The Effect of Infant Orthopedics on the Occlusion of the Deciduous Dentition in Children With Complete Unilateral Cleft Lip and Palate (Dutchcleft)

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Objective: Evaluation of the effect of infant orthopedics (IO) on the occlusion of the deciduous dentition in patients with unilateral cleft lip and palate (UCLP).

Design: Prospective, two-arm, randomized, controlled clinical trial with three participating cleft palate centers (Dutchcleft).

Setting: Cleft Palate Centers of the University Medical Center Nijmegen, Academic Center of Dentistry Amsterdam, and Dijkzigt University Hospital Rotterdam, The Netherlands.

Patients: Children with complete UCLP (n = 54) were included.

Interventions: In a concealed allocation procedure, half of the patients was randomized to wear a plate till surgical closure of the soft palate (IO+), and the other half (IO–) did not have a plate.

Mean Outcome Measures: Dental arch relationships were assessed at 4 and 6 years of age with the 5-year-old index; the Huddart-score; and measurements of overjet, overbite, and sagittal occlusion.

Results: There were no significant differences found between the IO+ and IO– groups for the 5-year-old index; the Huddart-score; and overjet, overbite, and sagittal occlusion.

Conclusions: IO had no observable effect on the occlusion in the deciduous dentition at 4 and 6 years of age. Considering the occlusion only, there is no need to perform IO in children with UCLP.

KEY WORDS: cleft palate, deciduous dentition, dental occlusion, infant orthopedics, malocclusion, multicenter, randomized clinical trial, treatment outcome

Infant orthopedics (IO) was introduced as a treatment to improve maxillary arch form and the position of the alar base to prevent crossbites and to facilitate surgery (McNeil, 1954, 1956). Other advantages reported in the literature are straightening of the nasal septum, normalization of the deglutition process, prevention of twisting and positioning of the tongue in the cleft, and better speech development (Hotz and Gnoinski, 1976, 1979; Huddart, 1987; Weil, 1987; Gnoinski, 1990; Gruber, 1990; Kramer et al., 1994; Berkowitz, 1996; Mishima et al., 1996a, 1996b; 2000; Atack et al., 1998; Johnson et al., 2000b; Konst et al., 2000, 2002, 2003a, 2003b). Disadvantages mentioned in literature include maxillary growth restriction, negative influences on speech because of delayed palate closure, the costs of the treatment, and its complexity (Pruzansky and Aduss, 1964; Huddart and Bodenham, 1972; Ross, 1987; Kramer et al. 1992; Prahl et al., 2001).

Many different appliances, both active and passive, have been described (Berkowitz, 1996). The so-called Zürich approach, using a passive plate of soft and hard acrylic, has had a major influence on treatment by the European cleft teams (Gnoinski, 1990). Studies dealing with the effect of (passive) IO on occlusion show different results. Hotz and Gnoinski (1976, 1979) and Gnoinski (1990) described that there are less anterior and canine crossbites after presurgical orthopedic...
treatment with the Zürich appliance combined with delayed surgery, in comparison with their previous treatment procedure, which was the McNiel-type orthopedic treatment with conventional surgery. Huddart found good short-term results for the maxillary arch dimensions, when comparing patients treated with infant orthopedics (IO+) with patients not treated with infant orthopedics (IO−). However, at the age of 5 yr, the patient groups were comparable with respect to the number of teeth in crossbite and the severity of the crossbite (Huddart, 1972, 1987; Huddart and Bodenham, 1972). O’Donnell et al. (1974) evaluated the occlusion in the deciduous and mixed dentition of patients treated with IO in terms of crossbite malocclusion. A comparison was made with samples of other investigators, some with IO and some without IO. Because of differences in treatment protocol of the samples, the authors concluded that a comparison between IO+ and IO− could not be made (O’Donnell et al., 1974). In the Eurocleft studies, the centers that practice passive presurgical orthopedics did not show demonstrable advantages in terms of dental relationship. Here also, other differences in treatment protocols between centers were present (Shaw et al., 1992a, 1992b; Mars et al., 1992). One of the few studies with a better research design was conducted by Mishima et al. (1996a, 1996b, 2000). The investigators used a two-group quasirandomized design, in which 12 were treated with Hotz plate and eight without. At age 4 years, they observed larger transverse deciduous canine and second deciduous molar widths for the IO+ group, compared with the IO− group (Mishima et al., 1996a, 1996b, 2000).

