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## [原著] The effects of Palatal Plate on Velopharyngeal Function and Occlusion for Children with Cleft Lip and Palate after Primary Palatoplasty

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## The effects of Palatal Plate on Velopharyngeal Function and Occlusion for Children with Cleft Lip and Palate after Primary Palatoplasty

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### ABSTRACT

We employ palatal plates (obturator) immediately after palatoplasty to close the fistula in the alveolar cleft arising from push-back surgery. The aim of the present study is to evaluate the effect of palatal plate on the velopharyngeal function and maxillofacial growth. The subjects were 115 patients who underwent palatoplasty, followed by consistent treatment. The period of time required to achieve velopharyngeal competency (VPC-T) was examined in 107 patients (14 with bilateral cleft lip and palate: BCLP, and 20 with unilateral cleft lip and palate: UCLP) who received palatal plates within 3 months after surgery to close a fistula, and 31 patients without palatal plates (9 BCLP, and 22 UCLP), and 42 patients with cleft palate who didn't receive palatal plates. For occlusal evaluation by the Goslon Yardstick method, we evaluated 30 UCLP patients (14 palatal plate wearers, and 16 non-palatal plate wearers) who underwent palatoplasty, followed by the placement of a palatal plate within 3 months postoperatively, subsequent occlusal management, and eventually achieved a II C or III A occlusal relationship. Evaluation items included: 1. velopharyngeal competency evaluation, 2. VPC-T for speech, and 3. occlusal evaluation of cases with and without a palatal plate, and the following results were obtained: 1. Velopharyngeal competency (VPC) was achieved in 93.5% of all cases we analyzed. 2. The average of VPC-T was 10.3 (BCLP) and 8.9 (UCLP) months for palatal plate wearers, and 18.8 (BCLP) and 15.1 (UCLP) months for non-palatal plate wearers. 3. Palatal plate ( $p<0.0001$ ) and fistula ( $p=0.0002$ ) were selected for variables by logistic regression analysis, but cleft type was not. The odds ratio of palatal plate (20.978) showed strong association with VPC-T. Palatal plate attachment from an early stage may be a measure to acquire velopharyngeal function as early as possible. 4. The Goslon Yardstick scores were 2.49 for palatal plate wearers and 3.56 for non-palatal plate wearers, and 3.06 for all cases we analyzed. A palatal plate not only facilitates the acquisition of VPC, but promotes harmonized upper and lower occlusion and maxillofacial growth. This suggests the important role of the palatal plate in the esthetic improvement and acquisition of normal occlusion, which is one of the final goals of consistent treatment. *Ryukyu Med. J., 28(3,4)23~34, 2009*

Key words: cleft lip and palate, the Goslon Yardstick score, palatal plate

## INTRODUCTION

At Ryukyu University Hospital, the oral surgery department opened in 1973, laying a foundation for comprehensive therapy in the treatment of cleft lip and palate. In 1998, orthodontists joined the department to further enrich the comprehensive therapy, involving different specialists. At present, the department plays a central role in the comprehensive treatment of cleft lip and palate in Okinawa.

Initial palatoplasty surgery is performed to achieve favorable velopharyngeal closure, and it is important for the acquisition of favorable speech and occlusion. Therefore, by taking into account jaw development, we have employed the push-back procedure using a conventional modified mucosal flap (Kohama's method<sup>1,2</sup>). Push-back palatoplasty has also been associated with postoperative fistula formation in the anterior region of the

palate. We use palatal plates (fistula closure plates) immediately after palatoplasty to close the fistula in the alveolar cleft arising after push-back surgery. These patients underwent palatoplasty, followed by the placement of a palatal plate within 3 months postoperatively, subsequent occlusal management, and eventually achieved a Hellman Dental Age II C or III A occlusal relationship (Table 1).

Wearing a palatal plate at an early stage helps increase the intraoral pressure. It also works as a retainer for the collapse after palatoplasty. The present paper describes the effect of a palatal plate on speech and maxillary growth, which are primary goals of palatoplasty.

## SUBJECTS AND METHODS

The subjects were 115 patients born between 1996 and 2005 who had been treated in our department from immediately after birth (Table 2).

