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Analysis of alveolar molding effects in infants with bilateral cleft lip and palate when treated with pre-surgical naso-alveolar molding appliance

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The goals of this study were 1) to present pre-surgical naso-alveolar molding (PNAM) appliance for bilateral cleft lip and palate treatment and 2) to evaluate the effects of the PNAM appliance on the alveolar molding of the premaxilla and the lateral segments.

Subjects consisted of 8 bilateral cleft lip and palate infants (7 males and 1 female, mean age at first visit = 61.6 days after birth) who were treated with PNAM appliances in Department of Orthodontics, Seoul National University Dental Hospital.

Average alveolar cleft gap between the premaxilla and the lateral segment was 8.09 ±5.03 mm and average duration of alveolar molding treatment was 8.8 ± 3.1 weeks.

These patients' models were obtained at initial visit (T0) and after alveolar molding (T1). 20 linear and 14 angular variables were measured by using photometry and digital caliper. All statistical analyses were performed by Microsoft Excel 97 program. Paired t-test was used to discriminate the effect of alveolar molding by PNAM appliance.

1. Closure of the alveolar cleft gap in bilateral cleft cases by molding therapy was completed successfully.
2. Alveolar molding inhibited outward growth of lateral segments and produced inward bending of lateral segments.
3. By bending the anterior part of the vomer, the premaxilla could be rotated and moved posteriorly via alveolar molding.

Conclusion : This appliance can be applied to bilateral cleft lip and palate infants with satisfactory results before cheiloplasty.

Key Words : Bilateral cleft lip and palate, Pre-surgical naso-alveolar molding appliance(PNAM)

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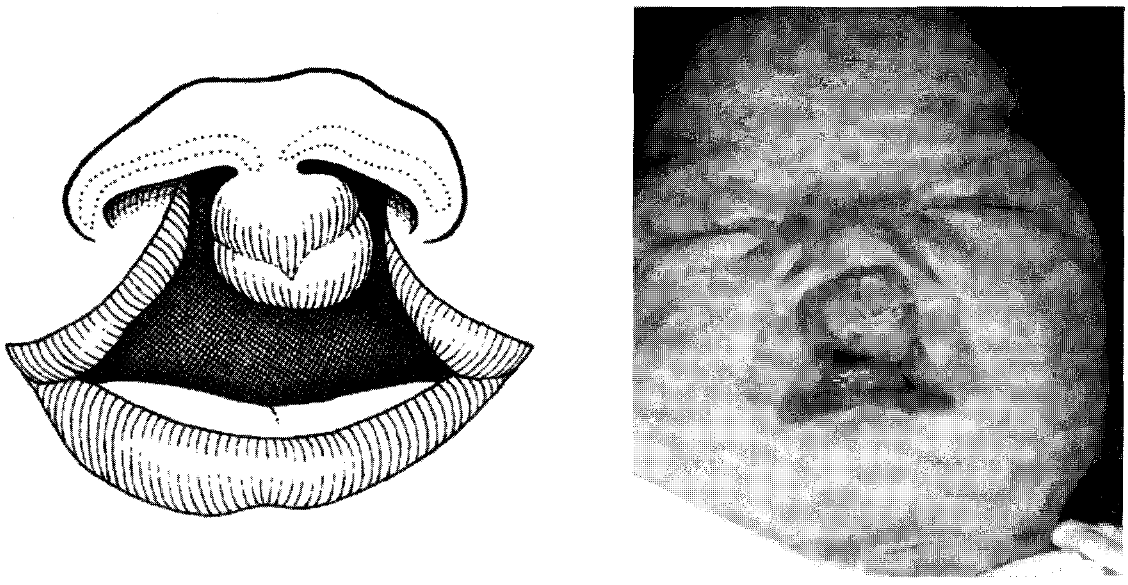
The protruding pre-maxilla and deficient columella have been the main obstacles to achieving a satisfactory result in the bilateral cleft.[2,4,6,7,10,14,16-18)]

In the bilateral cleft the alar cartilages have failed to extend up into the nasal tip and stretch the columella. The prolabium lacks muscle tissue and is attached to the end of the short columella. The alar cartilages are positioned along the alar margins and



A B

Fig. 1. The bilateral cleft lip, and palate and nose.
A: In the bilateral cleft the alar cartilages have failed to extend up into the nasal tip and stretch the columella. The cartilages are positioned along the alar margins and are stretched over the cleft as flaring alae.
B: Initial facial photo. Note the severely deficient columella, alar rim deformity, and everted pre-maxilla.

are stretched over the cleft as flaring alae. In the complete bilateral cleft, the pre-maxilla is suspended from the tip of the nasal septum and the lateral alveolar segments remain behind (Fig. 1).