Because many studies on the effect of IO have a retrospective design, include only a small sample of subjects with unilateral cleft lip and palate (UCLP), lack a control group of UCLP children without IO, do not take confounding variables into account, or measure only at a certain age, uncertainty about the effectiveness of IO remains (Roberts et al., 1991; Mars et al.; Shaw et al., 1992a, 1992b; Winters and Hurwitz, 1995; Kuipers-Jagtman and Long, 2000; Prahl-Andersen, 2000). Therefore, a prospective randomized clinical trial was performed in three cleft palate centers in the Netherlands, i.e., the Cleft palate Centers of Amsterdam, Nijmegen, and Rotterdam, to investigate the effect of IO in children with complete UCLP (Dutchcleft). The results, until 1½ years of age, showed that IO had a temporary effect on the maxillary arch dimensions, which did not last beyond surgical soft palate closure (Prahl et al., 2001). Also, it did not prevent collapse of the maxillary arch (Prahl et al., 2003). Evaluation of speech and language development showed that at the age of 12 months, the IO+ group presented enhanced use of alveolar articulations; however, at the age of 18 months, sound production in babbling was comparable in both groups (Konst et al., 1999). The speech results at 2.5 years of age showed differences in intelligibility between the groups. In two different experiments, untrained listeners as well as experienced speech and language therapists gave higher ratings to the intelligibility of the IO+ group (Konst, 2002). However, data obtained by a transcription task indicated no differences in intelligibility (Konst et al., 2000). At 2.5 years of age, the phonological development of the IO+ children was normal or delayed, whereas most IO− children had abnormal development. Half a year later it appeared that the IO+ children had acquired more initial consonants than the IO− group (Konst et al., 2003b). In the same age groups, the IO+ children used longer sentences than the IO− children, indicating that their grammatical development was more advanced. At the age of 6 years, no differences in expressive language skills between the two groups were found (Konst et al., 2003a).

The purpose of the part of the Dutchcleft trial presented here was to evaluate the effect of IO on the occlusion of the deciduous dentition in children with UCLP, aged 4 and 6 years. The hypothesis to be tested is that the occlusion is not different between the IO+ group and the IO− group.

**METHODS**

A detailed description of the experimental design, treatment assignment, treatment protocol, and operators used in this study can be found in Prahl et al. (2001). A summary of the most important issues is given below.

The study was designed as a prospective, two-arm, randomized, controlled clinical trial in the Cleft Palate Centers in Nijmegen, Amsterdam, and Rotterdam, The Netherlands. The local ethical committees approved the study protocol. The inclusion criteria were complete UCLP, infants born at term, both parents Caucasian and fluent in the Dutch language, and trial entrance within 2 weeks after birth. The exclusion criteria were soft tissue bands and other congenital malformations. Figure 1 shows the follow-up until the age of 6 years, with the reasons for exclusion of evaluation. When the parents agreed to participate in the study, they were asked to provide informed consent. Between 3 and 6 months of age, all included children were checked by the geneticist of their own cleft lip and palate (CLP) team as being nonsyndromic.