Table 1 Hellman Dental Age

A	When the infant begins to get teeth	Predental period
C	There are also secondary divisions or subdivisions of these phases which refer to the beginning phenomena of erupting the deciduous second molars	Eruption stage of deciduous teeth
A	When by the acquisition of the second deciduous molars the deciduous or milk dentition is completed	Deciduous dentition period
C	The beginning phenomena of erupting the permanent molar including the elimination of the deciduous incisors and the eruption of their permanent successors	Mixed dentition period
A	When the permanent first molar is added on behind the deciduous dentition	
B	To the time of elimination of deciduous canines and molar teeth and the acquisition of their successors	
C	The beginning phenomena of erupting the second permanent molar teeth	Permanent dentition period
A	When the permanent second molar is added on behind the first molar	
C	The beginning phenomena of erupting the third permanent molar teeth	
A	When by the addition of the third molar or wisdom tooth the adult dentition is completed	

Table 2 Subjects

Cleft type	Male	Female	Total
BCLP	16	8	24
UCLP	32	14	46
CP	14	31	45
Total	62	53	115

BCLP: Bilateral Cleft lip and Palate UCLP: Unilateral Cleft lip and Palate CP: Cleft Palate

The 115 patients comprised 24 cases with bilateral cleft lip and palate (BCLP), 46 cases with unilateral cleft lip and palate (UCLP), and 45 cases with cleft palate (CP).

In our department, cheiloplasty is performed at 3 months of age, and a 5-6-kg body weight. The Tennison-Randall technique based on the triangular flap method is used. Palatoplasty is performed at 1.6 years of age, and a 9-10kg body weight. The modified mucosal flap (Kohama's method) maximally preserves the periosteum exposed by the push-back procedure. One surgeon performed cheiloplasty, and two others performed palatoplasty according to the same therapeutic concepts and with the same surgical technique. A plate is placed at an early stage (within 3 months after palatoplasty) postoperatively to avoid the disturbance of maxillary growth.

1) Velopharyngeal competency (VPC) evaluation

The subjects included 24 cases with BCLP, 46 cases with UCLP and 45 cases with CP.

VPC evaluation was performed by an oral surgeon and speech therapist according to our diagnostic criteria<sup>3)</sup> based on the auditory assessment

of speech and blowing test at 4 years old. Items to evaluate VPC include: 1) intraoral inspection - (1) normal soft palate movement, (2) normal distance between the soft palate and pharynx, and (3) normal movement of the lateral pharyngeal wall; 2) auditory diagnosis of speech - (1) no hypernasality on the auditory assessment of vowels and conversational speech, and (2) no nasal emission; and 3) blowing test - (1) no expiratory rhinorrhea (Tables 3 and 4).

VPC was evaluated based on intraoral inspection, auditory diagnosis of speech, and a blowing test, and was graded according to the following four criteria: 1. good - hyper-nasality (-), distorted consonants due to expiratory rhinorrhea (\*nasal emission) (-), expiratory rhinorrhea on a blowing test (-), and no abnormal findings on intraoral inspection; 2. Fair - expiratory rhinorrhea on a blowing test (-), hyper nasality (- / ±), and nasal emission (- / ±); 3. Slightly poor - expiratory rhinorrhea in blowing test (±), hyper-nasality (±), nasal emission (±); and 4. Poor - expiratory rhinorrhea (+ / ++), hyper nasality (+ / ++), and nasal emission (+ / ++) (Table 5).

Table 3 Intraoral inspection for the normal velopharyngeal function evaluations by an oral surgeon

	Repose	/a/ Generating
Soft Palate length	Normal, A little short, Short, Inspection impossible	Presence or contact with the posterior Pharyngeal
Soft Palate mobility	/	Good mobility, fair mobility, poor mobility, Inspection impossible
Lateral Pharyngeal mobility		Good mobility, fair mobility, poor mobility, Inspection impossible

Table 4 Blowing Test for the normal velopharyngeal function evaluations by a speech therapist

	Degree of nasal escape				
Soft blowing	-	±	+	++	Inspection impossible
Hard blowing	-	±	+	++	Inspection impossible

-: No nasal escape    ±: Less than 1 cm    +: More than 1 cm    -: Less than 2 cm    ++: More than 2 cm

Table 5 Evaluation items for the velopharyngeal function

	Blowing of nasal escape	Hyper nasality	Nasal emission
Good	-	-	-
Fair	-	- or ±	- or ±
Slightly poor	±	±	±
Poor	+ or ++	+ or ++	+ or ++

2) The period of time required to achieve VPC (VPC-T) after palatoplasty

VPC-T was the period from palatoplasty to VPC achievement. VPC-T was investigated in 107 patients excluding 8 patients with slightly poor and poor function among our 115 patients.

