# The association of simple anterior dental crossbite to gingival margin discrepancy

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## Abstract

*The purpose of this study was to determine the severity of gingival margin discrepancy affecting the mandibular incisors in children with a single-tooth anterior crossbite. The response of the position of the gingival margin to correction of the crossbite also was investigated. Twenty-two subjects with a single central crossbite and 16 subjects with a single lateral crossbite were identified from two orthodontic practices. Seventeen of the 22 central incisor patients had immediate posttreatment records available; six patients had long-term follow-up records. An insufficient number of posttreatment records were available for the patients with lateral crossbites. The mean clinical crown length of crossbite mandibular incisors, measured on the study models, was compared with mean crown length of contralateral control incisors and the difference in clinical crown length was determined. A gingival margin discrepancy was identified when the gingival margin of the crossbite incisor was at least 1.0 mm apical to the gingival margin of the control incisor. The proportion of subjects with gingival margin discrepancy was significantly higher in subjects with central incisor crossbite (12/22 = 54%) than in those with lateral incisor crossbite (4/16 = 25%), $P < 0.05$. While a gingival margin discrepancy persisted for eight of the 17 central incisor crossbites after discontinuing the appliance, 8.9 ± 4.7 months, the severity of the discrepancy showed a significant reduction from 2.2 ± 0.5 mm to 1.3 ± 0.8 mm, $P < 0.05$. True recession with exposure of cementum was not observed in any subjects. In general, esthetic problems associated with discrepancies in the position of the gingival margin resolve with orthodontic correction of the crossbite. Improvement of the gingival morphology is mainly a result of continued eruption of the noncrossbite incisor and to a lesser extent due to coronal migration of the gingival margin of the crossbite incisor. (Pediatr Dent 13:296–300, 1991)*

## Introduction

Nonskeletal anterior dental crossbite involving the permanent central or lateral incisors is a relatively common malocclusion. The etiology and possible sequelae of anterior crossbite are the subjects of several reviews (Lee 1978; Purcell 1984; Asher et al. 1986). Labial inclination is a characteristic associated with a mandibular permanent incisor in crossbite. A number of investigators have observed that the gingival margin of a labially inclined mandibular incisor often is positioned more apically than the gingival margin of the adjacent incisor (Parfitt and Mjor 1964; Powell and McEniery 1981; 1982; Bimstein 1989). This discrepancy in clinical crown length of one tooth relative to an adjacent tooth is primarily an esthetic problem. However, some investigators suggest that the apical displacement of the gingival margin may traverse the cementoenamel junction and expose cementum, resulting in true recession (Valentine and Howitt 1970).

Recent recommendations by the American Academy of Periodontology (1989) suggest that gingival augmentation be considered for an erupting tooth in which the gingival margin is located apical to the cementoenamel junction or when esthetic concerns exist. It is essential that the severity and long-term sequelae of any gingival defects associated with anterior crossbite be determined and that the relationship between treatment of crossbite and the final position of the gingival margin be established. The purpose of this study was to determine the severity of gingival margin discrepancy affecting the mandibular incisors in children with a single tooth anterior crossbite. The response of the position of the gingival margin to correction of the crossbite also was investigated.

## Method

The dental records of all children who were referred to two orthodontic offices over an eight-year period for treatment of nonskeletal anterior crossbite in the mixed dentition were examined. The records included intact study models with sufficiently erupted incisors, photographs, and information regarding duration and type of appliance therapy. The sample was restricted to those cases with a single-incisor crossbite. By restricting the analysis to single central or lateral incisors in crossbite, characteristics of the mandibular incisor in crossbite (the "crossbite" incisor) could be compared to

the contralateral or "control" incisor. In all cases, there was incisal contact in centric relation (CR = most retruded mandibular position) from where the patient postured the mandible forward into anterior crossbite (CO = centric occlusion).

Twenty-two subjects with a single-central crossbite and 16 subjects with a single-lateral crossbite were identified. Seventeen of the 22 central incisor patients had immediate posttreatment records available; six patients had long-term follow-up records. Immediate posttreatment records were available for only eight of the 16 single lateral incisor subjects; long-term follow-up records were available for only five subjects. Because of the short treatment time, full records were not repeated on all subjects immediately following treatment, especially on those who would need additional orthodontic therapy. Results before and after treatment were not analyzed statistically for lateral incisor crossbites because of the small number with posttreatment records.