A variety of approaches have been utilized in repositioning the everted pre-maxilla. In the nineteenth century, an elastic bonnet was used to retract the pre-maxilla. There were surgical setbacks in the pre-maxilla at the time of the first operation. And lip adhesion[15] was introduced. Several kinds of pre-surgical infant orthopedic (PSIO) appliances were used.[3,8-10,12,16] Presently, we use pre-surgical naso-alveolar molding (PNAM) appliances to retract the protruding pre-maxilla. This appliance was introduced by Grayson and Cutting of NYU Medical Center.[3,9]

For the creation of columella, traditional surgical approaches usually split the excessive width of the prolabial skin vertically to elongate the columella in a planned second surgical procedure (skin paradigm). Grayson and Cutting introduced the "cartilage paradigm" protocol rather than the "skin paradigm". This process resolves the columella problem in bilateral cleft deformity via cartilage molding and columella stretching rather than surgery.[3,8] The goal of this less invasive procedure is to minimize the extent of scar tissue formation. Their expectation is that the nasolabial complex will grow more normally when free of the scar tissue that results from the conventional surgical lengthening of the columella thereby enhancing nasal and facial aesthetics.

The effects of the PNAM appliance on alveolar molding in unilateral cleft lip and palate were expressed in Baek, Yang, and Kim's *"Presurgical naso-alveolar molding appliance in unilateral cleft lip and palate"* in the Korea. J. Orthod. in vol 28(6) in 1998.[1] Familiarity with this article is helpful in understanding the PNAM appliance and treatment concept.

This article will present the pre-surgical naso-alveolar molding (PNAM) appliance for bilateral cleft lip and palate treatment.

A

B

Fig. 2. PNAM appliance in patients with bilateral cleft lip and palate.
A: After alveolar molding .
B: Two nasal stents in place. The appliance is maintained against the palate by an elastic band and tape applied to the prolabium and the cheek.

The goals of PNAM appliance therapy in the patient with bilateral cleft lip and palate are (1) to align the alveolar segments and achieve closure of the alveolar gap, (2) to mold and reposition actively the nasal cartilages toward the tip, and (3) to lengthen the deficient columella.

The pre-surgical naso-alveolar molding (PNAM) appliance for bilateral cleft lip and palate is composed of the alveolar molding plate and two nasal stents (Fig. 2).

The alveolar molding plate is made of a hard clear acrylic orthodontic resin which covers the pre-maxilla, the lateral segments, and the cleft palate. It does not extend into the nasal cavity and soft palate area. At weekly intervals, the authors commenced with a gradual addition of soft pink acrylic resin and selective removal of hard acrylic resin. The everted pre-maxilla and lateral segments were gently molded to grow into the desired shape and position in conjunction with elastic bands affixed to the cheeks or attached to a head cap (Fig. 2-A).

As the pre-maxilla and lateral segments gradually approximate one another, the nasal stents which resemble a swans neck are built from the labial vestibular flange of the acrylic alveolar molding plate and enter the nasal apertures (Fig. 2-B). The nasal stents are gradually modified through gradual addition of soft pink acrylic resin. These keep the alar cartilages closed and advance the lateral alar cartilages into the nasal tip while molding them to the normal configuration in the immediate neonatal period when the cartilages are still pliant enough for permanent correction of the deformity.[11)]

A horizontal prolabial band or tape depresses the base of the columella at the nasolabial fold, providing additional pressure on the columella tissue while the nasal stents stretch the columellar skin.

If the clinician believes the patient needs more columellar and prolabial tissue lengthening, a surgical tape may be applied to the prolabium, pulled down, and adhered to the inferior surface of the molding plate. This downward pull of the tape, combined with the pressure applied at the columellar base and the upward force from the nasal stents, results in stretching the columella and prolabial tissue.

Care must be taken not to over-retract maxillary segments or an iatrogenic anterior cross-bite will be introduced. If there is significant trauma at the premaxillary-vomerine suture, the downward and forward growth of the premaxilla will be severely hindered.