3) Occlusal evaluation of cases with and without a palatal plate

The upper and lower dental arch relationship was evaluated according to the Goslon Yardstick method<sup>4)</sup>. This method assures reproducibility and the straightforward evaluation of the degree of malocclusion in UCLP patients, and has been used for multi-institutional, comparative studies mainly in Europe in recent years. In the present study, 30 out of 46 UCLP patients with assessable upper and lower dental arch models in Hellman Dental Age IIC or III A were selected as the subjects.

Occlusion was assessed according to the criteria outlined by Mars et al.<sup>4)</sup> using plaster models based on bite impressions taken of the intercuspal position. Subjects were 14 UCLP patients with sufficient data who received a palatal plate shortly after palatoplasty in order to achieve VPC at an early stage, and to avoid scar contracture, and 16 UCLP patients with sufficient data who did not wear a palatal plate. The models were ranked subjectively by four experienced orthodontists working at Tokyo University Hospital. The ranking was repeated after an interval of one week, and the reliability was measured using Spearman's rank correlation coefficient. Spearman's rank correlation analysis was performed between the first and

second scores to assess reliability within examiners, and among the first scores to assess reliability between examiners, and the rank correlation coefficient  $p$  was calculated. After the models had been ranked, it became apparent that the cases could be readily separated into five groups, which then formed the basis of the Goslon groups.

Subjects were separated into the following 5 groups<sup>5)</sup> (Fig. 1):

*Group 1 (excellent)*

Group 1 (excellent) has a Class II upper and lower dentoalveolar relationship. This group does not require orthodontic treatment, or can be easily treated.

*Group 2 (good)*

Group 2 (good) has a normal upper and lower dentoalveolar relationship, but an abnormal position of individual teeth. As with Group 1, this group does not require treatment, or can be easily treated.

*Group 3 (fair)*

Group 3 (fair) has a mild Class III upper and lower dentoalveolar relationship. This group requires slightly complex orthodontic treatment, but favorable results can be expected.

*Group 4 (poor)*

Group 4 (poor) are at the limits of orthodontic treatment to achieve a favorable occlusal relationship without orthognathic surgery. Some cases require orthognathic surgery.

*Group 5 (very poor)*

Group 5 (very poor) has a Class III upper and lower dentoalveolar relationship. Cases in Group 5 require orthognathic surgery.

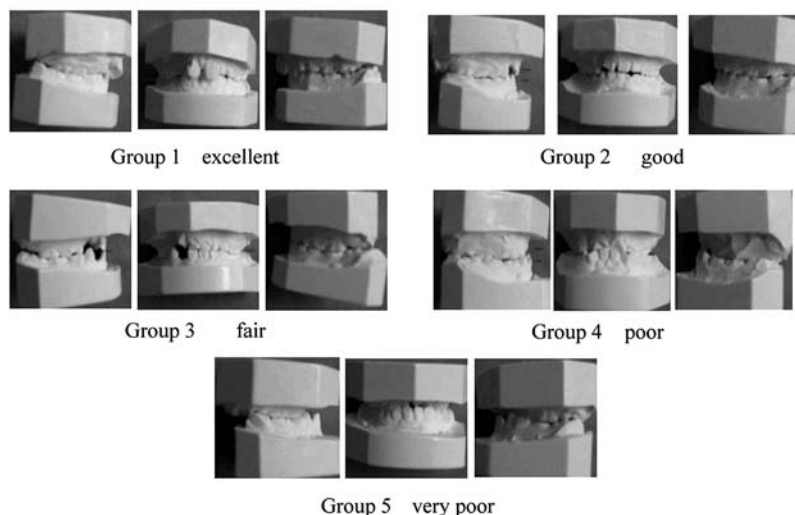


Fig. 1 Representative cases of the Goslon groups

Discussion items

The following items were discussed:

- 1) Velopharyngeal function and cleft type
- 2) Relationship between the cleft type and VPC-T
- 3) VPC-T with and without a fistula
- 4) VPC-T with and without a palatal plate
- 5) Occlusal evaluation of cases with and without a palatal plate

We performed Mann-Whitney test and multiple logistic regression analysis. Multivariate analysis was performed employing logistic regression analysis. VPC-T was divided into 2 groups: one year or shorter and longer than one year. Regarding these groups as dependent variables and the cleft type and presence or absence of the palatal plate and fistula as independent variables, the factors were categorized and subjected to statistical analysis.

