Extraoral Traction to the Maxilla With Face Mask: A Follow-up of 17 Consecutively Treated Patients With and Without Cleft Lip and Palate

KARL-VICTOR SARNÄS, D.D.S., PH.D.
BODIL RUNE, D.D.S., PH.D.

Lateral cephalometric films of seven cleft palate (CP) or unilateral cleft lip and palate (UCLP) and ten nonCLP patients were obtained immediately before extraoral traction with face mask, immediately after, and at 6 months follow-up. The mean age at start of treatment was 7 years for the CLP patients and 11 years for the nonCLP patients. The average duration of traction was 8 months in both groups. The traction force was gradually increased from 300 to 800 g on each side. Five angular measurements were defined and recorded. The mean net effect in anterior displacement of the maxilla in the CLP group was +0.2 degrees (range +2.5 degrees to −2.5 degrees) and in the nonCLP group +1.0 degree (range +2.5 degrees to −1.0 degree). The orthopaedic effect of extraoral traction to the maxilla was found to be independent of skeletal morphology, age, peak height velocity (PHV), and duration of traction, and thus to be unpredictable.

Normal overjet was obtained in most patients, because of a combination of anterior displacement of the maxilla, posterior displacement of the mandible, tipping of the incisors, and a possible anterior sliding of the maxillary dental arch on its base.

With the reintroduction of the face mask treatment (Delaire, 1971, Delaire et al, 1972) it has become possible to move the maxilla forward by means of extraoral traction. It has been recommended that extraoral traction start at an early age to facilitate movement of the maxillary bones while the circummaxillary sutures are still patent. Extraoral traction has been claimed to be superior to any orthodontic means to “reduce maxillary brachygnathia” in children with cleft lip and palate (Delaire et al, 1973). The use of extraoral traction in individual patients with midface deficiency of different etiology has been reported (Fenn, 1979; Subtelny, 1980; Friede and Lennartsson, 1981; Rune et al, 1982; Rygh and Tindlund, 1982). The treatment success varied, and no single factor was reported to be of significance in the selection of patients who would benefit from extraoral traction.

The present study concerns the first 17 patients consecutively treated with extraoral traction at our clinic from 1979 to 1982. The purpose was to assess the effect of extraoral traction in relation to facial morphology, age, and peak height velocity (PHV) in patients with cleft lip and palate (CP and UCLP) and in patients without this defect, in terms of sagittal displacement of the jaws, mandibular rotation, and incisor inclination in both jaws.

MATERIALS AND METHODS

Subjects

The examined patients (Table 1) were 10 boys and seven girls, who had a relative maxillary retrognathia and a negative overjet. According to the “architectural and structural craniofacial analysis” (Delaire, 1978; Delaire et al, 1981), the maxillary base was well behind the CFI line in all patients except four (Patients 8, 9, 16 and 17) in whom the base coincided with this line (Fig. 1).

Of the seven patients with a maxillary cleft (Patients 1 to 7) none had had primary or secondary
### TABLE 1
Examined Patients in Relation to Sex, Age at the Start of Extraoral Traction, Presence of Maxillary Cleft, Treatment Time, and Peak Height Velocity

<table>
<thead>
<tr>
<th>Pat.</th>
<th>Sex</th>
<th>Start of Extraoral Traction (yr and mo)</th>
<th>Maxillary Cleft</th>
<th>Treatment Time (d)</th>
<th>Start of Extraoral Traction in Relation to Peak Height Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>64</td>
<td>UCLP</td>
<td>318</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>73</td>
<td>UCLP + CP*</td>
<td>242</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>77</td>
<td>UCLP</td>
<td>366</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>77</td>
<td>UCLP</td>
<td>131</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>77</td>
<td>UCLP</td>
<td>242</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>8°</td>
<td>CP</td>
<td>166</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>9°</td>
<td>CP</td>
<td>209</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>8°</td>
<td></td>
<td>156</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>9°</td>
<td></td>
<td>167</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>11°</td>
<td></td>
<td>211</td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>11°</td>
<td></td>
<td>240</td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>11°</td>
<td></td>
<td>272</td>
<td>X</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>12°</td>
<td></td>
<td>311</td>
<td>X</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
<td>13°</td>
<td></td>
<td>277</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>13°</td>
<td></td>
<td>241</td>
<td>X</td>
</tr>
<tr>
<td>16</td>
<td>M</td>
<td>14°</td>
<td></td>
<td>255</td>
<td>X</td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>13°</td>
<td></td>
<td>344</td>
<td>X</td>
</tr>
</tbody>
</table>