After nasal and alveolar molding, the nasal cartilages, columella, philtrum, and alveolar processes were aligned to permit surgical restoration of normal

A B

Fig. 3. Pre-op. and post-op. photo
A: Pre-op. photo. Elongation of the columella and repositioning of the pre-maxilla and lateral segments, lip, and nose were achieved during pre-surgical treatment.
B: Post-op. photo. Good lip and nose repair. Pre-surgical naso-alveolar molding appliance helps optimal surgical restoration of anatomy.

anatomic relationships (Fig. 3-A). The primary lip-nose correction is performed (Fig. 3-B).

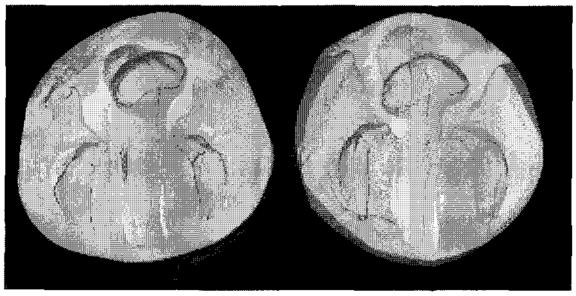
There is little written about pre-surgical infant orthopedics of cleft lip and palate in Korea because of measuring limitations and difficulties in gathering infant cleft cases. This article evaluated the effects of PNAM appliance on the alveolar molding of the premaxilla and the lateral segments.

MATERIALS AND METHODS

1. Materials

The subjects were 8 bilateral cleft lip and palate infants (7 males and 1 female) who were treated with PNAM appliances in the Department of Orthodontics, Seoul National University Dental Hospital.

Ages at their initial visit ranged from 11 days to 168 days after birth (mean age : 61.6 days after birth). Average alveolar cleft gap between the premaxilla and lateral segments was 8.09±5.03 mm. Average duration of alveolar molding treatment was 8.8±3.1 weeks. These patients' models were obtained at their initial visit (T0) and after successful alveolar molding (T1) (Fig. 4).



To T1

Fig. 4. Patients' models obtained at initial visit (T0) and after alveolar molding (T1)

2. Methods

The reference points and lines are summarized in Table 1-2 and Fig. 5-6. 20 linear and 14 angular variables were described in Table 3-4 and Fig. 7-8. The data was derived by photometry and measured by digital caliper (Mytutoyo, Tyoko, Japan).

The authors performed a preliminary statistic study on the effects of PNAM in alveolar molding of bilateral cleft lip and palate patients. All statistical analyses were performed by Microsoft Excel 97 program. Paired t-test was used to describe the alveolar molding effects of PNAM appliance in BCLP between pre- and post-treatment (Table 5-8).

Table 1. Reference points

1. PR	: Postgingivale in the right segment. The most posterior point of the alveolar crest in the right segment.
2. PL	: Postgingivale in the left segment. The most posterior point of the alveolar crest in the left segment.
3. BR	: Buccal frenum point of the alveolar crest in the right segment
4. BL	: Buccal frenum point of the alveolar crest in the left segment
5. ACR	: The most anterior point of the alveolar crest in the right segment.
6. ACL	: The most anterior point of the alveolar crest in the left segment.
7. MR	: The point farthest right of the alveolar crest in the pre-maxilla.
8. ML	: The point farthest left of the alveolar crest in the pre-maxilla.
9. MA	: The most anterior point of the alveolar area in the pre-maxilla.
10. MP	: The most posterior point of the alveolar area in the pre-maxilla.
11. MM	: The middle point of the alveolar crest in the pre-maxilla.
12. VS	: Bending point, The premaxillary-vomerine suture.
13. VP	: The most posterior point of the vomer.

Table 2. Reference lines

1. PR - PL	: Horizontal reference line
2. PR - BR	: Describes configuration of the posterior part of the right segment.
3. BR - ACR	: Describes configuration of the anterior part of the right segment.
4. PR - ACR	: Describes configuration of the whole part of the right segment.
5. PL - BL	: Describes configuration of the posterior part of the left segment.
6. BL - ACL	: Describes configuration of the anterior part of the left segment.
7. PL - ACL	: Describes configuration of the whole part of the left segment.
8. MR - ML	: Describes horizontal configuration of the pre-maxilla .
9. MA - MP	: Describes anteroposterior configuration of the pre-maxilla .
10. MP - VS	: Describes bending configuration of the pre-maxilla to the vomer.
11. VS - VP	: Describes configuration of the vomer .
12. VP Sagittal line	: The perpendicular line to the PR-PL line. Crossed the VP.

