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Spectrum of Factors Affecting Dental Arch Relationships in Japanese Unilateral Cleft Lip and Palate Patients

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1. Introduction

Cleft lip and palate care involves multidisciplinary management of affected anatomical structures and functions. These include speech, hearing, and social integration. Maxillary growth retardation and high incidence of Class III malocclusion are the major problems in patients with cleft lip and palate (Ross and Johnston, 1972; Ross, 1987c; Mars and Houston, 1990; Mars et al., 1992; Ishikawa et al., 2002). Orthodontic anomalies such as crowding, rotation and malposition of the teeth are also common in cleft lip and palate patients. In children with cleft lip and palate, abnormalities in number, size, shape and timing of tooth formation are more frequent than in the general population (Ranta R, 1986). The development of methods to detect levels of treatment outcomes is necessary if surgeons are to have a sound basis on which they can justify modifications of their timing or techniques (Atack et al., 1997). Dental arch relationships are important parameters for facial growth and are thus an important indicator for the quality of cleft treatment outcome (Hathorn et al., 1996). This Cleft lip and palate is a congenital anomaly. The etiology has been thought to be multifactorial in nature with genetic and environmental factors contributing to its presence (Berkowitz, 2006). This congenital anomaly affects approximately 1.41 per 1000 live births in Japanese (nonsyndromic clefts) and 1.25 in the other Asian populations (Cooper et al., 2006).

Several methods have been proposed to evaluate dental arch relationships in patients with cleft lip and palate. To evaluate the occlusion in patients with cleft lip and palate, measurement of dental arch length and width (Keller et al., 1988) and examination on the prevalence of crossbite (Pruzansky and Aduss, 1967; Bergland and Sidhu, 1974; Dahl et al., 1981) have been used in many previous studies. Although these methods are useful to

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evaluate individual parameters, an overall estimate of the dental arch relationship is not obtained. To address this problem, Huddart and Bodenham (1972) developed a numerical scoring system of the crossbite in deciduous dentition and estimated the overall degree of the malocclusion. The degrees of crossbite for individual teeth were calculated to give a total score. Recently, Mossey et al. (2003) proposed a modified method to apply to the mixed dentition. However, these methods take time to rate individual models.

The dental arch relationship in patients with unilateral cleft lip and palate (UCLP) can be assessed using the Goslon Yardstick (Mars et al., 1987), the 5-Year-old index (Atack et al., 1997a, b) and the GOAL Yardstick (Friede et al., 1991). The Goslon Yardstick was developed for late mixed or early permanent dentition, and the 5-Year-old index was developed for the deciduous dentition to allow early assessment of the primary surgery. The GOAL Yardstick defined the condition of crossbite more strictly and has been used for mixed dentition. The Goslon (Great Ormond Street, London and Oslo) Yardstick was first described by Mars et al. (1987). This Yardstick rates the dental arch relationships in the late mixed and early permanent dentition of patients with unilateral cleft lip and palate (UCLP) into five categories: excellent, good, fair, poor, and very poor. The Goslon Yardstick proved to be capable of discerning dental arch relationships and inference of facial morphology outcomes between different centers (Mars et al., 1992; Hathorn et al., 1996; Morris et al., 2000; Williams et al., 2001). The Yardstick has been verified as an easy and practical evaluation to discriminate between the qualities of dental arch relationships during all stages of dental development (Noverraz et al., 1993). Moreover, the Goslon Yardstick can be used to predict surgical outcome as early as 5 years of age (Atack et al., 1997). 5-Year-Old Index was developed for the deciduous dentition to allow earlier assessment of the primary surgery. However, the Eurocleft study (Mars et al., 1992; Shaw et al., 1992a, 1992b) documented that it is possible to detect differences in outcome as early as 10 years of age by assessing the dental arch relationships with the Goslon yardstick. We used the Goslon Yardstick, the 5-Year-Old Index because these are robust (Mars et al., 1987) reproducible (Mars et al., 1987, Atack et al., 1997b), and reliable (Atack et al., 1997b).

The effect of factors such as using a presurgical orthopedic plate or not (Hotz and Gnoinski, 1976, 1979; Mishima et al., 1996; Pahl et al., 2001, 2006; Bongarts et al., 2006), type of cheiloplasty (Dahl et al., 1981; Ross, 1987a; Mars et al., 1992; Molsted et al., 1992; Kuijpers-Jagtman and Long, 2000), and type of palatoplasty (Dahl et al., 1981; Ross, 1987b; Mars et al., 1992; Molsted et al., 1992; Noverraz et al., 1993; Leenstra et al., 1995; LaRossa, 2000; Kuijpers-Jagtman and Long, 2000) on occlusion, are controversial. However, there are no clinical studies with large number of sample size using all these factors.

The contemporary use of preoperative orthopedics in the habilitation of children born with UCLP has been a controversial issue since it was first introduced by McNeil (1956). Preoperative orthopedics was introduced as a treatment to improve maxillary arch form and the position of alar base to prevent crossbites and to facilitate surgery (McNeil, 1956). Many specialists believe that orthopedic manipulation of the maxillary segments facilitates closure of the cleft lip and palate and improve the esthetic outcome of primary nasolabial repair (LaRossa, 2000). The efficacy of the Hotz plate in the improvement of feeding, growth and configuration of the maxillary segments, has been previously described (Huddart, 1979; Mishima et al., 1996). 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; Gnoinski, 1990; Kramer et al., 1994; Mishima et al., 1996a). Ishii et al., (2000) reported UCLP subjects with two-stage palatoplasty combined with Hotz plate was better than that in UCLP subjects with one-stage palatoplasty, and relatively similar to that of subjects with normal occlusion.

Although 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). But preoperative orthopedics has been criticized as being unnecessary and in some cases viewed as positively harmful, as it can restrict maxillary growth (Ross, 1987). Furthermore, it is difficult to come any firm conclusions, when so many variables affect the subsequent growth pattern. Many different appliances, both active and passive, have been described (Berkowitz, 2006). The so-called Zurich approach, using a passive plate of soft and hard acrylic, has had a major influence on treatment by the European cleft teams (Gnoinski, 1990).