* Incomplete cleft of the hard palate

---

**Face Mask Treatment**

A cap splint (Fig. 2) was cemented to the maxillary dental arch in all patients except one (Patient II), in whom a combined labial and lingual appliance was used. The cap splint was divided to allow expansion with a quad-helix in Patients by the same surgeon, but the palate repairs had been performed by six different surgeons. The alveolar cleft was not repaired except in Patient 4.

---

*Figure 1* Reference points: n = nasion, the most anterior point of the frontonasal suture; s = sella, the center of the sella turcica; ss = subspinale, the most posterior point on the anterior contour of the upper alveolar process (corresponds to point A in American literature); sm = supramentale, the most posterior point on the anterior contour of the lower alveolar process (corresponds to point B in American literature); gn = gnathion, the most inferior point on the mandibular symphysis; M = the junction of the nasofrontal, maxillofrontal, and maxillonasal sutures, which is the anterior part of the frontalmaxillary articulation (Delaire et al, 1981); FM = the point of intersection between CF1 and C3 lines (Delaire et al, 1981).

Reference lines: NSL = nasion-sella line, the line through n and s; ML = mandibular line, the tangent to the lower border of the mandible through gn; ILs = upper incisor axis line; ILi = lower incisor axis line; C3 = the line drawn from M through the apex of the posterior clinoid process of the sella turcica (Delaire et al, 1981); CF1 = the line perpendicular to line C3 registered at point FM, which is the intersect point of C3 and the line continuing to the anterior lacrimal crest (Delaire et al, 1981). Except for M, FM, C3, and CF1 see Solow and Tallgren (1976) and Sarnas and Solow (1980).

(The figure represents Patient 3; point ss could not be identified.)
In some of the younger patients the cap splint had to be recemented occasionally. Traction hooks were positioned on the labial side distal to the lateral incisors or, in patients who needed expansion, on the palatal side by the first premolars, and the traction force on each side was increased gradually from about 300 to 800 g. The patients were encouraged to wear the face mask (Verdon and Salagnac, 1977) at all times except when at school and during outdoor activities (Fig. 3). The actual treatment time could not be assessed. It was our impression that the face mask was used routinely during the night by all patients, but rarely during the day. In no instance was the face mask rejected by the patient, and the decision to terminate the traction was made by us. If there was no improvement in incisor relationship after 3 to 5 months, the traction was terminated. The average treatment time was about 8 months, with a range of from 4 to 12 months (Table 1) as recommended by Delaire (1979). Six months (or in Patient 4 immediately) after the termination of extraoral traction (i.e., at follow-up), orthodontic treatment was started in all patients except one (Patient 6). Eventually Patients 10, 14, and 15 developed a true mandibular prognathism with a negative overjet, which in Patient 15 was corrected by mandibular surgery.

**Roentgen Examination and Analysis of Films**

The study was based on lateral cephalometric films obtained immediately before and after extraoral traction and 6 months after termination of traction. The post-traction observation period was limited to 6 months in order to lessen the impact of growth on the findings, particularly growth in the area of nasion which is conclusive for measurements of the sagittal jaw relationship (Stramrud, 1959; Sarnäs and Solow, 1980). The films were obtained in a conventional cephalostat. The distance from focus to the median plane of the head was fixed although the distance from this plane to the film varied (Iikubo et al, 1975). Because of the ensuing variation in enlargement, analysis of the films had to be based on point analysis (Sarnäs and Solow, 1980), and angular measurements only were recorded. At exposure the patient was seated with his or her teeth in habitual occlusion and with the Frankfort plane horizontal. Before the first examination, metal-
lic implants (Björk, 1968) had been inserted close to the median plane above/below the apices of the incisors in both jaws of Patients II, 13, 15, and 16 and in the mandible only in Patient 17. The implants were used to check the reliability of the reference points "ss" and "sm" and to assess possible remodelling growth at these points. The implants were assumed stable in the bone.