**RESULTS**

1) Velopharyngeal function and cleft type

The velopharyngeal function according to the

cleft type was as follows: good: 83.3%, fair: 12.5%, and poor: 4.2% in BCLP; good: 84.4%, fair: 8.9%, slightly poor: 4.4%, and poor: 2.3% in UCLP; good: 89.1%, fair: 2.2%, slightly poor: 6.5%, and poor: 2.2% in CP; good/fair: 93.5%, and slightly poor/poor: 6.5% in total (Table 6).

2) Relationship between the cleft type and VPC-T

VPC-T was investigated in the 107 patients excluding 8 patients with slightly poor and poor function who could not achieve velopharyngeal function.

VPC-T was 13.7 months in BCLP, 11.8 months in UCLP, and 9.3 months in CP. The period was within 12 months in 14 out of 23 cases (60.8%), and more than 13 months in 9 cases (39.2%) in BCLP; within 12 months in 25 out of 42 cases (59.5%), and more than 13 months in 17 cases (40.5%) in UCLP; and within 12 months in 34 out of 42 cases (81.0%), and more than 13 months in 8 cases (19.0%) in CP. The overall VPC-T was 11.2 months (Table 7).

Table 6 Velopharyngeal function and cleft type

	Good % (n)	Fair % (n)	Slightly poor % (n)	Poor % (n)
BCLP (24)	83.3 (20)	12.5 (3)	0	4.2 (1)
UCLP (45)	84.4 (38)	8.9 (4)	4.4 (2)	2.3 (1)
CP (46)	89.1 (41)	2.2 (1)	6.5 (3)	2.2 (1)
	85.6	7.9	3.6	2.9
	┌──────────┐			
	93.5			

Table 7 Relationship between cleft type and the period of time required to achieve velopharyngeal competency

Cleft Type \ VPC-T	Total 107 cases VPC-T (month): 11.2				Total
	0-6 m	7-12 m	13-18 m	19 m -	
BCLP VPC-T: 13.7 m	14 (60.8%)		9 (39.2%)		23 (100.0%)
	3 (13.0%)	11 (47.8%)	5 (21.8%)	4 (17.4%)	
UCLP VPC-T: 11.8 m	25 (59.5%)		17 (40.5%)		42 (100.0%)
	9 (21.4%)	16 (38.1%)	11 (26.2%)	6 (14.3%)	
CP VPC-T: 9.3 m	34 (81.0%)		8 (19.0%)		42 (100.0%)
	17 (40.5%)	17 (40.5%)	3 (7.1%)	5 (11.9%)	

VPC-T: The period of time required for velopharyngeal competency

3) VPC-T according to the cleft type with and without a fistula

Fistula presence was observed in 49 out of 65 cases (75 %) in BCLP and UCLP patients with cleft jaw.

Fistula indicates cleft jaw exposed by push-back surgery. (In our department, closure of the alveolar cleft is not performed during cheiloplasty or palatoplasty.)

VPC-T was 12.3 months for those without (6 cases) and 14.1 months for those with (17 cases) a fistula in BCLP, 6.7 months without (10 cases) and 13.3 months with (32 cases) a fistula in UCLP, and 9.3 months in CP (Table 8).

4) VPC-T with and without a palatal plate

The groups with and without palatal plate attachment were established after 1998.

VPC-T according to the cleft type was 10.3 months for those with (14 cases) and 18.8 months for those without (9 cases) a palatal plate for BCLP. This result shows that VPC-T was significantly shorter in cases with a palatal plate ( $P=0.0089$ ).

Similarly, VPC-T was 8.9 months for those with (20 cases) and 15.1 months for those without (22 cases) a plate for UCLP, suggesting that it was significantly shorter in cases with a palatal plate ( $p=0.0022$ ). VPC-T in BCLP and UCLP cases with a palatal plate was similar to that in CP cases (9.3 months) (Table 9).

A comparison of VPC-T between cases with and without a palatal plate showed no significant

difference between BCLP and UCLP patients with a plate (within 12 months postoperatively), but showed a wide range from 4 to 32 months in both BCLP and UCLP patients without a plate (Fig. 2).