For several decades, an abundance of research on cleft lip and palate has been published from a variety of specialties. Clearly, the malformation due to cleft lip and palate presents tremendous challenges for the patients, their families, and health care teams who provide treatment. The team approach for the management of cleft lip and palate patients involves the service of specialists like the plastic surgeon, oral and maxillofacial surgeon, pediatrician, otolaryngologist, pedodontist, orthodontist, speech therapist and prosthodontist. Generally, the orthodontist examines cleft lip and palate patients at 5 or 6 years of age for starting orthodontic treatment. Cleft lip and palate patients often show underdevelopment of the maxilla in the sagittal, vertical, and transverse dimensions following surgical repair of the cleft (Tindlund et al., 1993). Numerous investigations and discussions on the influence of primary surgery have been reported (Ross and Johnston, 1972; Kuijpers-Jagtman and Long, 2000; Berkowitz, 2006), but the cause of retrusion is still controversial. Many of the orthodontic problems of cleft lip and palate children in the late and early mixed dentition result not from the cleft itself, but from the effects of surgical repair. Closure of the cleft lip inevitably creates some constriction across the anterior part of the maxillary arch, and closure of the cleft palate causes at least some degree of lateral constriction, though the techniques for repair of cleft lip and palate have improved tremendously in recent years. As a result, surgically treated cleft lip and palate patients have a tendency toward both anterior and lateral crossbite, which is not seen in patient with untreated clefts (Ross and Johnston, 1972). The aims of this study were to determine the treatment outcome based on the dental arch relationship of Japanese patients with nonsyndromic unilateral cleft lip and palate (UCLP) and to assess the various congenital and environmental factors that affect dental arch relationship in UCLP patients using multivariate statistical analyses.

2. Materials and methods

2.1 Subjects

Among the 450 Japanese cleft lip and palate patients who visited the orthodontic clinic at Hokkaido University Hospital from 1996 to 2005 (10 years), 164 nonsyndromic UCLP subjects were finally included in this study.

The inclusion criteria were;

1. Non syndromic UCLP,
2. Lip surgery and palatoplasty had been performed at Hokkaido University Hospital
3. No previous orthodontic treatment.
4. No alveolar bone graft.

The Exclusion criteria were;

1. Syndromic UCLP
2. Lip surgery and palatoplasty had not been performed at Hokkaido University Hospital
3. Previous orthodontic treatment
4. Insufficient clinical records

The average gestation period and weight at birth of these subjects were 276 days and 3020 grams, respectively. Among these, 31 subjects had a family history of skeletal Class III (maxillary growth retardation and/or excessive mandibular growth). There were 93 males and 71 females. Forty seven patients had right-sided UCLP. Eighty nine subjects had not received any presurgical orthopedic treatment (Psot) while 41 subjects had received Hotz plate (Figure 1) and 34 subjects had received an active plate (Figure 2). Though there were subjects who had received a Hotz plate and subjects who had received an active plate, we compared the subjects who had received Psot (Hotz plate and active plate) with those who had not received any treatment in this study. Treatment with Hotz plate according to a modified Zurich approach was usually initiated within 24 to 48 hours after birth (Hotz and Gnoinski, 1976, 1979). The active plate was an active, pin-retained device that moved the maxillary alveolar segments by screw activation (Latham, 1980).

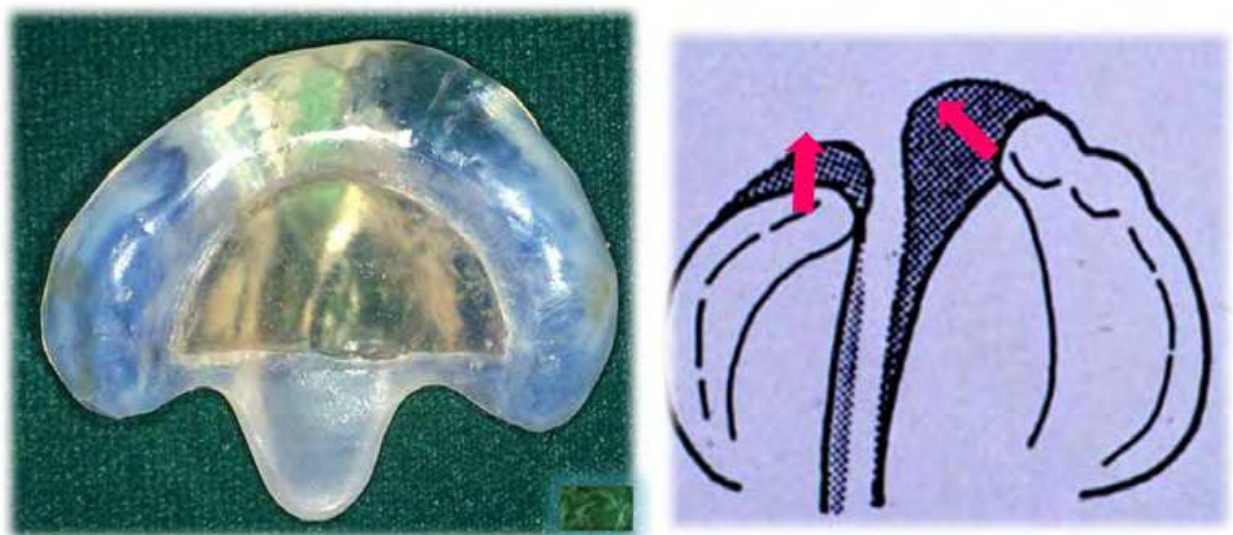


Fig. 1. Hotz plate.

Age	→	6.85±1.56 Mean ± SD
Sex	→	•Male: 93 •Female: 71
Cleft affected side	→	•Right: 47 •Left: 127
PSOT	→	•Hotz plate: 41 •Active plate: 34 •Nothing: 89
Lip operation	→	•Modified Millard: 68 •Modified Millard with vomer flap: 96
Palate operation	→	•Push back: 54 •Push back with buccal flap: 97 •Two stage palatoplasty: 13
Family history of Class III	→	•Positive: 31 •Negative: 133

Psot: presurgical orthopedic treatment.

Fig. 2. Distribution of subjects with variable factors.

All subjects had undergone cheiloplasty at the Department of Plastic Surgery, Hokkaido University Hospital. In 68 subjects, modified Millard technique for lip closure (Figure 3) had been performed and in 96 subjects, modified Millard technique with anterior palate closure by vomer flap had been performed.

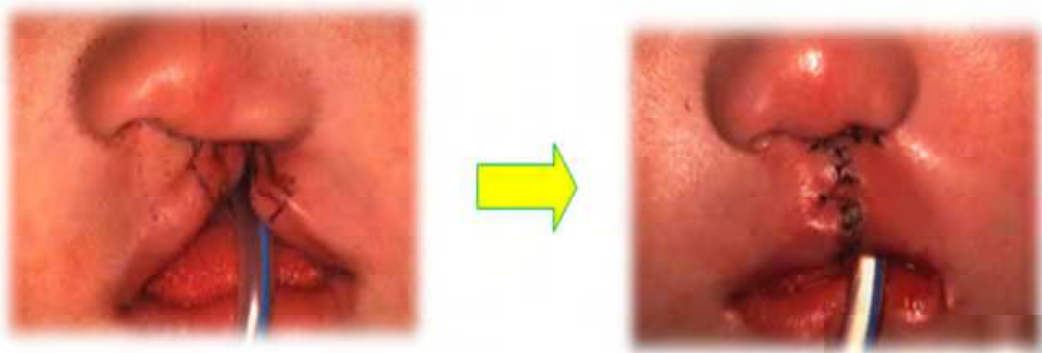


Fig. 3. Modified Millard technique for lip closure.

