.

Ninety-six patients were initially studied. Of these, 32 had been treated for a unilaterally displaced cuspid, 19 had been bilaterally affected, and in 45 the cuspids had erupted normally.

Each maxillary cuspid in each patient was considered as a separate case. The unilaterally-displaced cases presented one affected cuspid and one control, the bilaterally-displaced cases two affected, and the normal cases two controls each. This yielded 70 palatally-displaced cuspids and 122 controls. Radiographic views of rotated cuspids which presented difficulty in location of the cementoenamel junction, or poor contrast or definition on the films, resulted in a reduction of the sample to 70 affected cuspids and 106 controls.

Measurements were made of the overall length and root length of lateral and central incisors in all cases, using a caliper accurate to 0.05mm. The mesial and distal extremities of the cementoenamel junctions were marked on acetate tracing film and joined by a straight line. Two lines were then drawn parallel to the first, marking the tangents to the apical extremity of the root and the most incisal point on the crown. The distance between the two most distant lines was recorded as the overall tooth length, while that between the cementoenamel junction line and the apical tangent was recorded as the root length.

Repeat measurements on 40 of the cases from both experimental and control groups were compared with the original determinations, yielding an average error of 0.06mm in root length, with a maximum error of 0.10mm.

Each lateral incisor was classified as normal, small or peg-shaped, as described by BECKER ET AL. IN 1983. Repeat measurement of the mesiodistal widths of these teeth yielded an average error of 0.04mm, with a maximum of 0.07mm. No error was found on double determination of the type of crown shape.

The mean ratio of lateral:central incisor root length was also calculated for the experimental group and the controls, males and females, and for right and left sides.

Results

Average lengths of teeth and roots are shown in Table 2. This shows the average projected length of lateral incisors adjacent to a palatally-displaced cuspid to be 2.12mm shorter than those adjacent to normally-erupted cuspids. Statistical significance of this difference is high ($p < 0.02$). Much of this difference is due to the 1.4mm discrepancy in root length, which is statistically significant at $p < 0.03$.

Table 2

Overall tooth length and root length of central and lateral incisors on affected and control sides

Central incisors

With palatal cuspids

		Tooth length				Root length			
	N	Low	Mean	High	S.D.	Low	Mean	High	S.D.
Total	64	21.8	30.7	40.9	3.71	14.0	20.1	27.5	2.86
Females	43	21.8	30.0	35.3	3.50	14.0	19.7	24.2	2.82
Males	21	25.8	32.0	40.9	3.83	16.1	21.0	27.5	2.81

With normally-erupted cuspids

Total	105	23.7	31.3	39.1	2.71	13.1	20.6	26.8	2.25
Females	80	23.7	30.6	35.2	2.07	13.1	20.1	23.6	1.96
Males	25	26.2	33.8	39.1	3.26	18.5	22.3	26.8	2.39

Lateral incisors

With palatal cuspids

Total	64	18.9	27.2	35.8	3.73	13.0	18.4	25.4	2.70
Females	43	18.9	26.4	32.2	3.73	13.0	17.8	22.0	2.50
Males	21	22.6	28.7	35.8	3.24	14.2	20.0	25.4	2.76

With normally-erupted cuspids

Total	105	20.3	29.3	35.4	2.44	14.3	19.8	25.5	1.99
Females	80	20.3	28.7	35.1	2.04	14.3	19.3	24.2	1.73
Males	25	22.7	31.4	35.4	2.72	16.7	21.3	25.5	2.16

The average central incisor on nonaffected sides was 0.64mm longer, with a root 0.49mm longer, but these small differences were not statistically significant.

The overall length of centrals and laterals was greater in males than in females (Table 2). On the affected sides the mean differences were 1.99mm for centrals and 2.29mm for laterals ($p < .04$). On the unaffected sides the comparable values were 3.20mm and 2.70mm ($p < .02$).

Fig. 1 shows the relation between lateral and central incisor root length in cases with palatal cuspids, compared to

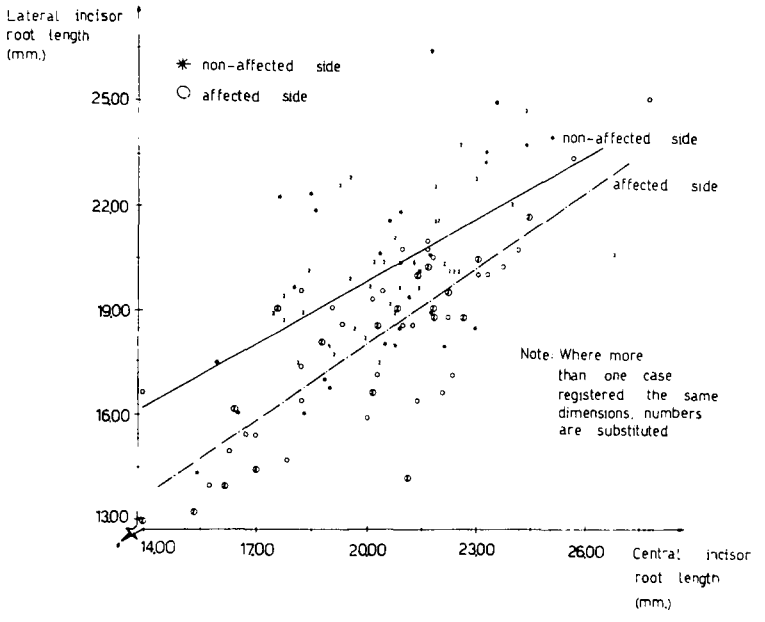

Fig 1 Distribution of lateral incisor root length versus central incisor root length. The dashed regression line representing the affected side is significantly below the solid regression line representing the non-affected side, demonstrating the relatively shorter lateral root length adjacent to palatal cuspids.

those with normally-erupted cuspids. These results were taken from measurements of panoramic and periapical views. The regression lines show a difference between the two groups, with the smaller root length ratio in the affected cases.