5) Influence of maxillary fistula and palatal plate attachment on VPC-T

Thirty palatal plate-attached cases with a fistula were designated as Group A, 6 palatal plate-attached cases without a fistula as Group B,

Table 8 The periods of time required to achieve velopharyngeal competency with and without a fistula

	Fistula (-)	Fistula (+)	Total
BCLP (23)	12.3 m N=6	14.1 m N=17	13.7 m
	P=0.70		
UCLP (42)	6.7 m N=10	13.3 m N=32	11.8 m
	P=0.001		
CP (42)			9.3 m

Table 9 The periods of time required to achieve velopharyngeal competency with and without a palatal plate

	Plate (+)	Plate (-)	Total
BCLP (23)	10.3 m N=14	18.8 m N=9	13.7 m
	P=0.0089		
UCLP (42)	8.9 m N=22	15.1 m N=20	11.8 m
	P=0.0022		
CP (42)			9.3 m

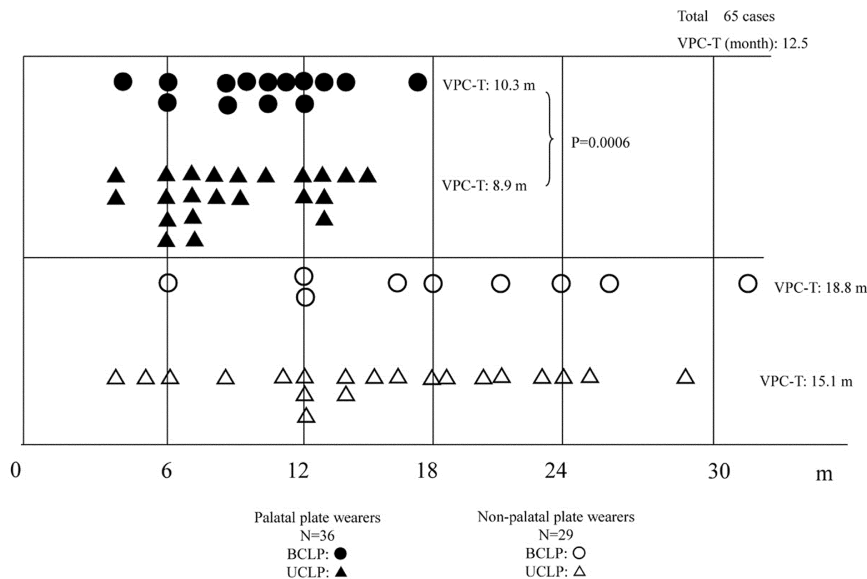


Fig. 2 The periods of time required to achieve velopharyngeal competency with and without a palatal plate



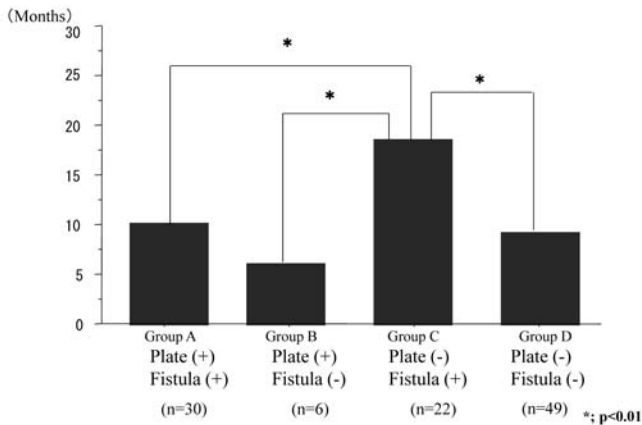


Fig. 3 Influence of maxillary fistula and palatal plate attachment on the period of time required for velopharyngeal competency (VPC-T)

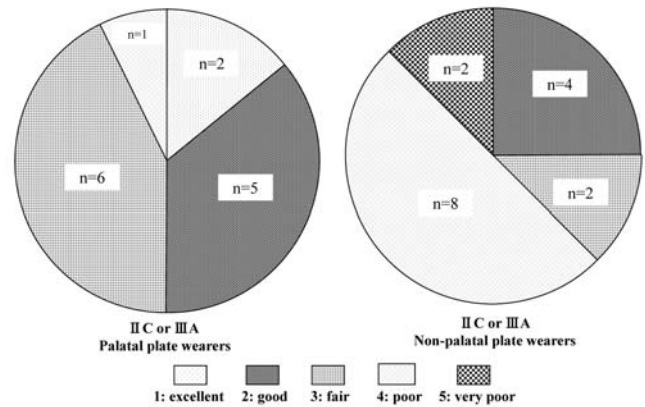


Fig. 4 Occlusal evaluation between cases with and without a palatal plate using Goslon Yardstick