Subjects had undergone cheiloplasty at the average age of 5 months. All subjects underwent palatoplasty at the 1st or 2nd Departments of Oral and Maxillofacial Surgery or the Department of Plastic Surgery of Hokkaido University Hospital. Regarding palatoplasty, 54 subjects underwent pushback method (Figure 4a) at the average age of 20 months, 97 subjects underwent palatoplasty using pushback with buccal flap at the average age of 18 months. Pushback with buccal flap and two-stage palatoplasty (Figure 4b and 4c) were carried out to decrease the raw surface. The remaining 13 subjects underwent two-stage palatoplasty (using Furlow or Perko technique for closing the soft palate and then closing hard palate) at the average age of 20 months and 56 months. In this study, we compared subjects who received pushback only (palatoplasty with exposed raw surface) with subjects who received pushback with buccal flap or two-stage palatoplasty (palatoplasty with decreased raw surface).

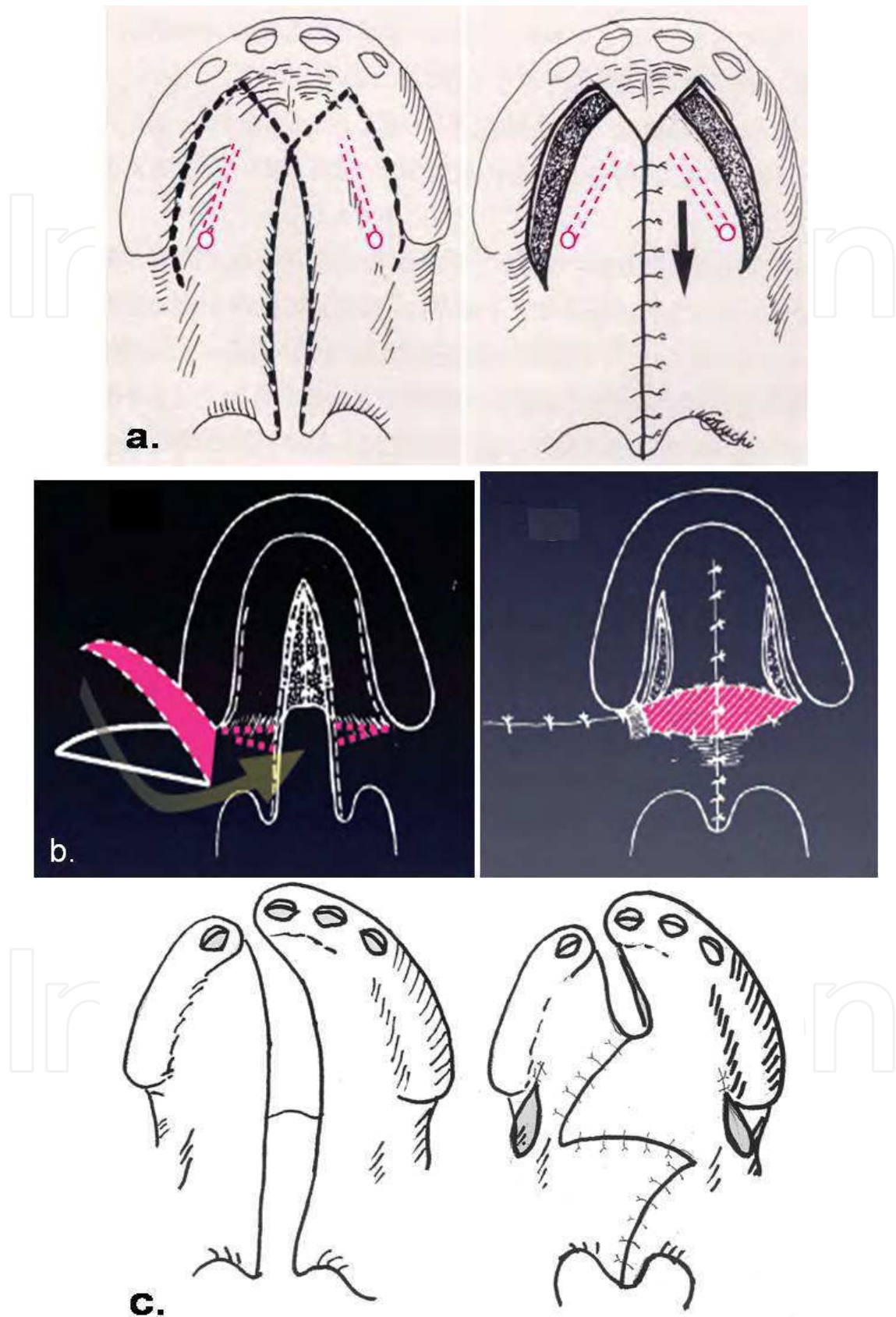


Fig. 4. a,b and c: a. Palatoplasty using pushback method, b. pushback with buccal flap and c. two-stage palatoplasty.

2.2 Assessment

Dental models taken at the initial examination (Mean age 6.85 ± 1.56 years) at the orthodontic clinic of Hokkaido University Hospital, were used for evaluating dental arch relationships. Dental arch relationships of these patients were assessed using the 5-year-old index (Atack et al., 1997a, b; Bongaarts et al., 2004) or the Goslon Yardstick (Mars et al., 1987, 2006; Morris et al., 2000; Chan et al., 2003) which have five-category ratings namely, 1: excellent, 2: good, 3: fair, 4: poor, and 5: very poor. The 5 year-old-index and the Goslon Yardstick are presented in tables in a simplified manner for assessment (Table 1 and 2).

The 5-year-old Index	Anterior OverJet (OJ)	Unilateral Cross Bite (CB) (Minor segment)	Unilateral Cross Bite (Major segment)	Open Bite (Around Cleft side)	Upper Incisor Proclination	Special feature
1 (Excellent)	+	- ~ ± (1 or 2 teeth)	-	-	- ~ ±	Good maxillary shape and palatal vault
2 (Good)	+	± ~ +	-	±	± ~ +	Edge to edge bite in the front plus no unilateral CB
3 (Fair)	± or - (with retroclined upper central incisor)	+	-	±	± ~ +	Edge to edge bite with average inclined or proclined incisors.
4 (Poor)	-	+	±	±	± ~ +	
5 (Very poor)	-	+	+		+	Poor maxillary shape and palatal vault

Table 1. General features of the models in the 5-year-old Index (+: positive, -: negative, ±: tendency, and ~: to) Alam et al., 2008.