**Treatment**

Half of the patients were treated with IO by means of passive plates until surgical soft palate closure (n = 27), and half did not receive a plate (n = 27). The plates were made on a plaster cast using compound soft and hard acrylic. The IO+ children had their plates adjusted every 3 weeks to guide the maxillary segments by grinding at the cleft margins; maxillary growth and emergence of deciduous teeth indicated the necessity for a new plate. After surgical lip closure, the plate was replaced the same day. Checkups were planned every 4 to 6 weeks following lip surgery. The plate was maintained until soft palate closure. The IO− group visited the clinic at 6 weeks and before and after lip surgery and soft palate closure. In both groups, lip surgery was performed at the age of 18 weeks by the Millard technique; soft palate surgery was performed at the age of about 52 weeks according to a modified Von Langenbeck method. In the studied age period (until 6 years of age), other interventions were performed if indicated: pha-
ryngoplasty (n = 22), lip revision (n = 13), facial mask treatment (n = 1), plate to improve speech (n = 15), and closure of the anterior palate (n = 6). These extra interventions are equally distributed over the IO+ and the IO− group.

Data Acquisition

To evaluate the occlusion, impressions were taken at ages 4 and 6 years. In Nijmegen the impressions were made with Cavex CA 37 (Cavex Holland BV, Haarlem, The Netherlands); in Amsterdam with Lastic (Kettenbach Dental, Eschenburg, Germany); and in Rotterdam with Tetra-chrom (Kaniedenta, London and München). Plaster casts were then fabricated. To eliminate bias, the examiners were able to identify neither children nor the cleft palate center the models came from. Therefore, all models were duplicated and trimmed in the same way.

The dental arch relationship was assessed on the study models using the 5-year-old index (Atack et al., 1997a, 1997b). This index categorizes arch relationships of patients with UCLP using reference models. The method is comparable with the Goslon Yardstick, used for the late mixed and early permanent dentition (Mars et al., 1987). A pilot examination was done by four observers with 10 casts. It appeared necessary to adjust some rules within the original index because many casts were categorized between 1 and 2 or 2 and 3. The adjustments are shown in Table 1. Three examiners, experienced in cleft lip and palate, and one less experienced examiner, assessed all casts twice. For the second scoring, the sequence of the casts was changed to minimize memory effects.

The overjet and the overbite were measured to the nearest millimeter with Korkhaus divider at the central incisors of the noncleft side on the casts. The overbite was calculated as a percentage of the length of central lower incisor of the noncleft side.

The sagittal occlusion was scored for the deciduous canines and second deciduous molars according to the Angle classification. Class I occlusion was scored as zero; Classes II and III occlusions were scored in premolar widths. A quarter premolar width was scored as 1, half a premolar width was scored as 2, three quarter premolar width was scored as 3, and a full premolar width was scored as 4. A positive sign meant Class II and a negative sign meant Class III (Heidbüchel and Kuijpers-Jagtman, 1997). The scoring system is described in Table 2.

Huddart’s scoring system was used to evaluate the severity and location of crossbites. A score, as shown in Figure 2, is given to each tooth in relation to its antagonist. The lateral incisors are not assessed because they are often missing at the cleft side. If another tooth is missing, it will be scored as the mean of the scores of the neighboring teeth. The sum of the scores of all teeth forms the Huddart score (Huddart, 1972; Huddart and Bodenham, 1972; Heidbüchel and Kuijpers-Jagtman, 1997).

To assess the inter- and intraobserver agreement for the

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**TABLE 1 A Listing of Features to Be Assessed on the Study Models of the 5-Year-Old Index**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (excellent)</td>
<td>Positive (normal or enlarged) overjet with average inclined or retroclined incisors. No crossbites/crossbite tendency of 1 or 2 teeth in the smaller segment. No open bites or vertical steps around the cleft site. Good maxillary arch shape and palatal vault anatomy.</td>
</tr>
<tr>
<td>2 (good)</td>
<td>Positive overjet with average inclined or proclined incisors. Unilateral crossbite/crossbite tendency of the whole smaller segment. Open bite tendency around cleft site. Edge to edge in the front without crossbites in the lateral segments.</td>
</tr>
<tr>
<td>3 (fair)</td>
<td>Edge-to-edge bite with average inclined or proclined incisors. Reversed overjet with retroclined incisors. Unilateral crossbite. Open bite tendency around cleft site.</td>
</tr>
<tr>
<td>4 (poor)</td>
<td>Reversed overjet with average inclined or proclined incisors. Unilateral crossbite/bilateral crossbite tendency. Open bite tendency around cleft site.</td>
</tr>
<tr>
<td>5 (very poor)</td>
<td>Reversed overjet with proclined incisors. Bilateral crossbite. Poor maxillary arch form and palatal vault anatomy.</td>
</tr>
</tbody>
</table>