Table 10 Multiple logistic regression analysis

	B	p-value	Odds (95%CI)
Cleft type	-0.016	0.9622	0.984 (0.516-1.880)
Fistula	-2.562	0.0002	0.077 (0.020-0.293)
Palatal Plate	3.043	<0.0001	20.978 (5.766 ~ 76.324)

B: regression coefficient CI: confidence interval

Table 11 Intra-and inter-examiner agreement determined using Spearman's rank correlation

Examiner	A	B	C	D
A	0.93			
B	0.93	0.89		
C	0.88	1.00	0.88	
D	0.96	0.95	0.95	0.95

Table 12 Occlusal evaluation between cases with and without a palatal plate (average Goslon score)

	Goslon score
Palatal plate wearers N=14	2.49
SD	± 0.08
Non-palatal plate wearers n=16	3.56
SD	± 0.11
-----	
Total N=30	3.06
SD	± 0.09

22 non-palatal plate-attached cases with a fistula as Group C, and 49 non-palatal plate-attached cases without a fistula as Group D. The mean VPC-T was 10.1, 6.2, 18.6, and 9.2 months in Groups A, B, C, and D, respectively, showing that the VPC-T was significantly prolonged in Group C compared to those Groups A, B, and D (Fig. 3). Palatal plate ( $p < 0.0001$ ) and fistula ( $p = 0.0002$ ) were selected for variables by logistic regression analysis, but cleft type was not. The odds ratio of palatal plate (20.978) showed a strong association with VPC-T (Table 10).

6) Occlusal evaluation between UCLP cases with and without a palatal plate

The Goslon Yardstick method was used to assess the occlusal condition. Spearman's rank correlation coefficient was 0.88-1.0, indicating a relatively strong correlation and satisfactory reliability between examiners (Table 11).

Among 14 cases with a palatal plate, 2 cases were excellent, 5 were good, and 6 were fair. The average Goslon score was 2.49. Among 16 cases without a palatal plate, there was no excellent case, 4 cases were good, 2 were fair, 8 were poor, and 2 were very poor. The average Goslon score was 3.56 (Table 12, Fig. 4).

**DISCUSSION**

Cleft lip and palate is associated with various esthetic and functional problems, including facial dysmorphism and speech difficulty. Consistent treatment from birth to adulthood is recommended,



and team-based medical care<sup>6)</sup> performed by a range of specialists is considered important. The final goals of CLP treatment are to achieve an esthetic lip and nose contour, normal speech, and the desired occlusal relationship. Primary palatoplasty plays a key role in achieving normal speech and a satisfactory occlusal relationship in later treatment. Ishikawa et al.<sup>7)</sup> reported that occlusal maintenance from birth markedly affects the future occlusal relationship and growth, and midfacial growth. Oyama et al.<sup>8)</sup> reported that achieving a favorable occlusal relationship is the key to maintaining normal speech after treatment. In our department, the Hotz palatal plate<sup>9)</sup> was used to promote maxillary development immediately after birth. In Kohama's method<sup>1)</sup>, modified palatoplasty using a mucosal flap was performed considering maxillary development, and a palatal plate was placed at a relatively early stage in a fistula area<sup>10)</sup> of the anterior palate exposed by the push-back method to increase the intraoral pressure. The results<sup>8,11)</sup> showed a favorable postoperative occlusal relationship, and, therefore, we have been introducing the palatal plate as a retainer for postoperative collapse.

The present study investigated the effect of the palatal plate on VPC-T in BCLP, UCLP, and CP and the occlusal condition in UCLP.

For the fabrication of a palatal plate, we use non-clasps, and a plate is placed at an early stage postoperatively to avoid the disturbance maxillary growth. The palatal plate is replaced every 3-6

months. The problems arising from using a palatal plate include the fact that children often do not comply with impression-taking, and there is a risk of aspiration of the palatal plate due to its small size in order to fit in children's mouths. In our department, we introduce a Hotz palatal plate<sup>9)</sup> during consistent treatment. As a result, children wear a palatal plate with little resistance. Regarding aspiration problems, a metal wire is embedded into a resin palatal plate to enhance its radiopacity so that it can be detected by X-ray in the case of aspiration<sup>11)</sup>. Fortunately, we have not experienced such a case so far (Fig. 5).