For the central-incisor crossbites, a maxillary removable appliance was used in all cases except two that were treated with a mandibular removable appliance. The treatment objectives were to decrease the CR-CO shift and eliminate the crossbite. Ideal alignment of the incisors was not a primary goal, because many of the patients would need additional orthodontic treatment in the future.

All measurements were taken by one examiner (RH). Children whose mandibular incisors showed evidence of attrition or fracture on the study models were excluded. Only crossbite and contralateral control incisors whose incisal edges were on the same horizontal plane were included in the analysis. Thus, the measurements reflected the relative positions of the gingival margins. The crown lengths of the crossbite and control incisor were measured with a Boley gauge to the nearest 0.1 mm from the incisal edge to the most apical point on the gingival margin of the midfacial aspect of each mandibular incisor. This measurement may not represent the amount of gingival recession, but it does give an estimate of the initial position of the gingiva and any changes in position demonstrated after treatment (Persson and Lannartsson 1986).

Method error was studied by repeating 40 of the measurements, and was tested according to the formula:

$$si = \sqrt{\frac{d^2}{2\,(N-1)}}$$

The error was established as 0.13 mm.

The mean clinical crown length of a mandibular central incisor occluding with a maxillary central incisor in crossbite was compared with the mean crown length of the contralateral control incisor. The same comparisons of mean crown length were made for a mandibular lateral incisor occluding with a maxillary lateral incisor in crossbite, using the contralateral lateral incisor as the control tooth. The difference in clinical crown length between crossbite and control incisor was determined. A gingival margin discrepancy was identified when the gingival margin of the crossbite incisor was at least 1.0 mm apical to the gingival margin of the control incisor. True recession was present if the gingival margin was at least 1 mm apical to the cementoenamel junction (O'Leary et al. 1971).

The mean, standard deviation (SD), and range were determined for all measurements. Statistical comparisons used patients as the unit of analysis. Differences for measurements on contralateral teeth and across time were assessed within patients by paired *t*-tests.

## Results

Gender of the subjects and the number of right and left incisors in crossbite were distributed equally between the crossbite groups.

The prevalence and severity of gingival margin discrepancy are shown in Table 1. The proportion of subjects with gingival margin discrepancy was significantly higher in subjects with central incisor crossbite (12/22 = 54%) than in those with lateral incisor crossbite (4/16 = 25%), $P < 0.05$. Eight of the 12 mandibular central inci-

**Table 1. Prevalence and severity of crown length discrepancy• in single-tooth crossbite cases: pretreatment**

| *Tooth in crossbite* | *Subjects* ***with*** *crown length discrepancy* | | | | | *Subjects* ***with no*** *crown length discrepancy* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *N* | *% of subjects* | *Mean*† | *SD* | *Range* | *N* | *Mean*† | *SD* | *Range* |
| Central incisor (N = 22) | 12 | 54%‡ | 2.2 mm | (0.5) | 1.3–2.9 mm | 10 | – 0.3 mm | (0.6) | – (1.5) – 0.5 mm |
| Lateral incisor (N = 16) | 4 | 25%‡ | 1.7 mm | (0.6) | 1.0–2.2 mm | 12 | – 0.3 mm | (0.4) | – (0.7) – 0.5 mm |

• Crown length discrepancy = gingival margin of crossbite incisor at least 1.0 mm apical to gingival margin of control incisor.

† Mean difference in crown length (plus SD and range) between crossbite and control incisor.

‡ Significantly different, $P < 0.05$.