1 (Excellent)	Favorable Advantageous skeletal form Positive overjet and overbite Exhibit Angle Class II division 1	Straightforward Ortho Tx or none at all
2 (Good)	Favorable relationship Class I dental relationship	Straightforward Ortho Tx or none at all
3 (Fair)	Edge to edge dental relationship (Class III malocclusion) In case of borderline case between 3 and 4: Deep overbite - group 3	Complex Orthodontic Tx
4 (Poor)	Unfavorable facial growth Reverse overjet of 3 to 5 mm case belong to group 4 In case of borderline case between 3 and 4: anterior openbite - group 4	Borderline Tx
5 (Very poor)	Significant Class III Reverse overjet of 3 to 5 mm but marked proclination of upper incisors and retroclination of lower incisor	Surgical Tx

Table 2. General features of the models in the Goslon yardstick (Tx: treatment) Alam et al., 2008.

Three examiners rated the 164 models of subjects four times, twice for the 5 year-old-index and for the Goslon Yardstick on different days. Taking together the data in each model, we generated a mean score (Mars et al., 1992). Based on the 5-year-old index and the Goslon Yardstick, the subjects were divided into two groups, favorable (category ratings 1-3) and unfavorable (category ratings 4 and 5) groups. This grouping was carried out because the patients in the favorable groups could be treated with conventional orthodontics, whereas patients in the unfavorable groups sometimes required surgical correction (Chan et al., 2003).

2.3 Statistical analysis

The kappa statistics has been used previously to determine inter-examiner agreement of the 5-year-old index or the Goslon Yardstick scores (Mars et al., 1992; Noverraz et al., 1993; Atack et al., 1997a; Morris et al., 2000; Chan et al., 2003; Bongaarts et al., 2004). The intra- and interexaminer agreements of the 5-year-old index and the Goslon Yardstick scores were carried out with the weighted kappa statistic. According to Altman (1991), the kappa values of the intra- and interexaminer agreements were interpreted (Table 3).

Logistic regression analysis was performed using the dichotomous dependent variable, favorable and unfavorable groups (Hosmer, 1989). Both crude and backward stepwise logistic regression analyses were done to determine which factors affect the dental arch relationship in UCLP patients (Kleinbaum, 1994). These analyses were carried out using the statistical package SPSS Ver. 8.0 (SPSS Inc, Chicago, I11), with a probability level of 0.05 considered statistically significant. Hosmer-Lemeshow tests were used for assessment of goodness-of-fit of the overall model.

Kappa Value	Strength of Agreement
<0.20	Poor
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Good
0.81-1.00	Very good

Table 3. Interpretation of Kappa Values (Altman, 1991).

3. Results

The dental arch relationships (degree of malocclusion) of 164 Japanese patients with UCLP were evaluated at Hokkaido University Hospital and to assess the factors that affect the dental arch relationship using multivariate statistical analyses.

Intra- and Interexaminer Agreement for the 5 Year-Old-Index and the Goslon Yardstick: Intraexaminer agreements for examiners A, B, and C were 0.778, 0.744, and 0.762, respectively. The kappa scores ranged from 0.679 to 0.871 for the interexaminer agreement among all examiners. A kappa value >0.6 indicates good agreement and >0.8 represents very good agreement (Table 3, Altman, 1991). The kappa scores for the 5-year-old index thus indicated sufficient intra- and interexaminer agreement.

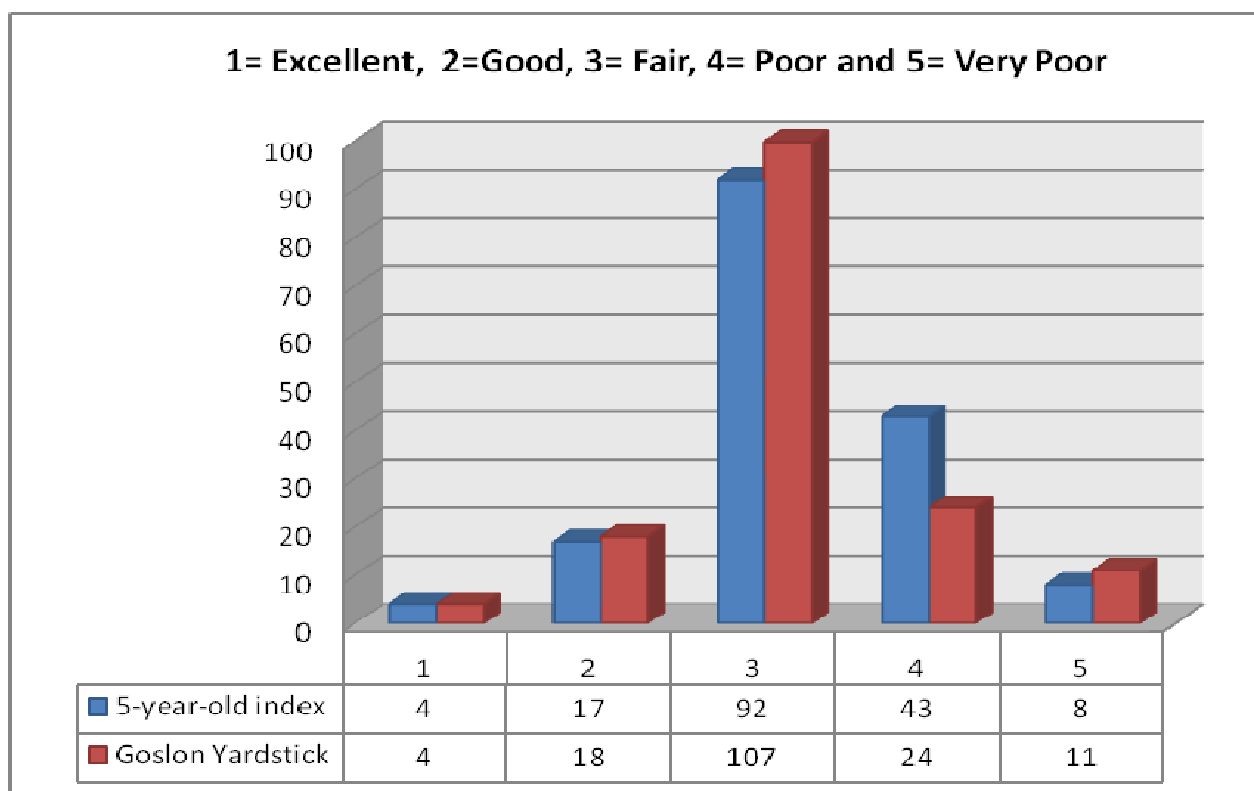
Intraexaminer agreements for examiners A, B, and C were 0.798, 0.674, and 0.879. The kappa scores ranged from 0.718 to 0.876 for the interexaminer agreement among all examiners. The kappa scores for the Goslon Yardstick thus indicated sufficient intra- and interexaminer agreement.