In the analysis of the films, one investigator (K.V.S.) marked all the reference points directly on the films (Fig. 1), and the three films of each patient were marked at the same time to obtain maximal agreement in the location of the reference points. The nasal line was not used because the localization of a posterior palatal reference point would be unreliable in the seven CLP patients. Five angular measurements were defined (s-n-ss, s-n-sm, NSL/ML, IL/NSL, IL/ML) and recorded. The maxillary permanent incisors had not yet erupted in four CLP patients at the start of extraoral traction. The axial inclination of these incisors (IL/NSL) could not be recorded, accordingly. In two CLP patients point “ss” could not be accurately identified. The "architectural and structural craniofacial analysis" (Delaire, 1978; Delaire et al, 1981) was done on the films obtained before the start of extraoral traction.

Body Height

At each roentgen examination body height was recorded to supplement the annual routine registration of body height. For each patient, the velocity curve was constructed to assess the age of greatest height gain, i.e., peak height velocity (PHV).

RESULTS AND DISCUSSION

The skeletal morphology at the start of extraoral traction and the changes at termination of traction (Diff 1) and at six months after termination of traction (Diff 2) are given for each patient (Table 2).

Error of Method

Delaire et al (1976) recognized the difficulties in assessing maxillary displacement as the significance of the results depends on the reliability of the reference points “ss” and “n.” In the young patient, point “ss” may be obscured by erupting or abnormally positioned tooth germs. Thus, in the present study a misshapen medial incisor in an abnormal position of eruption (Fig. 1) obscured point “ss” in two CLP patients (Patients 1 and 3). In this situation, metallic implants may be used as reference points, provided they remain stable in the bone (i.e., are placed well above the alveolar bone where they are undisturbed by erupting incisors or by alveolar arch deformation resulting from traction or orthodontic treatment). In the four patients supplied with implants in the present study, the changes (Diff 1 and Diff 2) were similar when measured to point “ss” and to the corresponding implant (i.e., point “ss” was as reliable a reference point as was the implant in these patients).

Appositional growth in the area of nasion (Stramrud, 1959; Sarnäs and Solow, 1980) may conceal a forward displacement of the maxilla as measured by the angle s-n-ss. Therefore, the posttraction observation period was limited to 6 months.

In the small sample, no systematic assessment was made of the method error. In a recent study of 141 children, we found most angles had method errors of about 0.5 degrees, and angles involving incisors had method errors of about 2 degrees (Sarnäs and Rune, 1983).

The use of metallic implants not only in the maxilla and in the mandible, but also in the frontal bone in combination with roentgen stereometry (Selvik, 1974), would have eliminated the dependence on the anatomical reference points ss, sm and n. Metallic implants and roentgen stereometry is at present the most effective method to record displacement of facial bones in three dimensions and with a high degree of accuracy (Rune et al, 1982).

Morphology

All patients had a relative maxillary retrognathia, a negative overjet, and a maxillary base that was either well posterior to or coincided with the CF1 line (Delaire, 1978; Delaire et al, 1981)
TABLE 2  Skeletal Morphology at Start of Extraoral Traction, Change at Termination of Traction = Treatment Change (Diff 1) and Change From Termination of Traction to Six Months Follow-Up = Follow-Up Change (Diff 2) Given for Each Measurement (In Degrees) and Each Patient. The Mean Values (M) of Each Initial Measurement Are Also Given