**Table 2. Clinical crown lengths of orthodontically treated central incisor crossbite cases (pre- and posttreatment)**

| *Treated single central crossbite cases* | | *Pretreatment Clinical crown length (mm)* | | | | *Posttreatment Clinical crown length (mm)* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Age (years)* | *Crossbite Incisor* | *Control Incisor* | *Difference* | *Age (years)* | *Crossbite Incisor* | *Control Incisor* | *Difference* | *Treatment time (months)†* |
| Crown length discrepancy (N = 9) | Mn(SD) | 8.2 | 8.9 (1.0) | 6.7 (1.0) | 2.2* (0.5) | 8.9 | 8.6 (0.9) | 7.4 (0.8) | 1.3* (0.8) | 8.4 (4.3) |
| | Range | (5.9–10.9) | (7.0–10.0) | (5.3–8.3) | (1.3–2.9) | (6.7–11.5) | (7.5–11.0) | (6.2–8.5) | (-0.3–2.2) | (4.0–18.0) |
| No crown length discrepancy (N = 8) | Mn(SD) | 8.4 | 7.0 (0.8) | 7.2 (1.2) | -0.2 (0.5) | 9.2 | 7.2 (0.6) | 7.3 (1.0) | -0.1 (0.7) | 9.4 (5.3) |
| | Range | (7.8–9.8) | (6.0–8.0) | (6.0–9.3) | (-1.3–0.5) | (8.3–10.8) | (6.3–7.6) | (6.3–9.1) | (-1.6–1.0) | (3.0–18.0) |
| All subjects (N = 17) | Mn(SD) | 8.3 | 8.0(1.3) | 6.9(1.1) | 1.1(1.3) | 9.1 | 7.9(1.1) | 7.3(0.9) | 0.6(1.0) | 8.9(4.7) |

* Significantly different, $P < 0.05$. † Treatment time = time from appliance insertion to discontinuation, including retention period.

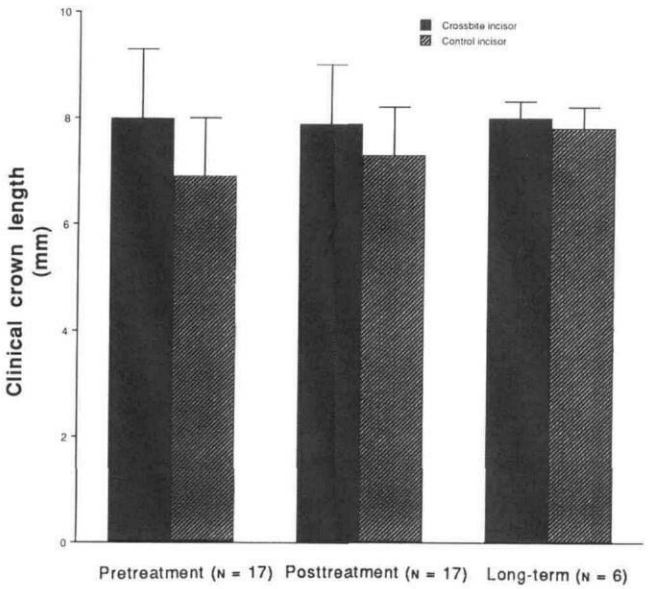


**Fig 1**. Clinical crown length (mean, ± S.D.) of crossbite mandibular incisor and control incisor in subjects with single central incisor crossbite. Records were available for 17 subjects before appliance treatment (pretreatment), for 17 subjects at appliance removal (posttreatment), and for six subjects, 42.8 ± 21.3 months after appliance removal, prior to beginning the next phase of treatment (long term).

sors with a gingival margin discrepancy had a difference of more than 2.0 mm. However, two subjects with central incisor crossbite displayed a discrepancy on the control, noncrossbite tooth and had a normally positioned gingival margin on the crossbite tooth.

Of the central incisor crossbite cases, 17 had both pretreatment and immediate posttreatment records available for analysis. Table 2 depicts posttreatment changes in clinical crown length of the crossbite and control central incisor in these cases, nine of which had a crown length discrepancy. Crown length measurements were available at the time of appliance insertion and at the time when the appliance was discontinued, 8.9 ± 4.7 months later. The mean time to correct the crossbite was actually 2.8 ± 1.9 months, but posttreatment models were not taken until retention was completed and the appliance was removed. While a gingival margin discrepancy persisted for eight of the 17 subjects after appliance removal, the severity showed a significant reduction from 2.2 ± 0.5 mm to 1.3 ± 0.8 mm, $P < 0.05$. The reduction was primarily due to an increase in crown length of the control incisor, from 6.7 ± 1.0 mm to 7.4 ± 0.8 mm, and less a result of a decrease in length of the crossbite incisor, 8.9 ± 1.0 mm to 8.6 ± 0.9 mm. Measurements for six of the subjects with central incisor crossbite were available 42.8 ± 21.3 months after appliance removal (Fig 1). Resolution of gingival discrepancy had occurred in all six subjects, and the mean difference between crown lengths of crossbite and control central incisors was (-0.2) ± 0.4 mm. Although not illustrated here, similar patterns of resolution after treatment were observed for gingival margin discrepancy affecting lateral incisors.