*Italic text represents features that were adjusted in the original index.*
TABLE 2 Sagittal Occlusion Scoring System*

<table>
<thead>
<tr>
<th>Score</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>1 premolar width</td>
</tr>
<tr>
<td>+3</td>
<td>¾ premolar width</td>
</tr>
<tr>
<td>+2</td>
<td>½ premolar width</td>
</tr>
<tr>
<td>+1</td>
<td>¼ premolar width</td>
</tr>
<tr>
<td>0</td>
<td>Class I</td>
</tr>
<tr>
<td>−1</td>
<td>1/4 premolar width</td>
</tr>
<tr>
<td>−2</td>
<td>1/2 premolar width</td>
</tr>
<tr>
<td>−3</td>
<td>¾ premolar width</td>
</tr>
<tr>
<td>−4</td>
<td>1 premolar width</td>
</tr>
</tbody>
</table>

* + = Angle class II; − = Angle class III; 0 = Angle class I. Every point difference corresponds with one fourth premolar width difference in occlusion.

overjet, overbite, sagittal occlusion, and Huddart’s score, all measurements at age 4 years were done twice by two examiners.

Statistical Analysis

For intra- and interexaminer agreement of the 5-year-old index, weighted kappas were calculated at 4 and 6 years of age. Cronbach’s alpha was calculated as the reliability coefficient of the mean 5-year-old index score, for 4 and 6 years of age.

For the overjet, overbite, sagittal occlusion according to Angle (overall, cleft side, and noncleft side), intraexaminer error (duplicate error) was calculated for 4 and 6 years of age. The interexaminer error and the corresponding reliability coefficient (Pearson correlation coefficient) were calculated at the age of 4 years.

To test the differences between IO+ and IO− at ages 4 and 6 years and for the increment, Student’s t tests were used.

RESULTS

General

At intake, 54 patients participated in the study. An overview of the sample characteristics is given in Table 3. Two IO+ children hardly used the plate, and in one case the plate was mistakenly worn until 78 weeks. These children remained in the IO+ group based on the intention-to-treat principle. The

FIGURE 2 Huddart’s scoring of transverse dental relationship.
mean duration of IO was 50 ± 16 weeks. Of all children, 44 were available for evaluation at the age of 4 years and 45 at the age of 6 years. The flow diagram in Figure 1 shows the reasons for nonevaluation.

Reliability of Measurements

The kappas for the intraexaminer agreement of the 5-year-old index measurements varied from 0.91 to 0.97. The kappas for the interexaminer agreement of the 5-year-old index measurements ranged from 0.77 to 0.91. A kappa value between 0.81 and 1.00 indicates a very good agreement, whereas a kappa between 0.61 and 0.80 indicates a good agreement. The result of the reliability analysis showed a Cronbach’s alpha of 0.97 for the first series of measurements and for the second series of measurements, 0.96.

The interexaminers errors were small: 0.5 mm for the overjet, 1.3% for the overbite, 0.4 points for the sagittal occlusion, and 1.6 points for the Huddart score. As expected, the intraexaminer errors were lower than the interexaminer errors. The reliability coefficients for the interexaminer errors were between 0.86 and 0.92, indicating a good reproducibility.