<table>
<thead>
<tr>
<th>Patient</th>
<th>s-n-ss</th>
<th>Diff 1</th>
<th>Diff 2</th>
<th>s-n-sm</th>
<th>Diff 1</th>
<th>Diff 2</th>
<th>NSL/ML</th>
<th>Diff 1</th>
<th>Diff 2</th>
<th>IL9/NSL</th>
<th>Diff 1</th>
<th>Diff 2</th>
<th>IL9/ML</th>
<th>Diff 1</th>
<th>Diff 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*</td>
<td>--</td>
<td>-0.5</td>
<td>84.5</td>
<td>-3.0</td>
<td>+0.5</td>
<td>30.0</td>
<td>+2.0</td>
<td>-0.5</td>
<td>*</td>
<td>--</td>
<td>+3.0</td>
<td>74.0</td>
<td>+4.5</td>
<td>+7.5</td>
</tr>
<tr>
<td>2</td>
<td>77.5</td>
<td>±0</td>
<td>-0.5</td>
<td>78.0</td>
<td>-2.5</td>
<td>+0.5</td>
<td>35.5</td>
<td>+1.0</td>
<td>+0</td>
<td>*</td>
<td>--</td>
<td>±0</td>
<td>*</td>
<td>--</td>
<td>+4.5</td>
</tr>
<tr>
<td>3</td>
<td>*</td>
<td>--</td>
<td>-2.5</td>
<td>75.0</td>
<td>+0.5</td>
<td>+1.5</td>
<td>39.0</td>
<td>-0.5</td>
<td>-0.5</td>
<td>75.0</td>
<td>+1.5</td>
<td>+2.3.5**</td>
<td>88.5</td>
<td>+1.0</td>
<td>±0</td>
</tr>
<tr>
<td>4</td>
<td>77.0</td>
<td>±0</td>
<td>-2.5</td>
<td>75.0</td>
<td>+0.5</td>
<td>+1.5</td>
<td>39.0</td>
<td>-0.5</td>
<td>-0.5</td>
<td>75.0</td>
<td>+1.5</td>
<td>+2.3.5**</td>
<td>88.5</td>
<td>+1.0</td>
<td>±0</td>
</tr>
<tr>
<td>5</td>
<td>75.0</td>
<td>±0</td>
<td>-0.5</td>
<td>74.0</td>
<td>-2.0</td>
<td>+1.0</td>
<td>41.0</td>
<td>+0.5</td>
<td>-0.5</td>
<td>75.0</td>
<td>+1.5</td>
<td>+2.3.5**</td>
<td>88.5</td>
<td>+1.0</td>
<td>±0</td>
</tr>
<tr>
<td>6</td>
<td>73.0</td>
<td>±1.0</td>
<td>+0.5</td>
<td>72.0</td>
<td>±0</td>
<td>+1.5</td>
<td>37.5</td>
<td>-1.0</td>
<td>-1.5</td>
<td>*</td>
<td>--</td>
<td>+3.0</td>
<td>*</td>
<td>--</td>
<td>±0</td>
</tr>
<tr>
<td>7</td>
<td>76.0</td>
<td>±0</td>
<td>±0</td>
<td>76.0</td>
<td>±0</td>
<td>±0</td>
<td>37.0</td>
<td>-2.5</td>
<td>+0.5</td>
<td>101.0</td>
<td>+6.0</td>
<td>-3.0</td>
<td>92.5</td>
<td>+4.5</td>
<td>-2.5</td>
</tr>
</tbody>
</table>

M=75.7
M=76.4
M=36.0
M=88.0
M=85.8

8 83.5   +0.5   +0.5   83.0   ±0    ±0     37.0   +0.5   ±0    111.0   +0    +3.0   91.5   -5.0   +3.5
9 89.5   +3.0   +0.5   91.0   -3.0   +1.5   27.0   +3.0   -1.0  119.5   -9.0  +2.0   90.0   -7.5   +1.5
10 76.5  +2.0   -0.5   82.0   -1.0   +1.0   39.0   -2.0   -1.0  106.5   +2.0  +5.0   77.0   +2.5   +1.5
11 75.0  +0.5   -0.5   75.5   -1.0   +0.5   47.0   -1.0   -1.5  103.5   -1.5  ±0    88.5   -16.5  +9.5
12 77.5  ±0     +1.5   81.5   -1.0   +1.0   31.0   +1.0   +0.5  99.5   +2.5   +9.5  81.5   -2.5   ±0
13 76.5  +1.5   ±0     79.0   -0.5   +0.5   39.0   +1.0   -2.0  94.5   +5.0   +2.5   80.0   -2.5  -1.5
14 78.0  +0.5   -1.5   77.0   ±0    ±0     39.0   +1.0   ±0    98.0   ±0    -6.5  85.5   -0.5  +1.5
15 75.0  +1.5   -0.5   82.0   -2.0   +0.5   33.0   +3.0   -0.5  112.5   +1.0  +2.0   74.0   +8.0  -7.0
16 79.5  ±0     +0.5   80.5   -1.0   ±0     27.5   +1.5   -0.5  112.5   +2.0  +1.0   98.0   +0.5  -2.0
17 80.0  +2.0   -1.0   80.0   +1.0   ±0     33.5   -1.0   -0.5  105.5   +0.5  -1.0   90.0   ±0    +3.0

