Transverse Maxillary Growth In Combined Cleft Lip and Palate
A longitudinal roentgencephalometric study by the implant method

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Transverse maxillary growth was studied radiographically by the metallic implant method in 5 Danish boys with combined cleft lip and palate. The study covered the age range of five to 20 years with individual observation periods of 9 to 12 years. Lip closure and palate closure had been performed at two months and 24 months of age respectively by conventional methods. Orthodontic treatment was carried out in all cases. The maxillary width was determined from posteroanterior cephalometric radiographs as the distance between metallic implants inserted at the lower aspect of the maxillary-zygomatic process on both sides. Other roentgencephalometric measurements were obtained for further estimate of the facial growth in width. Distance curves and velocity curves for these measurements and for body height were constructed and compared. The growth curves for maxillary width differed definitely from normal and indicated that the spontaneous transverse palatal growth was inhibited in these patients.

Knowledge concerning transverse growth of the maxilla in patients with combined cleft lip and palate is still incomplete. Much information has been collected on the preoperative morphology of the maxilla, and the immediate postoperative changes are well described (Pruzansky 1955, Aduss and Pruzansky 1967, 1968, Huddart, MacCauley, and Davis 1969, Stöckli 1970). Longitudinal studies of transverse maxillary growth have been limited to younger ages (Mazaheri, Harding, and Nanda 1967, Ishiguro, Korgman, Mazaheri, and Harding 1976), and data on longitudinal increase in the width of the maxilla have not been available.

The present study was a longitudinal evaluation of transverse maxillary growth by the implant method in subjects with combined cleft lip and palate.

Materials and Methods

Three boys with bilateral and two boys with unilateral clefts of the lip and palate had metallic implants inserted bilaterally in the infrazygomatic crest of the maxilla by the technique described by Björk (1968). The study was based on annually obtained posteroanterior cephalometric radiographs and dental casts. Recordings of body height and radiographs of the right hand were obtained in order to relate maxillary growth to general physical growth and maturation. The individual observation periods are indicated in Figure 1. Reference points are shown in Figure 2, and the location of the implants is shown in Figure 3. The distance between the implants in the two infrazygomatic crests measured on the posteroanterior cephalometric radiographs was considered indicative of the maxillary width.

Surgical treatment

All surgery had been performed by the same surgeon. In the bilateral cases, the lip was repaired in two stages by the Blair-Brown technique. The first side was done at two months of age and the second side six weeks later. At the same time, the cleft in the hard palate was closed in two layers by a palatovomer plasty. The remainder of the cleft was

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The periods of active orthodontic treatment in the individual cases are indicated on the growth curves.

**Case reports**

Case No. 1 (No. 6333) Diagnosis: Incomplete bilateral cleft lip, complete bilateral cleft palate.

Orthodontic treatment, consisting of an initial phase of twelve months' duration at eight years of age, was aimed at transverse and sagittal expansion of the maxilla. The appliances used for this correction were a lingual arch with auxiliary springs and a labial appliance for positioning the premaxilla. A removable retainer was then used until the age of 13. The case was then finished by using a multiband appliance for 12 months followed by a removable retainer (Figure 4). The distance and velocity curves for maxillary width and body height are shown in Figure 5. Coincident with the orthodontic expansion in the mixed dentition, an increase in maxillary width was seen. During the following period, the width of the maxilla remained unchanged. Subsequent to the orthodontic treatment, maxillary width decreased so that the total increase in width of the maxilla during the twelve-year observation period was 1.5 millimeters.

Comparison of the growth curves for body height and maxillary width revealed remarkable differences. All of the increase in maxillary width occurred during orthodontic expansion in the juvenile period, and the well defined pubertal growth spurt seen in the curves for body height was completely absent in the curves for the width of the maxilla. The other transverse facial measurements indi-
FIGURE 4. Case no. 1. The maxillary dental arch before (a) and after (b) the orthodontic expansion; (c) the occlusion after final alignment in the permanent dentition.

cated a pubertal growth spurt. The increase of these measurements from 10–11 years to adult age is shown in Table 1.

Case No. 2 (No. 873). Diagnosis: Complete bilateral cleft lip and palate.