#### 1) Velopharyngeal function and cleft type

We evaluated the velopharyngeal function based on previous reports in our department<sup>3,12)</sup>. Although various factors are involved including the cleft type, cleft shape, operative method, and postoperative speech training in the results of velopharyngeal function, push-back palatoplasty has generated consistent results<sup>13,14)</sup>. Push-back palatoplasty in our department showed results as satisfactory as those reported by Maekawa et al.<sup>3)</sup>.

#### 2) Relationship between the cleft type and VPC-T

The prolonged impairment of velopharyngeal function causes articulation disorders including glottal explosives<sup>3)</sup>, pharyngeal fricatives, and faucal plosives, resulting in the prolongation of speech therapy. Therefore, we have noted VPC-T. It has been reported that the preoperative cleft

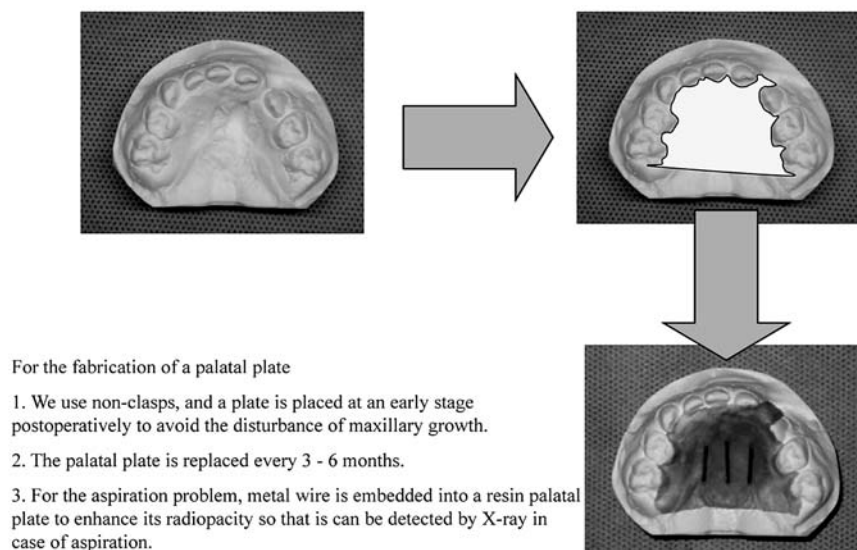


Fig. 5 A concept for fabrication of the palatal plate

morphology has a marked influence on the velopharyngeal function, and that accurate preoperative assessment will lead to achieving satisfactory velopharyngeal function at an early stage postoperatively and successful results in speech therapy<sup>15</sup>). Diah et al. found that patients who underwent a successful fistula-closing operation showed improved velopharyngeal function<sup>16</sup>). The results of the present study demonstrated that VPC-T was delayed in BCLP and UCLP patients compared to those without an alveolar cleft, suggesting the marked impact of the fistula on VPC-T. The period of time required to achieve such competency according to the cleft type showed the longest period in BCLP with a bilateral alveolar cleft. Considering that VPC-T is short in CP without a fistula, it is speculated that fistula presence prolongs this period, and, therefore, fistula closure is important to achieve velopharyngeal function at an early stage.

### 3) VPC-T with and without a fistula

Since the influence of fistula presence on VPC-T was suggested, that of each cleft type was evaluated according to the presence of a fistula. We performed a push-back method for primary palatoplasty. In this method, palatal tissue is used to extend the soft palate. As a result, the more the tissue is pulled posteriorly, the more likely it is to cause developmental deficiency of the maxilla. The incidence of a fistula (residual fistula) near the alveolar cleft is relatively high unless closure of the maxillary cleft is performed<sup>17</sup>). Okubo reported that jaw growth in CLP children is impaired compared to that in normal children due to the anatomical deficiency and limited potential for growth along with surgical stress, and the problem is inevitable even when surgery is performed successfully<sup>18</sup>). Our department agrees with this concept, and, hence, we do not close a maxillary cleft during cheiloplasty and palatoplasty<sup>17,18</sup>) considering anteroposterior and vertical jaw development disorder and closure of the maxillary cleft<sup>19</sup>), performing it at a later stage of treatment. As a result, the incidence of a fistula (residual fistula) near the alveolar cleft has been high. The results of the present study revealed the involvement of fistula presence in velopharyngeal function, and the need for fistula treatment was suggested.