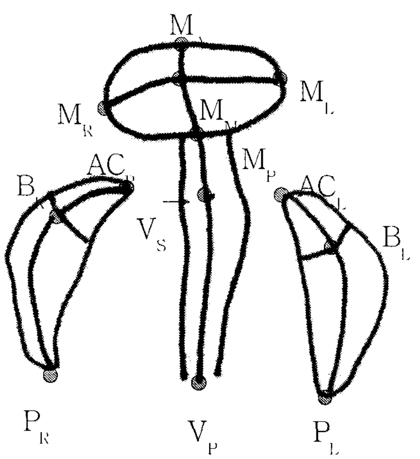


Fig. 5. Reference points

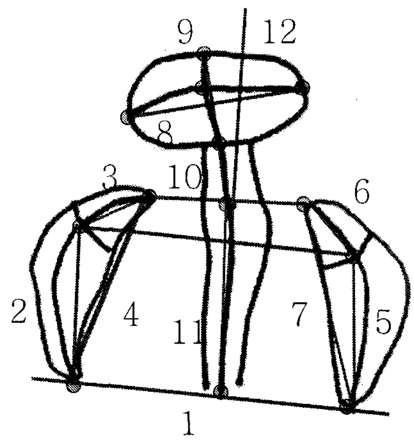


Fig. 6. Reference lines

Table 3. Linear measurement variables

1. PR - PL	: The distance between PR in the right segment and PL in the left segment
2. BR - BL	: The distance between BR in the right segment and BL in the left segment
3. ACR - ACL	: The distance between ACR in the right segment and ACL in the left segment
4. MR - ML	: The horizontal dimension of the pre-maxilla.
5. MA - MP	: The anteroposterior dimension in the anterior part of the pre-maxilla.
6. MP - VS	: The anteroposterior dimension in the posterior part of the pre-maxilla.
7. VS - VP	: The anteroposterior dimension of the vomer.
8. MM - VS	: The anteroposterior dimension of the pre-maxilla and the vomer.
9. PR - BR	: The length of the posterior part of the right segment
10. BR - ACR	: The length of the anterior part of the right segment
11. PL - BL	: The length of the posterior part of the left segment
12. BL - ACL	: The length of the anterior part of the left segment
13. ACR - PRPL	: Longitudinal length of the right segment from PR-PL.
14. ACL - PRPL	: Longitudinal length of the left segment from PR-PL.
15. trans. ACR - MR	: The transverse distance between AC in the right segment and MR of the pre-maxilla.
16. A-P. ACR - MR	: The anteroposterior distance between AC in the right segment and MR of the pre-maxilla.
17. dis. ACR - MR	: The shortest distance between AC in the right segment and MR of the pre-maxilla.
18. trans. ACL - ML	: The transverse distance between AC in the left segment and ML of the pre-maxilla.
19. A-P. ACL - ML	: The anteroposterior distance between AC in the left segment and ML of the pre-maxilla.
20. dis. ACL - ML	: The shortest distance between AC in the left segment and ML of the pre-maxilla.