3.1 Score distributions

The distribution of subjects based on the five-category ratings of the 5-year-old index and the Goslon Yardstick were showed in Figure 5. Mean scores of the 5-year-old index and the Goslon Yardstick were 3.16 and 3.12, respectively.

The mean scores of the 5-year-old index of different countries, and the present study studies were showed in figure 6 (Atack et al., 1997a, b, Boongarts et al., 2004, 2006, William et al., 2001, William et al., 2001). The mean scores of the Goslon Yardstick of different countries, Eurocleft center and different Japanese studies were showed in figure 7 (Mars et al., 1987, 1990, 1992, 2006, Morris et al., 2000, Molsted et al., 1992, Nollet et al., 2005, Okazaki et al., 2002, Susami et al., 2006).

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Fig. 5. Score distribution (percentages) for 164 UCLP subjects at Hokkaido University Hospital: The 5-year-old index and the Goslon yardstick.

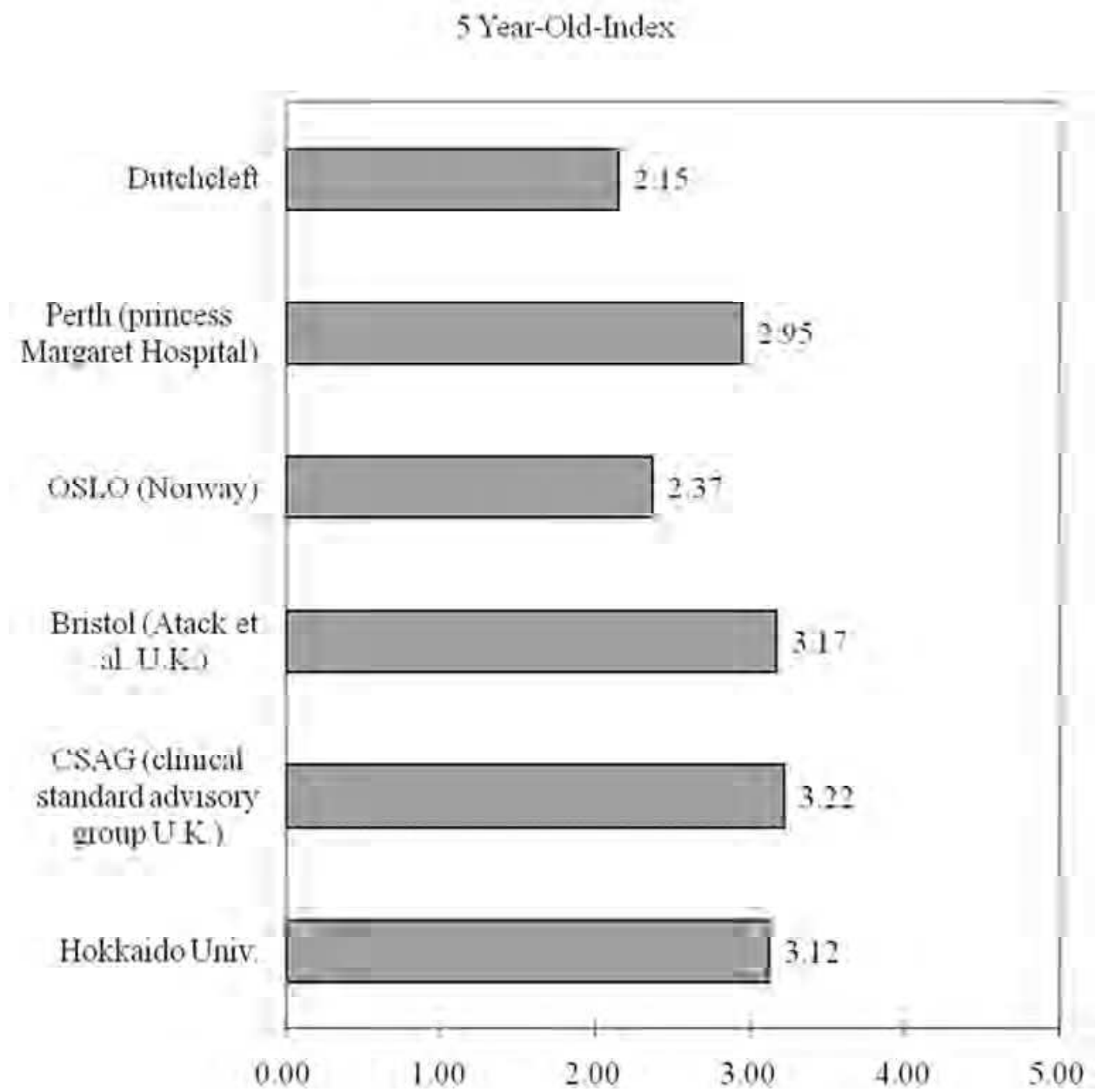


Fig. 6. Mean 5 Year-Old-Index score of other countries and present study.