### 4) VPC-T with and without a palatal plate

Since the relationship between a fistula and VPC-T was elucidated, a palatal plate has been used for fistula presence since 1998. Patients using a palatal plate achieved a velopharyngeal function similar to that of CP patients. This was considered to be because a palatal plate used immediately after palate formation plugs the cleft near the alveolar cleft and creates negative intraoral pressure, leading to the early activation of the levator and tensor veli palatini muscles. These factors created an ideal condition to achieve a satisfactory velopharyngeal function. This assumption was confirmed by our results, in which the palatal plate user group achieved VPC early, whereas the non-user group showed a wide range from 4 to 32 months. Arakaki et al. described the importance of the early acquisition of velopharyngeal function given that it affects the length of articulation therapy and the achievement of normal speech before school age<sup>20</sup>). The results suggested that a palatal plate plays an important role in the success of speech therapy as part of consistent CLP treatment.

### 5) Influence of maxillary fistula and palatal plate attachment on VPC-T

The above findings suggested that when a fistula is present, palatal plate attachment from an early stage may be a measure to acquire velopharyngeal function as early as possible.

### 6) Occlusal evaluation between cases with and without a palatal plate

The advantages of using a palatal plate include the noninvasive closure of a fistula and alleviating the collapse caused by postoperative scarring by serving as a retainer for speech and the dental arch, leading to a favorable occlusal condition<sup>7,11</sup>). In recent years, the Goslon Yardstick method<sup>4</sup>) using the model of UCLP patients has been frequently employed. This method was originally developed in Northern Europe to establish a therapeutic system for CLP patients. The craniofacial morphology, lateral view of the soft tissue, and facial contour of the nose and lip region were assessed using lateral cephalograms from 6 centers<sup>21,22</sup>), and the Goslon Yardstick method was applied to divide CLP patients according to the severity of malocclusion<sup>23</sup>). This method

focuses on the relationship between the upper and lower dental arches. The severity of malocclusion was assessed with scores visually and clinically by examining the standard model without using measurement equipment in view of various clinical factors. The difficulty in orthodontic treatment can be straightforwardly evaluated using this method, and many centers in European countries<sup>24)</sup> have introduced this method as an indicator of the occlusal relationship. The average Goslon score in our department employing the mixed dentition model was 3.06. This result was favorable compared to the previous data reported by Okazaki et al.<sup>25)</sup> (3.41), Susami et al.<sup>26)</sup> (3.64), and the push-back group reported by Hirano<sup>27)</sup> (3.85). In the comparison of cases with and without a palatal plate, the average Goslon score was 2.49 in the user group and 3.56 in the non-user group, suggesting more favorable results in the former. These results were better than those from 6 European centers<sup>23)</sup>. Susami et al.<sup>26)</sup> pointed out that there are ethnic differences between Japanese and Westerners including the skeletal morphology. In view of this point, the results were much more satisfactory in the palatal plate user group. It is considered that a Hotz plate placed immediately after birth facilitated occlusal guidance, and a satisfactory occlusal condition was achieved. This occlusal condition was maintained until the mixed dentition stage using a palatal plate at an early stage. Ishikawa et al.<sup>28)</sup> reported that deciduous teeth cases with a good occlusal condition showed favorable results in the mixed dentition stage if occlusal management was performed during consistent treatment.

Appropriate occlusal management contributes to favorable midfacial development. In general, consistent treatment from palatal formation to school age focuses on speech therapy. In addition to such speech therapy, we conduct occlusal management and guidance simultaneously to avoid unnecessary surgery for the abnormal dentition and alveolar morphology, and maxillary hypogrowth. It was suggested that occlusal guidance at an early stage (immediately after birth) facilitates favorable results not only regarding the occlusal condition but also in the development of the midface and speech, suggesting marked long-term esthetic involvement. Therefore, active occlusal management and guidance from infancy is

considered to be key to the success of consistent treatment.

## CONCLUSION

A palatal plate not only facilitates the VPC-T, but promotes harmonized upper and lower occlusion and maxillofacial growth. This suggests the important role of the palatal plate in the esthetic improvement and acquisition of normal occlusion, which is one of the ultimate goals of consistent treatment.

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