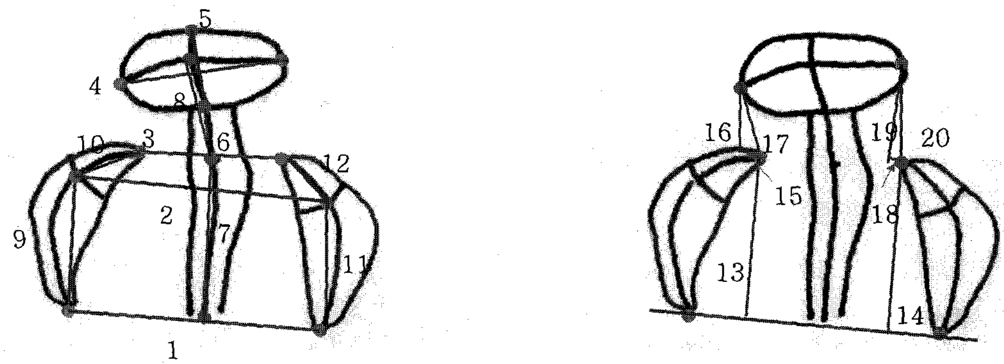


Fig. 7. Linear measurement variables

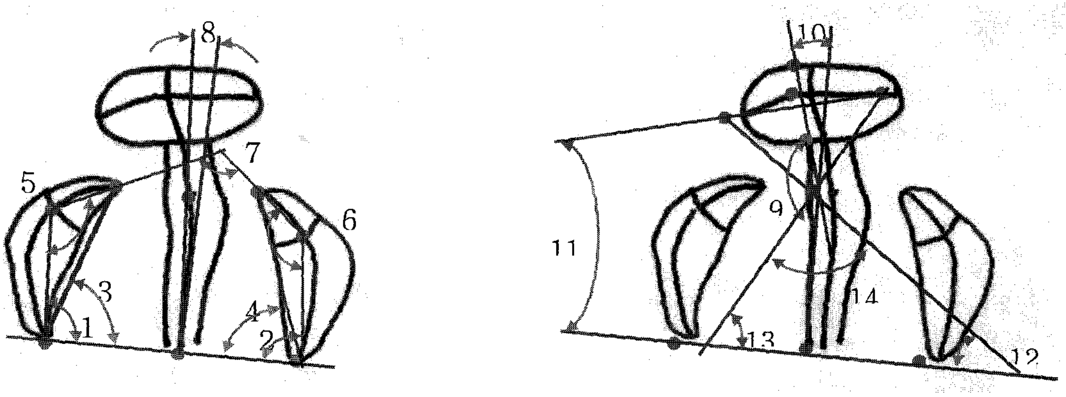


Fig. 8. Angular measurement variables

Table 4. Angular measurement variables

1. (BR-PR)-(PR-PL)	: The angle between BR-PR and PR-PL in the right segment Configuration in the posterior part of the right segment
2. (BL-PL)-(PR-PL)	: The angle between BL-PL and PR-PL in the left segment Configuration in the posterior part of the left segment
3. (ACR-PR)-(PR-PL)	: The angle between ACR-PR and PR-PL in the right segment Configuration of the whole part of the right segment
4. (ACL-PL)-(PR-PL)	: The angle between ACL-PL and PR-PL in the left segment Configuration of the whole part of the left segment
5. ACR-BR-PR	: The angle between ACR, BR, and PR in the right segment Configuration in the anterior part of the right segment
6. ACL-BL-PL	: The angle between ACL, BL, and PL in the left segment Configuration in the anterior part of the left segment
7. (BR-ACR)-(BL-ACL)	: The angle between BR -ACR in the right segment and BL -ACL in the left segment Relationship of the right and the left segments
8. (VS-VP) - VP Sagittal line	: The angle between VS-VP and VP Sagittal line The side of bending of the vomer
9. (VS-VP) - (VS-MM)	: The angle between VS-VP and VS-MM The side of bending of the pre-maxilla to the vomer
10. (MA - MP) - VP Sagittal line	: Sagittal line : The angle between MA - MP and VP Sagittal line It means side of bending of the pre-maxilla to the sagittal line
11. (MR - ML)-(PR - PL)i	: The angle between MR - ML and PR - PL The side of bending of the pre-maxilla to the vomer. Positive means left bending and negative means right bending
12. (MR - VS)-(PR - PL)	: The angle between MR - VS and PR - PL Amount of bending of the pre-maxilla to the vomer
13. (ML - VS)-(PR - PL)	: The angle between ML - VS and PR - PL Amount of bending of the pre-maxilla to the vomer
14. (MR - VS)-(PR - PL)-(ML - VS)-(PR - PL)	: difference between the angle between MR - VS and PR - PL and the angle between ML - VS and PR - PL . Positive means left bending and negative means right bending

RESULTS

The authors performed t-tests to demonstrate that differences of the bilateral linear and angular variables' values between right and left segment existed (Table 5, 7). There were no statistically significant differences in bilateral linear valuables (AC-PRPL, PRL-BRL, BRL-ACRL, trans. ACRL-MRL, A-P. ACRL-MRL, dis. ACRL-MRL) (Table 5) and in bilateral angular valuables (BP-PRPL, ACP-PRPL, AC-B-P) (Table 7). Thus, the values of bilateral linear and angular variables were summated.

Comparisons between pretreatment and post-treatment in linear and angular variables' values were listed in Table 6 and Table 8.