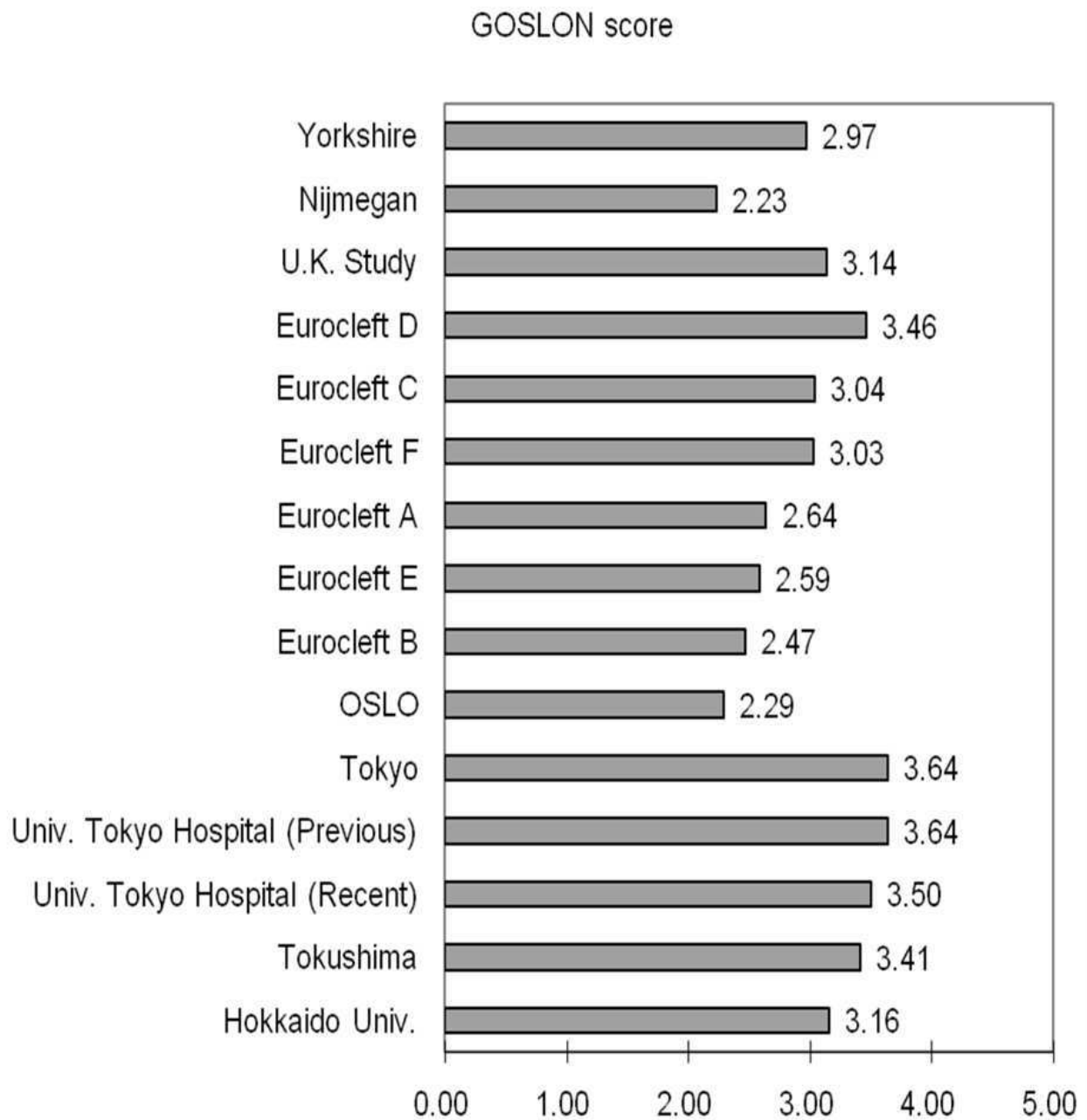


Fig. 7. Mean Goslon Yardstick score of other countries, Eurocleft centers. different Japanese studies and present study.

3.2 Comparisons of factors between favorable and unfavorable groups

Using the 5-year-old index and the Goslon yardstick presented in Table 4.

Variables		The 5-year-old index		The Goslon Yardstick	
		Favorable %	Unfavorable %	Favorable %	Unfavorable %
Family history of skeletal Class III	Positive	16	20	15	27
	Negative	84	80	85	73
Gender	Male	55	52	55	50
	Female	45	48	45	50
UCLP affected side	Right	30	20	29	20
	Left	70	80	71	80
Psot	Nothing	51	53	51	54
	Wearing Psot	49	47	49	46
	Modified				
Cheiloplasty	Millard with vomer flap	53	66	54	70
	Modified Millard	47	34	46	30
Palatoplasty	Pushback with exposed raw surface	27	41	27	47
	Pushback with decreased raw surface	73	59	73	53

Table 4. Distribution of subjects with variable factors in favorable and unfavorable groups using the 5-year-old index (the number of subjects in favorable and unfavorable groups was 113 and 51, respectively) and the Goslon Yardstick (the number of subjects in favorable and unfavorable groups was 129 and 35, respectively).

3.3 Crude logistic regression analysis using the 5-year-old index scores

Table 5 shows the results of the crude logistic regression analysis that estimated the associations between various factors (independent variable) and dental arch relationships (dependent variable). Odds ratio, 95% confidence interval, and *p* value for the various factors are presented. Although no significant associations were found among various factors, the methods of cheiloplasty (odds ratio of modified Millard with vomer flap for anterior hard palate closure = 1.716) and palatoplasty with exposed raw surface (odds ratio of pushback only = 1.874) were slightly correlated with the dental arch relationship.

Variables	Odds Ratio	95% Confidence Interval	<i>P</i> Value
Family history of skeletal Class III	1.269	0.567-3.462	0.463
UCLP affected side (right)	0.591	0.244-1.346	0.221
Psot	0.897	0.456-1.844	0.862
Cheiloplasty (modified Millard with vomer flap)	1.716	0.812-3.569	0.148
Palatoplasty with exposed raw surface	1.874	0.876-3.938	0.101

Psot: presurgical orthopedic treatment.

Table 5. Crude odds ratios: Favorable vs unfavorable group using the 5-year-old index.

Note: An odds ratio greater than 1 indicates that the respective independent factor associates with unfavorable dental arch relationship and less than 1 indicates that the respective independent factor associates with favorable dental arch relationship.

3.4 Stepwise logistic regression analysis using the 5-year-old index scores

Table 6 shows the results of the stepwise logistic regression analysis that estimated the associations between various factors and dental arch relationships. Although no significant associations were found among various factors, the method of palatoplasty with exposed raw surface (odds ratio of pushback only = 1.987) was slightly correlated with dental arch relationship.

Hosmer-Lemeshow tests were used for assessment of goodness-of-fit of the overall model. The probability value was 0.725 (by the 5-year-old index). Thus, these models fitted well.

Variables	Odds Ratio	95% Confidence Interval	<i>P</i> Value
Family history of skeletal Class III	1.659	0.588-4.057	0.364
UCLP affected side (right)	0.513	0.204-1.263	0.139
Palatoplasty with exposed raw surface	1.987	0.919-4.154	0.071

Table 6. Adjusted odds ratios (Stepwise regression analysis: backward method): Favorable vs unfavorable group using the 5-year-old index.

3.5 Crude logistic regression analysis using the Goslon Yardstick scores

Table 7 shows the results of the crude logistic regression analysis that estimated the associations between various factors and dental arch relationships. Significant associations were found between palatoplasty with exposed raw surface (odd ratio of pushback only = 2.328) and dental arch relationship. Family history of skeletal Class III (odds ratio = 2.146) and method of cheiloplasty (odds ratio of modified Millard with vomer flap for anterior hard palate closure = 2.014) also seemed to be correlated with dental arch relationship.

Variables	Odds Ratio	95% Confidence Interval	<i>P</i> Value
Family history of skeletal Class III	2.146	0.811-5.520	0.114
UCLP affected side (right)	0.610	0.225-1.622	0.319
Psot	0.807	0.396-2.033	0.714
Cheiloplasty (modified Millard with vomer flap)	2.014	0.848-4.794	0.109
Palatoplasty with exposed raw surface	2.328	1.014-5.355	0.047 *

* $P < 0.05$

Psot: presurgical orthopedic treatment.

Table 7. Crude odds ratios: Favorable vs unfavorable group using the Goslon Yardstick.

Note: An odds ratio greater than 1 indicates that the respective independent factor associates with unfavorable dental arch relationship, and less than 1 indicates that the respective independent factor associates with favorable dental arch relationship.