Orthodontic treatment was initiated at five years and four months of age with a removable plate for transverse expansion. The plate was used for 18 months and kept as a retainer for 12 months. A lingual arch was then inserted to continue the transverse expansion and to correct the position of the premaxilla. This appliance was used for a period of 17 months. Subsequently, a retainer was used until the final alignment was initiated at sixteen years of age and finished within 19 months. The appliance was a lingual arch with auxiliary springs. A multiband appliance was not used for this patient.

Nearly all of the increase in maxillary width occurred during the orthodontic expansion in the juvenile period. The width of the maxilla was unchanged from approximately 11 years of age and was completely unaffected by the general pubertal growth spurt (Figure 6). The increase of other transverse measurements is shown in Table 1.

Case No. 3 (No. 6188). Diagnosis: Bilateral cleft lip and palate.

Orthodontic treatment was started at six years and five months with a removable plate for transverse expansion. The expansion was continued for seven months, and the plate was then kept as a retainer. At eight years of age, a lingual arch and class III traction were applied to correct the position of the premaxilla. After one year with this appliance, the case was retained. At 13 years and six months, the final orthodontic correction was undertaken with a multiband appliance in both the maxilla and mandible. Treatment time was three years and 9 months.

The implants were inserted after the initial period of transverse expansion. Therefore, the
effect of this period of orthodontic treatment could not be determined. After the insertion of the implants at eight years of age, the width of the maxilla remained the same throughout the juvenile period. During final orthodontic correction, which occurred in the later part of the pubertal growth spurt, the width of the maxilla became one millimeter larger (Figure 7). This increase in width took place later than the pubertal growth maximum for body height and for the other transverse measurements which increased during the entire growth period and showed a fairly well defined pubertal growth spurt (Figure 7c). The distance between the implants showed the smallest increase during the adolescent period (Table 1).

Case No. 4 (No. 1798). Diagnosis: Complete unilateral cleft lip and palate.

Immediately after the implants had been placed at age 11 years and three months, orthodontic expansion was initiated with a multiband appliance. After one year, the mandibular teeth were banded and class III elastics applied. Orthodontic treatment was finished at age 15 years and six months. During the first part of orthodontic treatment, an increase of 1.5 millimeters was registered between the implants. Subsequent to the removal of the appliances, a relapse of 1.0 millimeter occurred, so that an increase in width of only 0.5 millimeter persisted (Figure 8).

This patient also had implants placed bilaterally in the anterior part of the hard palate at the level of the canines. During orthodontic treatment, an increase of 2.0 millimeters occurred between these implants. In the next two years following the removal of the orthodontic appliance, a complete relapse of this expansion was recorded (Figure 9).

The changes in the other transverse measurements appear in Table 1.

Case No. 5 (No. 3236). Diagnosis: Complete unilateral cleft lip and palate.

![Graphs showing distance curves and velocity curves for maxillary width and body height.](image)

**Figure 5.** Case no. 1. Distance curves (a) and velocity curves (b) for maxillary width and body height. H indicates the time for pubertal growth maximum in body height.

**Table 1.** Changes in facial width measurements from 10-11 years to adult age.

<table>
<thead>
<tr>
<th>Case</th>
<th>lo-lo</th>
<th>mo-mo</th>
<th>zy-zy</th>
<th>ne-ne</th>
<th>ag-ag</th>
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<tr>
<td>1 (6333)</td>
<td>2.5</td>
<td>1.0</td>
<td>13.5</td>
<td>2.0</td>
<td>7.5</td>
<td>-1.0</td>
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<tr>
<td>2 (873)</td>
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<td>2.5</td>
<td>15.0</td>
<td>3.5</td>
<td>7.5</td>
<td>0.5</td>
</tr>
<tr>
<td>3 (6186)</td>
<td>2.0</td>
<td>2.5</td>
<td>13.0</td>
<td>3.0</td>
<td>9.0</td>
<td>1.0</td>
</tr>
<tr>
<td>4 (1798)</td>
<td>3.5</td>
<td>2.0</td>
<td>12.5</td>
<td>1.5</td>
<td>7.0</td>
<td>0.5</td>
</tr>
<tr>
<td>5 (3236)</td>
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<td>1.5</td>
<td>15.0</td>
<td>1.0</td>
<td>4.5</td>
<td>-</td>
</tr>
<tr>
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<td>1.9</td>
<td>13.8</td>
<td>2.2</td>
<td>7.1</td>
<td>0.3</td>
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Orthodontic treatment consisted of initial transverse expansion of the maxilla with a lingual arch at four years and 11 months of age. Implants were inserted at the same time. Expansion was completed in eight months and a removable retainer inserted. From the age of seven years and seven months, a head gear was used for a period of five months to correct the position of the first molars. A final treatment period with multiband appliance was carried out in the permanent dentition (14 months in the mandible and 22 months in the maxilla).