### TABLE 3 Sample Characteristics*

<table>
<thead>
<tr>
<th>Variable</th>
<th>IO+ (n = 27)</th>
<th>IO− (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex: male/female (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side of cleft: left/right (n)</td>
<td>20/7</td>
<td>21/6</td>
</tr>
<tr>
<td>Patients per center: 1/2/3 (n)</td>
<td>17/10</td>
<td>18/9</td>
</tr>
<tr>
<td>Age 4-y casts</td>
<td>7/11/9</td>
<td>7/10/10</td>
</tr>
<tr>
<td>Years.months</td>
<td>Range: 3.8–4.4</td>
<td>Range: 3.10–4.6</td>
</tr>
<tr>
<td>Age 6-y casts</td>
<td>Mean: 6.0</td>
<td>Mean: 6.0</td>
</tr>
<tr>
<td>Years.months</td>
<td>Range: 5.9–6.2</td>
<td>Range: 5.11–6.5</td>
</tr>
</tbody>
</table>

* Some variables are presented in percentiles because of skewness (P10, P50, and P90). IO+ = patients treated with infant orthopedics; IO− = patients not treated with infant orthopedics; P10 = 10th percentile; P50 = 50th percentile; P90 = 90th percentile.

### Treatment Effects

Mean values and SDs for all variables describing the occlusion are given in Table 4 for both ages. Because there were two extreme positive overjet measurements in the 4-year group, the distribution for the variable overjet was not normal. Winsorization was applied as a transformation to normality; values larger than 5 mm were reduced to 5 mm. For the 5-year-old index, the overjet, the percentage overbite, the sagittal occlusion (overall, cleft side, and non-cleft side), and the transverse occlusion (overjet, non-cleft side, and non-left side), no significant differences were found between IO+ and IO− (all p > .05).

Table 5 shows the results of the Student’s t tests for the increments between 4 and 6 years. No significant differences between the IO+ and IO− group were found for any of the variables.

The distribution of subjects over the five categories of the 5-year-old index at the age of 4 years and 6 years is shown in Figure 3 for IO+ and IO−.

### DISCUSSION

To compensate for shortcomings of earlier studies, the design of the present study was a prospective, two-armed, randomized, controlled clinical trial (Prahl et al., 2001). The number of patients involved in the study decreased from 54 to 44 in the 4-year-old age group and from 54 to 45 in the 6-year-old group. Still, the number was larger than most previous studies. For example, Mishima et al. (1996a, 1996b, 2000) had a sample of 12 IO+ and 8 IO− patients, Huddart (1972) had 34 IO+ patients and 13 IO− patients, Pruzansky and Aduss (1964) studied 33 patients, and the Eurocleft centers had samples of 19 to 30 patients (Mars et al., 1992). But none of these studies was designed as a randomized clinical trial.

To evaluate occlusion in patients with CLP, different methods have been used in the past. Mostly, these methods describe the transverse (e.g., Huddart score; Huddart and Bodenham, 1972), vertical (e.g., overbite), or sagittal relationship (e.g., occlusion according to Angle classification or overjet; Morris et al., 2000). An evaluation of the occlusion in more than one...
TABLE 5  Mean and SD of the Increments From 4 to 6 y of the Measured Variables for IO+ and IO−*  

<table>
<thead>
<tr>
<th>Variable</th>
<th>IO+ Increment</th>
<th></th>
<th>IO− Increment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n†</td>
<td>Mean (SD)</td>
<td>p</td>
<td>n†</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-y-old index (group)</td>
<td>20</td>
<td>0.22 (0.32)</td>
<td>.49</td>
<td>21</td>
</tr>
<tr>
<td>Overjet (mm)</td>
<td>18</td>
<td>−0.18 (1.02)</td>
<td>.81</td>
<td>19</td>
</tr>
<tr>
<td>Overbite (%)</td>
<td>15</td>
<td>−21.29 (21.87)</td>
<td>.12</td>
<td>19</td>
</tr>
<tr>
<td>Sagittal occlusion, overall (pt)</td>
<td>20</td>
<td>0.07 (0.61)</td>
<td>.88</td>
<td>21</td>
</tr>
<tr>
<td>Sagittal occlusion, cleft side (pt)</td>
<td>20</td>
<td>0.13 (0.94)</td>
<td>.78</td>
<td>21</td>
</tr>
<tr>
<td>Sagittal occlusion, noncleft side (pt)</td>
<td>20</td>
<td>0.01 (0.87)</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Transverse occlusion, overall (pt)</td>
<td>20</td>
<td>−1.67 (1.47)</td>
<td>.87</td>
<td>21</td>
</tr>
<tr>
<td>Transverse occlusion, cleft side (pt)</td>
<td>20</td>
<td>−0.93 (0.94)</td>
<td>.06</td>
<td>21</td>
</tr>
<tr>
<td>Transverse occlusion, noncleft side (pt)</td>
<td>20</td>
<td>−0.74 (0.89)</td>
<td>.94</td>
<td>21</td>
</tr>
</tbody>
</table>