In linear measurements there was a statistically significant increase in PR-PL from T0 to T1. But there were no statistically significant differences in BR-BL and ACR-ACL between T0 and T1 (Table 6). Pre-maxilla width and length, pre-maxilla and vomer length, and length of anterior, posterior, and the whole part of the lateral segment did not show statistically significant differences between T0 and T1 (Table 6). The amounts of alveolar cleft gap were significantly reduced in the anteroposterior distance, the transverse distance, and the shortest distance

Table 5. Comparison of right and left segment in linear measurements

Linear Variables	Right segment (mean±sd)	Left segment (mean±sd)	Significance
(T0) AC - PRPL	21.68±2.44	22.75±2.57	N.S.
(T1) AC - PRPL	22.94±2.48	21.85±3.33	N.S.
(T0) PRL - BRL	17.12±2.32	17.13±2.17	N.S.
(T1) PRL - BRL	17.85±3.18	16.99±3.30	N.S.
(T0) BRL - ACRL	6.98±1.24	7.62±1.35	N.S.
(T1) BRL - ACRL	8.16±0.99	7.69±1.59	N.S.
(T0) trans. ACRL - MRL	2.81±2.61	2.58±3.20	N.S.
(T1) trans. ACRL - MRL	0.24±1.99	1.75±3.03	N.S.
(T0) A-P. ACRL - MRL	8.22±3.85	10.70±6.22	N.S.
(T1) A-P. ACRL - MRL	3.12±2.36	6.45±4.61	N.S.
(T0) dis. ACRL - MR	9.28±3.86	11.92±5.50	N.S.
(T1) dis. ACRL - MR	3.69±2.21	7.48±4.58	N.S.

N.S. : not significant
* : $p < 0.05$
** : $p < 0.01$
*** : $p < 0.001$

Table 6. Comparison of pretreatment and post-treatment in linear measurements

Linear Variables	Pretreatment(T0) (mean±sd)	Post-treatment(T1) (mean±sd)	Significance
Change of Inter-lateral segment width			
PR - PL	34.92±2.59	37.30±1.92	*
BR - BL	32.60±2.17	32.14±2.31	N.S.
ACR - ACL	22.33±2.49	20.55±3.63	N.S.
Dimensional change of Pre-maxilla and vomer			
MR - ML	17.44±2.72	18.54±2.69	N.S.
MA - MP	8.76±3.18	8.96±1.92	N.S.
MP - VS	9.26±4.49	6.45±2.88	N.S.
VS - VP	19.41±2.02	17.89±3.52	N.S.
MM - VS	15.53±3.27	12.81±3.52	N.S.
Dimensional change of lateral segment			
ACRL - PRPL	22.21±2.49	22.39±2.89	N.S.
PRL - BRL	17.13±2.17	17.42±3.16	N.S.
BRL - ACRL	7.30±1.30	7.93±1.30	N.S.
Closure of Alveolar Cleft gap			
Trans. ACRL - MRL	2.70±2.82	1.00±2.59	*
A-P. ACRL - MRL	9.46±5.16	4.78±3.93	***
Dis. ACRL - MRL	10.60±4.79	5.59±3.98	***

N.S. : not significant
* : $p < 0.05$
** : $p < 0.01$
*** : $p < 0.001$

Table 7. Comparison of right and left segment in angular measurements

Angular Variables	Right segment (mean±sd)	Left segment (mean±sd)	Significance
(T0) BP - PRPL	84.06±4.18	88.19±4.91	N.S.
(T1) BP - PRPL	81.13±6.03	79.63±7.19	N.S.
(T0) ACP PRPL	72.63±4.76	76.13±4.55	N.S.
(T1) ACP PRPL	67.25±5.14	69.50±4.33	N.S.
(T0) AC - B - P	139.31±13.80	140.88±12.76	N.S.
(T1) AC - B P	139.25±11.59	143.63±13.17	N.S.