It appears that the major part of the increase in width of the maxilla took place during orthodontic treatment in the juvenile period with no increase thereafter (Figure 10).

From the age of 12 years, the implants on the left side were lost, and further measurements between the implants were not possible.

The other transverse measurements increased during the entire observation period. The increase from 10 years of age is shown in Table 1.

Discussion

Evaluation of the sutural component in transverse maxillary growth is not possible from conventional posteroanterior radiographic films but requires the use of metallic implants.

Previous X-ray cephalometric studies by this method have demonstrated that sutural growth in normal individuals plays an essential role in the transverse development of the maxilla. It has been shown that the distance curves and velocity curves for the growth in the midpalatal suture follow the same course as the curves for body height with a well defined pubertal growth spurt (Björk and Skieller 1974, 1976). Histologic studies have revealed sutural growth activity beyond puberty (Melsen 1975).

In patients with cleft lip and palate, the palatal suture system is disturbed (Andersen and Matthiessen 1967, Prydsø, Holm, Dahl and Fogh-Andersen 1974). In complete unilateral clefts, the median palatine suture has an abnormal position lateral to the midline and in the untreated condition the segment on the cleft side has no sutural connection with the maxilla on the noncleft side. In complete bilateral cases, the midpalatal suture is completely absent, and there is a segmentation of the maxillary complex into three parts.

The present longitudinal study showed that the growth curves for maxillary width in the
cleft patients definitely differed from normal. Björk and Skieller (1974) have reported an average increase of 3.0 millimeters in maxillary width in the midpalatal suture at the level of the first permanent molars from 10/11 years to adult age in normal individuals. For the cleft patients under study, the average increase in width of the maxilla for the same
period was 0.3 millimeters, which was far less than the growth in width recorded for other transverse dimensions (Table 1).

The shape of the growth curves for transverse maxillary width were not similar to the growth curves for body height as seen in noncleft cases. A characteristic feature was that the distinct pubertal growth spurt seen in body height was not accompanied by corresponding growth in maxillary width. Increase in maxillary width was, to a varying extent, produced by the orthodontic expansion, and this extrinsic influence could not be clearly discriminated from the growth factor.

The shape of the curves, however, indicated that spontaneous transverse palatal growth was inhibited in these patients.

Adverse effects from surgical intervention is the most probable cause for this growth disturbance in patients with combined cleft lip and palate. It can be shown in unoperated patients that the cleft condition, in itself, does not prevent a nearly normal transverse development of the maxilla (Ortiz-Monasterio et al. 1966, Dahl 1971). In adult patients with combined cleft lip and palate, Dahl (1970) found a significantly smaller maxillary width in subjects with repaired cleft palate than in subjects where the palatal cleft had been left unrepaired. Prydsø, Holm, Dahl, and Fogh-Andersen (1974) demonstrated that palatoplasty may result in a bony ankylosis between the maxillary segment on the cleft side and the nasal septum. Additionally, it was suggested that this “ankylosis”, coupled with the abnormal position of the median palatine suture in complete unilateral clefts, might restrict transverse maxillary growth. This suggestion was substantiated by the present longitudinal investigation.

There is strong evidence that surgical repair of a cleft still represents the major secondary factor in the development of specific transverse malocclusions in patients with combined cleft lip and palate. The adverse effects may arise both from the production of a bony ankylosis and from scar tissue acting as a fibrous ankylosis. The surgical management of clefts should be planned and carried out with these factors in mind. Procedures which produce a bony union in the palate should be avoided during the growth period, and efforts
should be made to devise methods for each individual patient in order to keep adverse effects of scarring at a minimum.

References