* The differences between IO+ and IO− were tested with t tests. The level of significance is indicated with p values.
† n may vary due to incidental missing values (e.g., shedding of incisors). IO+ = patients treated with infant orthopedics; IO− = patients not treated with infant orthopedics.

direction is rare. Because the introduction of the Goslon Yardstick, a clinical tool is available to categorize late mixed and permanent dentitions in a sensitive way (Mars et al., 1987). Noverraz et al. (1993) showed that the original Goslon Yardstick was a reproducible method to score the dental arch relationship in other stages of dental development, too.

Nevertheless, a separate index, the 5-year-old index, was later developed to assess treatment outcome in the deciduous and mixed dentition (Atack et al., 1997a, 1997b). Because the 5-year-old index is the most commonly used method for the deciduous dentition, this method was used for Dutchcleft. Although many studies used indices (Friede et al., 1991; Mars et al., 1992; Hathorn et al., 1996; Atack et al., 1998; Johnson et al., 2000a; Williams et al., 2001), only one mentioned problems with the categorization. Friede et al. (1991) used a modification of the Goslon yardstick. In their yardstick, Class 1 represents no crossbite or minor lateral or minor anterior crossbite; class 2 is a lateral crossbite with or without a minor anterior crossbite; class 3 means an anterior and lateral crossbite; class 4 represents patients with an anterior and lateral crossbite and a slight malrelation between the maxilla and mandible, whereas in class 5 there is a definite malrelation between the arches. In Dutchcleft, all examiners tended to score many casts as 1.5 or 2.5, although the 5-year-old index has only five categories. Some rules of the original index (Table 1) were adjusted to be able to score such a cast as a 1 or 2, instead of

![Graphic representation of the percentages of the total sample in each 5-year-old index group; at the age of 4 and of 6 years for IO+ and IO− (1 = excellent, 2 = good, 3 = fair, 4 = poor, and 5 = very poor). The actual number of subjects in each group, given in the same sequence as the bars of this figure (from left to right), is: group 1: n = 6, 7, 6, 6; group 2: n = 12, 8, 9, 6; group 3: n = 3, 7, 6, 11; group 4: n = 1, 0, 1, 0; group 5: n = 0, 0, 0, 0.]
1.5. The results show that most patients were categorized in groups 1 to 3 (Fig. 3). Only two patients were graded as 4 (one at the age of 4 years and one 6 years of age). None of the patients was graded as 5. This is in contrast with the results of the Clinical Standards Advisory Group (CSAG) study (Sandy et al., 1998; Williams et al., 2001), for which the 5-year-old index was developed and 37% of the cases were classified in groups 4 and 5. To classify samples with good treatment results more precisely, future studies might consider modifying the original index in such a way that a better discrimination in the lower categories is achieved.

In addition to this index, the overjet, overbite, sagittal, and transverse occlusion were also measured to show whether positive differences between the IO+ and IO− groups for the 5-year-old index were due to deviations in the sagittal, vertical, or transverse dimension.

Few studies have been published regarding occlusion in the deciduous dentition, and even fewer studies have been written about the effect of IO on the deciduous dentition in patients with UCLP. Norden et al. (1973) evaluated the deciduous dentition in children treated without IO, using the overjet, the sagittal occlusion, and a crossbite score that was described by Pruzansky and Aduss (1964), but no conclusions on these variables can be drawn because the study included patients with all kinds of clefts.