Table 3 sharpens this contrast and illustrates a very significant difference ($p < 0.01$) between the lateral root:central root ratio on the affected sides (0.91 ± 0.09) and on the nonaffected controls (0.96 ± 0.09).

No significant differences were found between males and females, between unilateral and bilateral cases, or between left and right sides.

Small and peg-shaped lateral incisors were found associated with both palatally-displaced and normally-erupted cuspids. The ratio of the length of these anomalous lateral incisor roots to those of their adjacent central incisors showed markedly shorter lateral roots on affected sides (0.89 ± 0.12 vs. 0.96 ± 0.09) (Table 4). This table also shows clearly that for small and peg-shaped incisors in the control and experimental groups taken together, the lateral:central ratio is almost the same as for normally-sized lateral incisors in the combined groups. Similarly, within the group related to a palatal cuspid, this ratio for small and peg-shaped lateral incisors is not very different from that for normally-shaped incisors on the affected sides (0.89 ± 0.12, vs. 0.92 ± 0.10).

Numbers were too small for statistical comparison between small or peg- shaped lateral incisors and normally-shaped lateral incisors among the control cases.

Table 3

Maxillary lateral-to-central incisor root length ratios in affected and non-affected cases

	Palatal cuspids			Normally-erupted cuspids		
	N	Mean ratio	S.D.	N	Mean Ratio	S.D.
Total	70	0.91	0.09	106	0.96	0.09
Female	49	0.91	0.10	80	0.97	0.09
Male	21	0.93	0.06	26	0.96	0.10

Table 4

Maxillary lateral-to-central incisor root length ratios according to shape and size of the lateral incisor

	Total			Palatal cuspids			Normally-erupted cuspids		
	N	Mean ratio	S.D.	N	Mean Ratio	S.D.	N	Mean Ratio	S.D.
Normal size	155	0.95	0.09	55	0.92	0.10	100	0.96	0.09
Small or peg-shaped	21	0.94	0.11	15	0.89	0.12	6	—	—

Discussion

From Table 2, we note that the difference in length of the central incisors or their roots on affected and nonaffected sides is small and not statistically significant. This indicates that there is no connection between overall tooth length or root length of the central incisor and palatally-displaced cuspids, which suggests that if there is a connection between lateral incisor root length and impacted cuspids, it may be identified from the ratio between tooth or root length of the lateral incisor and the adjoining central incisor.

It is also important to verify that it is valid to regard contralateral maxillae as separate entities for the purposes of this work. Accordingly, the ratios between lateral and central incisors was calculated in the 19 cases in this study which were bilaterally affected. These showed no difference in their random distribution when compared with the same ratio found in the unilateral cases of this study, so it was considered justifiable to consider each side as a discrete entity.

Although delineation of root and crown is made elsewhere from a line joining the most apical and lingual points on the

cementoenamel junction of extracted teeth (KRAUS ET AL. 1969, SICHER AND DUBRUL 1970, AND WHEELER 1969), this method cannot be used for measurement on radiographs. In this study the delineation was made using a line joining the most mesial and distal points of the cementoenamel junction as seen on the film.

This necessary difference in method of measurement probably accounts for the differences in measured values from those reported in standard texts. While these texts show a ratio of lateral root to central root 1.0, the controls in our study showed an average of 0.96 ± 0.09. For overall tooth length, the texts present a ratio of 0.94, which is in agreement with the value of 0.94 ± 0.01 found in the 12 patients from a different sample group who were used in the pilot test to compare measurements taken from periapical and panoramic views. The ratio for the control group in this study was 0.96 ± 0.09.

For root length, the ratio of lateral incisor to central incisor on affected sides was 0.91 ± 0.09, compared with 0.96 ± 0.09 on the control sides. This is clearly illustrated in Fig. 1, in which the regression lines would be identical if the ratios had been the same. This ratio reflects the average 2.12mm relative deficiency in lateral incisor length on the affected side, and the 1.40mm difference in root length. These differences are more than 7%.

This ratio between root length of lateral and central incisors was essentially the same in unilateral and on bilateral cases, even though the bilateral condition is usually regarded as a more extreme expression of the anomaly of palatal displacement.

In contrast, where an affected side exhibits a peg-shaped or otherwise small lateral incisor crown, the root is shorter than the mean for both unilateral and bilateral cases (Table 4). Among the normally-erupted cuspids of the control group, only very few were associated with small or peg-shaped laterals, so it was impossible to make valid comparisons.

Conclusions

1 There is a definite link between small lateral incisor crown size and the incidence of palatal displacement of the adjacent cuspid.

2 There is a definite link between a short lateral incisor root and the incidence of palatal displacement of the adjacent cuspid.

3 There is a definite link between lateral incisor crown and root size.

4 Since roots of small and peg-shaped lateral incisors tend to be shorter than roots of lateral incisors with normal crowns, their reduced mesiodistal crown width may be merely reflecting the short root. The short root is the more likely critical factor, together with the lateness in development, depriving the cuspid of needed guidance in the early stages of development. A/O

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