The figures that follow show a typical subject with crossbite affecting the left maxillary and mandibular permanent central incisors. At age 6 years, 3 months (Fig 2a, see next page), when removable appliance treatment was begun, the amount of gingival margin discrepancy was 2.9 mm. Eleven months later (Fig 2b, see next page), the crossbite was corrected, retention was complete and the gingival discrepancy had resolved to 0.3 mm. Prior to beginning the next phase of orthodontic treatment, 4 years, 3 months after appliance removal (Fig 2c, see next page), no measurable gingival discrepancy remained, although rotational relapse of the left maxillary central incisor had occurred.

**Fig 2a.** A female subject, age 6 years 3 months, with crossbite of left permanent central incisors and gingival margin discrepancy, at the beginning of appliance therapy.

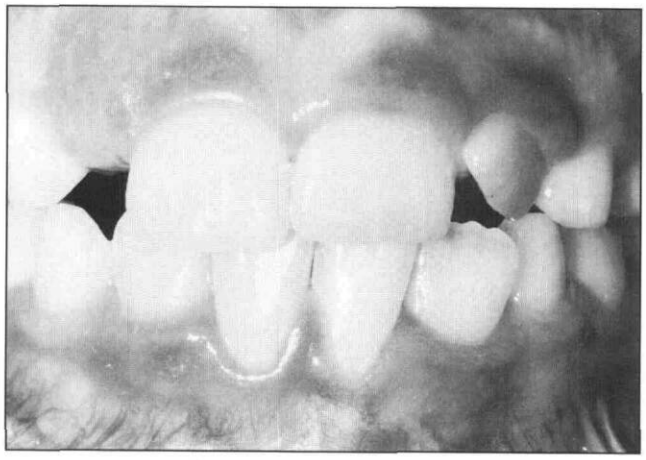

**Fig 2b.** The gingival margin discrepancy had decreased 11 months later when appliance was discontinued.

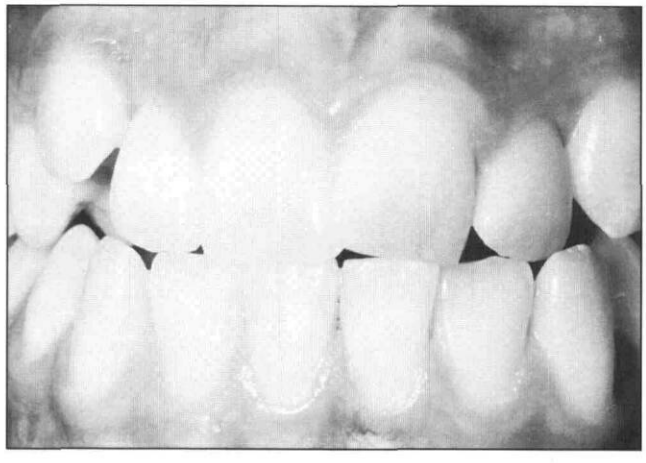

**Fig 2c.** Complete resolution of discrepancy at age 11 years 5 months, prior to beginning next phase of orthodontic treatment. Rotational relapse of the left central incisor has occurred.

## Discussion

More than half of the children in this sample with a central incisor crossbite demonstrated a gingival margin discrepancy. Only one quarter of lateral incisors in crossbite showed a discrepancy. Previous observations reported in patients without crossbite suggest that apical displacement of the gingival margin is associated with labial inclination of the affected tooth relative to its contralateral neighbor (Parfitt and Mjor 1964; Powell and McEniery 1981, 1982; Bimstein 1989). This relationship is consistent with the increased prevalence of gingival margin discrepancy on mandibular central incisors in our study. However, it is not surprising that a gingival margin discrepancy was not observed on many of the lateral incisor crossbite cases. A maxillary lateral incisor usually erupts into a lingual position because of an arch length deficiency. Therefore, because the maxillary lateral is sitting in this relatively lingual position, the opposing lateral incisor is not forced into a more labial position.