M=79.1
M=81.2
M=35.3
M=106.3
M=85.6

* Permanent incisors not yet erupted
** Conventional orthodontics during follow-up
† Masked by the cap splint
TABLE 3  Treatment Change (Diff 1), Follow-Up Change (Diff 2) and Net Change (Net) are Given for Each Measurement in Degrees for CLP and NonCLP Patients. Number of Paired Observations Within Brackets

<table>
<thead>
<tr>
<th>Measurement</th>
<th>CLP Patients</th>
<th>NonCLP Patients (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M_{Diff 1}$</td>
<td>$M_{Diff 2}$</td>
</tr>
<tr>
<td>s-n-ss</td>
<td>+0.6(5)</td>
<td>-0.4(6)</td>
</tr>
<tr>
<td>s-n-sm</td>
<td>-1.3(7)</td>
<td>+0.8(7)</td>
</tr>
<tr>
<td>NSL/ML</td>
<td>+0.4(7)</td>
<td>-0.4(7)</td>
</tr>
<tr>
<td>IL/NSL</td>
<td>+3.8(2)</td>
<td>+0.8(4)*</td>
</tr>
<tr>
<td>IL/ML</td>
<td>+2.0(4)</td>
<td>+2.4(7)</td>
</tr>
</tbody>
</table>

* Patient 4 excluded because of conventional orthodontics during follow-up.

at the start of face mask treatment. It has been claimed that the CFI line represents the limit for functional balance beyond which the maxillary base cannot be permanently rotated and that after the age of 3 years the CFI line can be used to determine where the maxillary base should be in a stable position (Delaire, 1978; Delaire et al, 1981). Accordingly, all patients in the present study (except Patients 8, 9, 16, and 17 in whom the maxillary base coincided with this line) should have benefited from extraoral traction. However, this was not the case (Table 2).

The pretreatment facial morphology varied considerably as did the response to extraoral traction. The CLP group (Patients 1 to 7) had a marked bimaxillary retrognathia with a slight negative sagittal jaw relationship (ss-n-sm = -0.7 degrees) while the nonCLP group had a slightly retrognathic maxilla, a slightly prognathic mandible, and a negative jaw relationship (ss-n-sm = -2.1 degrees). The extreme prognathism in Patient 9 was measured to an exceptionally short anterior cranial base (-3 standard deviations).

**Effect of Traction with Face Mask**

The effect of extraoral traction (Diff 1) on skeletal morphology varied between (Table 3) and within (Table 2) CLP and nonCLP patients. The effect was reversed in most measurements at follow-up (Diff 2), except for the upper incisor inclination (IL/NSL), which increased continuously. In the nonCLP patients, the maxillary displacement (s-n-ss) showed an insignificant relapse (0.2 degrees), which implied that a functional balance was established for the maxilla in this group (Delaire et al, 1981). The effect (Net) on the maxilla at follow-up in the CLP patients was only about 20 percent of the effect (Net) in the nonCLP patients (Table 3), but varied considerably (from -2.5 degrees to +2.5 degrees, Table 2).

**Cleft Lip and Palate Surgery**

The individual variation between the CLP patients in their response to traction may be due to a variation in the cleft itself as well as to a variation in the scarring after surgical repair of the lip and particularly of the palate. Delaire (1979) reported on a 12-year-old boy who did not respond to extraoral traction until after removal of heavy scars between the tuberosities and the pterygoid plates.

The sole patient in our study (Patient 4) who had had a pharyngeal flap operation did not benefit at all from the traction. In this boy, the maxillary bones were even displaced posteriorly during follow-up. The effect of a pharyngeal flap operation on maxillary displacement has been contradictorily reported; Ross (1977) found no retardation, but Subtelny and Pineda (1978) found such an effect.

**Bonegrafting**

Bonegrafting to the palate and to the alveolar cleft, and early periosteoplasty, were blamed for poor results in two of four UCLP patients examined by Friede and Lennartsson (1981). Rygh and Tindlund (1982) on the other hand reported a good result in an 8-year-old UCLP boy, who had had periosteoplasty to the alveolus at the age of 3 months. None of our CLP patients had had bonegraft to the palate or the alveolar cleft.