Huddart (1972) completed a retrospective nonrandomized study into the effect of IO with a passive plate. By using his numerical crossbite score, he showed that at 5 years of age, there was no significant difference between the IO+ group (−6.32 SD 4.55) and the IO− group (−6.31 SD 3.97). These findings are in accordance with our findings, but the crossbite scores in our study show fewer teeth in crossbite and less severe crossbites (4-year-olds: IO+: −1.44 SD 3.28; IO−: −2.46 SD 4.22; 6-year-olds: IO+: −3.02 SD 3.34; IO−: −3.52 SD 3.77). This might be explained by differences in treatment protocols. Part of the Huddart sample had lip surgery and palate closure in one operation, and part of the sample underwent two separate operations. The type of surgery used and the timing was not mentioned. In the Dutchcleft study, lip surgery was performed at the age of 18 weeks and the soft palate was closed at the age of 52 weeks. The differences in crossbite scores might also reflect an improvement in CLP treatment between the 1970s and today.

More recently studies mainly use the Goslon Yardstick or the 5-year-old index to evaluate occlusion. Table 6 shows the case distribution of several studies, including Dutchcleft, over the five categories of the 5-year-old index groups. Atack et al. (1998) evaluated samples from Bristol, United Kingdom (n = 46) and Oslo, Norway (n = 54). In the CSAG study, dental arch relationships of 5-year-olds (n = 223) from 50 National Health Service cleft teams in the United Kingdom were evaluated (Sandy et al., 1998; Williams et al., 2001). Five percent of the sample was found to have an excellent dental arch relationship, 24% had a good occlusion, and 34% a fair occlusion. The percentages for poor and very poor dental arch relationships were 18% and 19% respectively. Johnson et al. (2000a) found that 4% of the patients at the Princess Margaret Hospital in Perth had excellent results, 24% good results, 49% fair, 19% poor, and 4% very poor results. Table 6 shows that the results of the Dutchcleft sample compare favorably with the other studies, especially because there are only two patients in group 4 and none in group 5. Part of the different results among mentioned centers may be explained by the difference in treatment protocols. However, the Eurocleft study has shown that acceptable results can be achieved with different treatment schedules (Mars et al., 1992; Shaw et al., 1992a, 1992b). Only standardization and centralization of care and the participation of high volume operators seem to be associated with good treatment outcome (Mars et al., 1992; Shaw et al., 1992a, 1992b; Sandy et al., 1998; Williams et al., 2001). These criteria were all fulfilled in Dutchcleft.

The results of this part of the Dutchcleft study are in agreement with the other findings of this trial determined to date. Except for a small but significant improvement in speech development, no positive or negative influence of IO was found in the Dutchcleft study (Severens et al., 1998; Konst et al., 1999, 2000, 2003a, 2003b; Prahl et al., 2001, 2003; Konst, 2002).

**Conclusion**

Infant orthopedics did not influence the occlusion of the deciduous dentition at the age of 4 and 6 years. Therefore, from the orthodontic point of view, there is no need to perform IO in children with UCLP.

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REFERENCES


Konst EM. The Effects of Infant Orthopedics on Speech and Language Development in Children With Unilateral Cleft Lip and Palate. Enschede, the Netherlands: PrintPartners Ipskamp; 2002.


Mishima K, Sugahara T, MorI, Saduka M. Three-dimensional comparison between the palatal forms in complete unilateral cleft lip and palate with and without Hotz plate from cheiloplasty to palatoplasty. Cleft Palate Craniofac J. 1996a;33:312–317.

Mishima K, Sugahara T, MorI, Saduka M. Three-dimensional comparison between the palatal forms in infants with complete unilateral cleft lip, alveolus and palate (UCLP) with and without Hotz’s plate. Cleft Palate Craniofac J. 1996b;33:245–251.