N.S. : not significant
* : $p < 0.05$
** : $p < 0.01$
*** : $p < 0.001$

Table 8. Comparison of pretreatment and post-treatment in angular measurements

Angular Variables	Pretreatment(T1) (mean±sd)	Post-treatment(T2) (mean±sd)	Significance
Change of lateral segment			
(B-P)-(PR-PL)	86.13±4.89	80.38±6.46	*
(AC-P)-(PR-PL)	74.38±0.16	68.38±4.73	**
AC-B-P	140.09±12.86	141.44±12.19	N.S.
(BR-ACR)-(BL-ACL)	91.56±20.88	98.25±16.43	N.S.
Change of Vomer			
(VS-VP) - VP Sagittal line	4.81±3.20	5.13±3.53	N.S.
(VS-VP) - (VS-MM)	168.19±4.67	157.81±6.63	**
Change of Pre-maxilla			
(MA-MP) - VP Sagittal line	11.56±7.95	9.94±5.94	N.S.
(MR-ML)-(PR-PL)	14.31±4.03	9.00±6.30	N.S.
(MR-VS)-(PR-PL)	49.56±9.62	39.25±11.86	*
(ML-VS)-(PR-PL)	61.5±12.77	57.81±6.93	N.S.
(MR-VS)-(PR-PL)-(ML-VS)-(PR-PL)	74.56±14.42	82.88±9.35	N.S.

N.S. : not significant
* : $p < 0.05$
** : $p < 0.01$
*** : $p < 0.001$

between the most anterior point of the alveolar crest in the lateral segment and the most lateral point of the alveolar crest in the premaxilla (AC-MRL) after treatment.(Table 6).

In angular measurements there was a statistically significant decrease in the values of the anterior and the whole part of the lateral segment to PR-PL from T0 to T1. But there were no statistically significant differences in morphology of the lateral segment between T0 and T1 (Table 8). There were no statistically significant differences in the posterior part of vomer bending (VSVP-VP sagittal line). But, the bending of the premaxilla and anterior part to the vomer showed a statistically significant difference between T0 and T1 (Table 8).

DISCUSSION

This study may be regarded as reliably consistent since both authors used the same procedure. It is based on linear and angular measurements derived from BCLP patients' models at pre- and post-PNAM appliance treatment.

Closure of Alveolar Cleft gap

Alveolar cleft gap were significantly reduced in the anteroposterior distance (A-P. ACRL - MRL) ($P<0.001$), the transverse distance (trans. ACRL - MRL) ($P<0.05$), and the shortest distance (dis. ACRL - MRL) ($P<0.001$) between the most anterior point of the alveolar crest in the lateral segment and the most lateral point of the alveolar crest in the premaxilla (AC-MRL) after alveolar molding treatment (Table 6). Closure of cleft gap by molding was successfully completed.

The normal palatal arch form is determined by the result of the compressive forces of the orbicularis oris-buccinator-superior constrictor pharyngeous muscle ring which are counteracted by the protrusive and expansive forces of the tongue. Because of lateral pulls of the cleft lip musculatures, lateral segments are distorted to the lateral side in BCLP. So closure of transverse cleft gap was more difficult than closure of anteroposterior and the shortest distance of alveolar cleft gap (Table 6).

Dimensional change of lateral segments

The length of the anterior part (BRL-ACRL) and the posterior part (PRL-BRL) of lateral segment did not advance significantly during the treatment period (Table 7). Forward growth of the whole lateral segment (ACRL-PRPL) also was not significant (Table 6).

Change of Inter-lateral segment width

Results showed no statistically significant changes in BR-BL and ACR-ACL between T0 and T1(Table 6). There was a statistically significant increase in PR-PL due to growth from T0 to T1. So, closure of alveolar cleft gap was encouraged by alveolar molding which inhibited outward growth of the lateral segment.

Dimensional change of premaxilla and vomer

Premaxillary width and length (MR - ML, MA - MP), and length of posterior part of vomer (VS - VP) did not show statistically significant differences between T0 and T1(Table 6). Although length of pre-maxilla and anterior part of vomer (MM - VS) did not show statistically significant change between T0 and T1, our observations indicate that the premaxilla shifted posteriorly by 2.72 mm. This might be caused partially by setback of pre-maxilla to VS. Mishima et al[13] reported 2.93 mm. Robertson, Shaw, and Volp[17] have reported 4.16 mm. Reisberg et al[16] reported a range from 1.0 to 3.5 mm.

Change of lateral segment

Inward bending of the anterior and the posterior parts of the lateral segments ((AC-P)-(PR-PL), (B-P)-(PR-PL)) by molding attributed to closure of alveolar cleft gap. These connected with reduction of BR-BL and ACR-ACL and increase of PR-PL. But the morphology of the whole part of the lateral segment (AC-B-P) was unchanged during treatment (Table 8). Since the length of the anterior part of the lateral segment was as short as 7 mm, the molding effect of this portion could not be achieved as much as the unilateral case.