Almost half of crossbite mandibular central incisors did not exhibit a gingival discrepancy. Moreover, in two subjects it was the noncrossbite, or normally positioned, tooth that displayed a gingival discrepancy. Therefore, factors in addition to tooth position may predispose an incisor in crossbite to gingival margin discrepancy. A number of other factors, not considered in our retrospective study, including presence of facial alveolar bone, degree of gingival inflammation, width of attached gingiva, toothbrush abrasion and oral hygiene procedures, have been suggested to be equally important in the etiology of gingival margin discrepancy (Powell and McEniery 1981; 1982). In addition, length of time in crossbite and degree of CR-CO slide also may be important.

The gingival discrepancy resolved with orthodontic treatment and continued to improve in the years following orthodontic treatment, as shown by the six patients with long-term follow-up measurements. The discrepancy decreased primarily by apical movement of the gingival margin on the control tooth and, to a lesser extent, by coronal movement of the gingival margin on the tooth in crossbite. Our results demonstrate that continuing eruption of the control, noncrossbite incisor provides the main contribution to resolution of gingival margin discrepancy. This observation confirms a similar finding in orthodontic cases without crossbite (Persson and Lennartsson 1986) and suggests that procedures to correct the esthetic defect associated with gingival margin discrepancies should not be undertaken until well after correction of the crossbite.

True recession in children results mainly from loss of gingival tissue overlying root surfaces with a thin to absent alveolar housing. While recession may be more

likely to occur on labially inclined mandibular incisors in crossbite, the absence of true recession on crossbite incisors in this investigation suggests that true recession is not a necessary consequence of crossbite when treatment occurs soon after diagnosis. It is important to note that almost all subjects in our study presented for treatment promptly after initial diagnosis, and exposure to potential periodontal insult secondary to crossbite was brief. As a result, our sample is not truly randomly cross-sectional. Furthermore, because of the many variables that can affect the position of the gingival margin, we cannot be sure what would happen to gingival position if treatment does not take place. Cephalometric assessment of tooth position before and after treatment of crossbite, and of the change in alignment of the mandibular incisor secondary to orthodontic movement of the maxillary incisor are areas worthy of future investigation in clarifying the nature of the mandibular incisor's response to treatment.

## Conclusions

1. A gingival margin discrepancy occurred in about half of cases of single central incisor crossbite, but true recession did not occur on mandibular incisors of children with simple anterior crossbite in this sample.
2. In general, discrepancies in the position of the gingival margin resolved with orthodontic correction of the crossbite.

The authors sincerely thank the staff of the Oakridge-Richmond Paediatric Dental Group and the staff of the orthodontic practice of Dr. A. A. Lowe for their assistance in the collection of data for this study.

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American Academy of Periodontology: Proceedings of the World Workshop in Clinical Periodontics, Princeton, New Jersey, 1989, Chicago: AAP, 1989.

Asher RS, Kuster CG, Erickson L: Anterior dental crossbite correction using a simple fixed appliance: case report. Pediatr Dent 8: 53–55, 1986.

Bimstein E: Non-surgical treatment of pseudo-recession in children and adolescents. Amer J Dent 2: 25–27, 1989.

Lee BD: Correction of crossbite. Dent Clin North Am 22: 647–68, 1978.

O'Leary TJ, Drake RB, Crump PP, Allen MF: The incidence of recession in young males: a further study. J Periodontol 42: 264–67, 1971.

Parfitt GJ, Mjor IA: A clinical evaluation of local gingival recession in children. ASDC J Dent Child 31: 257–62, 1964.

Persson M, Lennartsson B: Improvement potential of isolated gingival recession in children. Swed Dent J 10: 45–51, 1986.

Powell RN, McEniery TM: Disparities in gingival height in the mandibular central incisor region of children aged 6–12 years. Community Dent Oral Epidemiol 9: 32–36, 1981.

Powell RN, McEniery TM: A longitudinal study of isolated gingival recession in the mandibular central incisor region of children ages 6-8 years. J Clin Periodontol 9: 357–64, 1982.

Purcell PD: The crossbite. J Mich Dent Assoc 66: 69–73, 1984.

Valentine F, Howitt JW: Implications of early anterior crossbite correction. J Dent Child 37: 420–27, 1970.

## Asthma fact

Between 1979 and 1987, the number of Americans with asthma increased by one third, and deaths from asthma rose from 2,600 in 1979 to 4,600 in 1988, according to an item in *In Health*, March/April 1991.