**Age**

The CLP patients were on average 4 years younger than the nonCLP patients (Table 1). It has been claimed that extraoral traction should start early, if possible in the primary dentition stage and, except for CLP patients, not later than age 12 years (Delaire et al, 1971, 1976, 1978; Irie and Nakamura, 1975) and before their peak of pubertal growth (Subtelny, 1980). In our study, the effect of extraoral traction on the maxilla and on the mandible was found to vary independently of age at start of treatment and PHV (Fig. 4). The overall better results in the older and nonCLP patients (Table 3) may be due to the absence of a maxillary cleft (and surgical repair) and to better cooperation. Moreover, in older children
a forward displacement of \( s_s \) (subspinale) is less likely to be masked by a simultaneous forward displacement of \( n \) (nasion) by appositional growth.

**Duration of Traction**

The mean duration of traction was almost the same (8 months, Table 1) for CLP and nonCLP patients and within the range (4 to 12 months) recommended by Delaire (1979). The duration of traction was not related to the age at start of traction. The effect of extraoral traction on the maxilla and on the mandible was found to vary independently of the duration of traction (Fig. 5). This result does not contradict the statement made by Delaire et al (1978) that the effect of extraoral traction occurs most rapidly within the first 6 months of traction. If 3 to 5 months of traction has no effect, traction should be discontinued in our opinion. Prolonged traction may cause sliding of the dental arch forward on the maxillary base, resulting in an excessive tipping of the incisors, which would be in contrast to the philosophy of Delaire (Delaire 1978; Delaire et al, 1981).

**Mandibular Rotation**

The position of the mandible is influenced by the face mask. Delaire et al (1978) cautioned against the use of the face mask in patients with a steep mandibular plane angle (NSL/ML) in order to avoid possible posterior rotation of the mandible. In the present study, the mandible rotated posteriorly by 0.4 degrees (range +3.5 degrees to −2.5 degrees) during extraoral traction in the CLP patients and by 0.7 degrees (range +3.0 degrees to −2.0 degrees) in the nonCLP patients. The rotation was reversed during follow-up (Table 3). The direction of mandibular rotation (\( M_{Net} \)) varied individually and seemed to be related to the initial mandibular plane angle (Fig. 6). Thus, an initially large mandibular plane angle tended to be reduced as a net result of extraoral traction, and vice versa.

**Incisor Relationship**

The overjet was improved in the majority of the patients, and a normal incisor relationship was obtained in four of the five CLP patients who had erupted permanent incisors at follow-up. In the
nonCLP patients, seven had a normal overjet at follow-up, one had an edge-to-edge relationship, and two retained a negative overjet. In spite of the limited forward displacement of the maxilla (s-n-ss), normal overjet was established because of a combination of a slight posterior displacement of the mandible with a labial and lingual tipping of the incisors in the maxilla and mandible, respectively (Delaire et al, 1976) and a possible forward sliding of the maxillary dental arch on its base (Rune et al, 1982). Extraoral traction alone was sufficient to correct the malocclusion in one patient (Patient 6); in the remaining patients extraoral traction was an integrated part of orthodontic treatment. This was in agreement with the recommendation by Delaire et al (1978, 1979), who also recommended repeated use of extraoral traction Delaire (1979). (Patient 4, who was unsuccessfully treated (Table 2), has recently completed a second period of traction with a satisfactory result).

Conclusions


SELVIK G. A roentgen stereophotogrammetric method for the study of the kinematics of the skeletal system. Thesis AV-

FIGURE 6 Net change (in degrees) in the mandibular plane angle (NSL/ML, △) in relation to the initial NSL/ML angle in CLP (filled symbols) and nonCLP (open symbols) patients after extraoral traction with face mask to the maxilla.

* = measurements identical in two patients (4 and 13)

and thus to be unpredictable. No single variable has been found that would allow us to identify the patient who will benefit from extraoral traction. We recommend a trial of from 3 to 5 months, however, since extraoral traction is the only orthopaedic means with which the maxilla may be brought forward.

References


SELVIK G. A roentgen stereophotogrammetric method for the study of the kinematics of the skeletal system. Thesis AV-
Sarnäs and Rude, EXTRAORAL TRACTION TO THE MAXILLA WITH FACE MASK

Centralen, University of Lund, 1974.