3.6 Stepwise logistic regression analysis using the Goslon Yardstick scores

Table 8 shows the results of the stepwise logistic regression analysis that estimated the associations between various factors and dental arch relationships. Significant associations were found between palatoplasty with exposed raw surface (odd ratio of pushback only = 2.465) and dental arch relationship. Family history of skeletal Class III (odds ratio = 2.491) was also correlated with dental arch relationship.

Hosmer-Lemeshow tests were used for assessment of goodness-of-fit of the overall model. The probability value was 0.322 (by the Goslon Yardstick). Thus, these models fitted well.

Variables	Odds Ratio	95% Confidence Interval	P Value
Family history of skeletal Class III	2.491	0.867-6.943	0.081
UCLP affected side (right)	0.465	0.144-1.277	0.134
Palatoplasty with exposed raw surface	2.465	1.056-5.849	0.039 *

* $P < 0.05$

Table 8. Adjusted odds ratios (Stepwise regression analysis: backward method): Favorable vs unfavorable group using the Goslon yardstick.

4. Discussion

In this field no large-scale Japanese intercenter comparisons or randomized control trials have been performed. However, it is highly desirable that the standards of Japanese cleft surgery be evaluated in a global context. A six-center comparative study of the treatment outcome in Japan (Japanleft) was recently proposed (Asahito et al., 2003), and continuing research along these lines should reveal the general standard of cleft care in Japan.

In this study, we analyzed 164 non-syndromic UCLP subjects. The sample size was comparatively much higher than the number of subjects in the previous studies (Mars et al., 1992; Mishima et al., 1996; Atack et al., 1997a, b; Morris et al., 2000; Pahl et al., 2001; Chan et al., 2003; Bongaarts et al., 2004; Susami et al., 2006).

We used the 5-year-old index and the Goslon Yardstick for evaluation of dental arch relationship (degree of malocclusion) because these were reproducible (Mars et al., 1987, 1992; Atack et al., 1997a, b), and reliable methods (Mars et al., 1992; Atack et al., 1997a, b). Our subjects had a mean age of 6.85 ± 1.56 (Mean \pm SD) years. The 5-year-old index was used to evaluate the primary dentition (Atack et al., 1997a, b). Initially, the Goslon Yardstick was used in the late mixed and early permanent dentition (Mars et al., 1987), but the Goslon Yardstick can be used to predict the surgical outcome as early as 5 years of age (Atack et al., 1997a, b). The Goslon Yardstick can also be used for all stages of dental development (Noverraz et al., 1993). Consequently, we used the Goslon Yardstick for primary and early mixed dentition in this study. The 5-year-old index and the Goslon Yardstick are thought to be the best-known clinical tools available to qualitatively assess dental arch relationships in UCLP patients. The future treatment plan can also be predicted using these indexes. In addition, these indexes are also closely related with cephalometric analysis (Morris et al., 2000).

In this study, intra- and interexaminer agreements were evaluated using the weighted kappa statistics and determine the repeatability and reproducibility of the of the five category ratings. The kappa scores for the 5 Year-Old-Index and the Goslon Yardstick were good to very good for both in the present study. The intraexaminer agreement for the

Goslon Yardstick was similar to that of the study reported by Susami T et al., (2006). Stepwise logistic regression analysis was used to explore the associations between precise factors (among various factors) and dental arch relationships. Crude logistic regression analysis was used to estimate associations between each congenital and environmental factor and dental arch relationships. Stepwise logistic regression analysis is used in the exploratory phase of research (Kleinbaum, 1994). Backward stepwise regression appears to be the preferred method of exploratory analyses, in which the analysis begins with a full model and variables are eliminated one by one using the largest p value (Kleinbaum, 1994). The final model is the last step model, in which eliminating another variable would not improve the model significantly (Kleinbaum, 1994).

Since it was first introduced by McNeil (1956), the contemporary use of preoperative orthopedics for treatment of children born with UCLP has been a controversial issue. Many different appliances, both active and passive, have been described (Berkowitz, 2006). The effect of infant orthopedics (IO) on maxillary arch dimensions in unilateral cleft lip and palate (UCLP) has been studied for decades, but controversy regarding the effect of IO on the maxillary arch still exists. Advocates of IO claim that the presurgical orthopedic plate molds the alveolar segments into a better arch form and prevents the tongue from positioning in the cleft. In this way, the dentomaxillary development would improve (McNeil, 1956; Hotz and Gnoinski, 1976, 1979; Gnoinski, 1990; Kramer et al., 1994; Berkowitz, 1996). Opponents of this therapy claim that lip surgery alone has the same effect and that the presurgical orthopedic plate is only an expensive appliance used to comfort the parents by starting treatment at the earliest moment possible (Pruzansky and Aduss, 1967; Ross, 1987; Kramer et al., 1992; Mars et al., 1992; Shaw et al., 1992a, 1992b; Prahel et al., 2001).

The results of the present study suggest that P_{sot} does not so much correlate with the dental arch relationship. Use of the Hotz' plate during the first 18 months improves anterolateral growth of the tip of the alveolus on the cleft sides, shaping the alveolar arch towards ideal morphology (Ono et al., 1995) thus, facilitating the lip closure. Furthermore, by continuing use of the plate after lip closure, it increasingly reduces the pressure exerted by this newly surgically closed lip on the alveolar bone of the premaxilla. Then, by also closing the soft palate, the anterior hard palate cleft width is reduced by 55% and the posterior part by 50% of that at the time of velar closure (Ono et al., 1996). This facilitates hard palate closure. From this time onwards, the patient must continue to wear the plate, until closure of the hard palate at 6 years. In our hospital, this is done mainly by vomer flaps, also using artificial dermis made of atelocollagen to cover the raw surface and reduce surgical damage and produce fewer postoperative fistulae and less scar tissue (Iida et al., 1998). The scarring is believed to retard maxillary growth (Blocksma et al., 1975). By postponing closure of the hard palate to a later age, less growth is affected and better final growth of the maxilla will result (Friede and Enemark, 2001). However, it is possible that P_{sot} correlates with other phenomena such as recovery of maxillary alveolar width/length and ease for palatoplasty (Mishima et al., 1996).

In the present study, it was speculated that cheiloplasty with vomer flap resulted in unfavorable dental arch relationship than cheiloplasty alone using crude logistic regression analysis, although this variable did not remain as a precise factor in the stepwise regression analysis using the 5-year-old index and the Goslon. Bardach and Kelly (1988) reported that closure of the lip defect with anterior palate resulted in more significant growth aberration

than lip repair alone in a study using beagles. Anterior palate closure with vomer flap was carried out due to the ease of the palatoplasty procedure. Modified Millard cheiloplasty with anterior hard palate closure showed unfavorable maxillary protrusion, unfavorable midface (facial vertical proportion), and small total maxillary area (horizontal and vertical development of anterior nasal spine) (Ross, 1987a).

In an intercenter study by Ross (1987a, 1987b, 1987c), 1600 cephalometric radiographs from males with complete UCLP were examined to discern the effects of surgical and orthopedic treatment on facial growth. Among other things, Ross concluded that simple treatment protocols produced the most favorable results, and similar to the suggestion made by Dahl et al., that surgical expertise was found to be a major determinant of overall success. Presurgical orthopedics was found to provide no long-term benefits. Despite the obvious significance of this large study, the fact that its design was limited to cephalometric analysis made the analysis of many occlusal relationships impossible. These dental and arch-form factors often play an important role in treatment considerations. In contrast, Mars et al. (1987) used dental casts and a new form of arch relation analysis called the Goslon Yardstick to compare outcomes between various clinics. The rating process is based on the Goslon reference models, which are divided into five groups. Depending on the amount of maxillary protrusion present, and to a lesser extent on transverse and vertical variables, the groups are ordered from the best arch relationships to the worst. "Ones" are considered the best, and conversely, "fours" and "fives" are considered severe enough to likely require surgical maxillary advancement during end-stage treatment. The dental casts to be studied are compared with these reference groups and are assigned a score. Simpler means of arch assessment have been suggested, such as crossbite evaluation (Huddart and Bodenham, 1972) and incisal overjet measurement (Morris et al.); these techniques, however, are not as sensitive and do not predict facial morphology outcomes as accurately as the Goslon Yardstick. The Yardstick is a practical means of evaluating malocclusion severity and associated treatment difficulty, and was used in the Mars et al. (1987) study to compare outcomes between a sample from Oslo and two samples from Greater Ormond Street (only one of which received presurgical orthopedics). Although the Oslo ratings were superior to those of Greater Ormond Street, no significant difference was found between the two subgroups of the latter. Presurgical orthopedics was therefore reported as having no major effect in this study. The Eurocleft study, published in 1992 as a series of five papers (Shaw et al., 1992a, 1992b; Mølsted et al., 1992; Mars et al., 1992; Asher-McDade et al., 1992) expanded the scope of intercenter research by comparing treatment outcomes of 8- to 10-year-olds with UCLP from six European cleft centers using cephalometric radiographs, dental casts evaluated with the Goslon Yardstick, and nasolabial photographs to evaluate craniofacial form, arch relationships, and nasolabial appearance.

Our study suggests that palatoplasty with exposed raw surface caused significantly unfavorable dental arch relationship than the palatoplasty with decreased raw surface (using the Goslon Yardstick). Pushback palatoplasty is generally thought to have more advantage in improving speech than the two-stage palatoplasty.

When we evaluated the dental arch relationship using the 5-year-old index, odds ratio of the palatoplasty with exposed raw surface failed to reach a significant level, but was still quite higher than that of the other factors. Over recent years, much attention has been given to the adverse effects of surgery in infants with cleft palate, with a number of reports indicating

that the growth and development of the maxillary arch may be inhibited as a result of the nature of the primary repair (Ross, 1987c; Mars and Houston, 1990; Mars et al., 1992). Pushback palatoplasty showed a higher degree of maxillary and dentoalveolar deformity (Ross, 1972), although it is generally thought to have more advantage in improving speech than the two-stage palatoplasty. In an animal study, it was reported that the type of surgical repair may have an influence on the lateral constriction of the upper arch, particularly the use of surgical flaps in which palatal bone is denuded of mucoperiosteum (Leenstra et al., 1995; Kim et al., 2002). These reports coincide with our results.

The degree of constriction of the maxillary arch in patients with repaired UCLP is an important factor when considering the merits of different surgical techniques (Joos, 1995; Kramer et al., 1996). The information available from many of these studies has been in the mixed and permanent dentitions with less information available about the primary dentition.

In untreated adult UCLP arches, there is certainly some narrowing of the maxillary arch (da Filho Silva et al., 1992). However, there is some evidence that the type of surgical repair may have an influence on the lateral constriction of the upper arch, particularly the use of surgical flaps in which palatal bone is denuded of mucoperiosteum (Leenstra et al., 1995). This is an area that requires further investigation.

Follow-up investigation of the push-back palatoplasty has shown deleterious effects on transverse maxillary arch growth (Ross, 1970). However, institution of alternative surgical regimes does not necessarily minimize adverse effects on maxillary growth (Friede et al., 2000).

In the present study, subjects who had a family history of skeletal Class III (maxillary growth retardation and/or mandibular excessive growth) were more likely to fall into an unfavorable dental arch relationship, especially using the Goslon Yardstick. The results suggest that cleft patients tend to develop Class III malocclusion not only as an effect of primary surgery but also due to the genetic influence of family history. Our results also revealed that patients who have right-sided UCLP were slightly correlated with favorable dental arch relationship using stepwise logistic regression analysis, although the correlation was not significant. It is interesting to note that patients who have a right-sided UCLP had favorable dental arch relationship. Future studies are needed to determine the cause.

5. Conclusion

Treatment outcome based on dental arch relationships among Japanese children born with nonsyndromic complete UCLP seems to be intermediate (the mean scores of the 5-year-old index and the Goslon Yardstick were 3.16 and 3.12, respectively). This study provided evidence that there was a significant association between palatoplasty with exposed raw surface and dental arch relationship using crude and stepwise logistic regression analysis (judged by the Goslon Yardstick). Early palatal closure may negatively affect the outcome, but a factor of craniofacial differences between ethnic groups should be taken into consideration. The results suggest that cleft patients tend to develop Class III malocclusion not only as an effect of primary surgery but also due to the genetic influence of family history.

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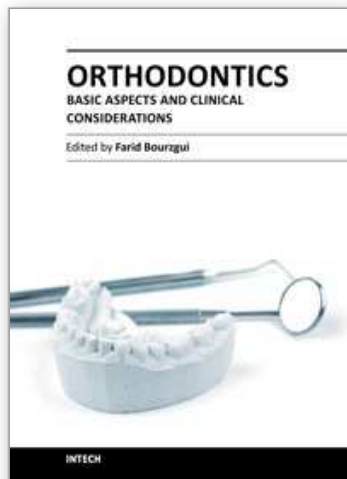
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The book reflects the ideas of nineteen academic and research experts from different countries. The different sections of this book deal with epidemiological and preventive concepts, a demystification of cranio-mandibular dysfunction, clinical considerations and risk assessment of orthodontic treatment. It provides an overview of the state-of-the-art, outlines the experts' knowledge and their efforts to provide readers with quality content explaining new directions and emerging trends in Orthodontics. The book should be of great value to both orthodontic practitioners and to students in orthodontics, who will find learning resources in connection with their fields of study. This will help them acquire valid knowledge and excellent clinical skills.

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