Change of Pre-maxilla

The premaxillary-vomerine suture has been considered the center of midfacial growth.[5] Therefore, configuration of the pre-maxilla and the vomer is an important consideration in the evaluation of infants with BCLP.

Change of right side premaxilla - anterior part of vomer angulation to the most posterior reference line

(MR-VS)-(PR-PL) showed that the premaxilla could be rotated to the left side at VS as a rotating point by alveolar molding. Although premaxillary angulation to the most posterior reference line (MR-ML)-(PR-PL) did not show statistically significant change between T0 and T1 : this variable value showed a decreasing tendency from 14.31 to 9.00 degree. So alveolar molding can bend the pre-maxilla and the anterior part of VS (Table 8).

Change of Vomer

In consideration of no significant change in VSVP - VP sagittal line, the posterior part of the vomer was a stable structure without bending. But the change of (VS-VP) - (VS-MM) showed a bending of the premaxilla and the anterior part of vomer during alveolar molding with a setback of premaxilla (Table 8).

The advantages of PNAM therapy in bilateral cleft lip and palate are as follows : 1) it guides the protruding pre-maxilla and lateral alveolar segments into normal position before surgery and allows the surgeon to create a tension-free lip closure with minimal freeing of soft tissue from the surface of the maxilla and optimal conditions for the least scar formation[9] : 2) it can improve nasal tip projection and lengthen the columella without secondary surgery,[9] and 3) it enables gingivoperiosteoplasty at the time of primary lip repair and eliminates the need for a secondary alveolar bone graft.[19]

CONCLUSIONS

In consideration of the linear and angular measurement between pre- and post-alveolar molding therapy, the effects of PNAM appliance on alveolar molding in bilateral cleft lip and palate can be summarized as follows :

1. Closure of the alveolar cleft gap in bilateral cleft cases by molding therapy was carried out successfully.
2. Alveolar molding inhibited outward growth of lateral segments and produced inward bending of lateral segments.
3. With bending the anterior part of the vomer, the premaxilla could be rotated and moved to the posterior by alveolar molding.
4. The major changes during alveolar molding were usually an inward bending of lateral segments, bending the anterior part of the vomer, and setback and rotation of the pre-maxilla.

Therefore this appliance can be applied to many cleft infants with satisfactory results before cheiloplasty. Unfortunately, the number of subjects available for this study was so small that further study will be needed.

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국문초록

양측성 순구개열 신생아 환자의 수술전 비치조 정형장치 치료에 의한 치조골 조형(molding) 효과의 분석

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본 연구의 목적은 1) 양측성 순구개열 신생아에 대한 수술전 비치조정형 장치 (Pre-surgical nasoalveolar molding appliance, PNAM) 치료를 소개하고, 2) 이 장치의 치조골 조형 (molding) 효과를 평가하는 것이다.

서울대학교병원 교정과에 내원하여 PNAM 장치를 사용하여 치료받은 8명의 양측성 순구개열 환자 (남자 7명, 여자 1명, 평균 초진 연령 : 61.6 일)를 연구대상으로 하였으며, 치조골에서 전상악골의 치조능 좌우측 말단부와 양측 분절 치조능 최전방점까지의 파열부간 평균거리는 8.09±5.03 mm 였고 치조골 정형치료의 평균 기간은 8.8±3.1주였다.

초진시 (T0)와 성공적인 치조골 정형술이 완료된 시기(T1)에 인상을 채득하여 모형을 제작한 후, 사진 촬영과 digital caliper를 사용하여 20개의 길이항목과 14개의 각도항목을 계측하였다. Microsoft사의 Excel 97 program을 사

용하여 각 항목의 계측치들을 통계 처리하였고, 치조골 정형술에 의한 치료전후의 차이를 비교하기 위하여 paired t-test를 사용하였다.

PNAM 장치에 의한 치조골 조형 효과에 대한 결론은 다음과 같다.

1. 양측성 순구개열 파열부의 폐쇄가 성공적으로 이루어졌다.
2. 양측 분절의 측방 성장이 억제되어 내측 굴곡이 발생하였다.
3. 전상악골 후방부에 위치한 서골(vomer) 전방부의 굴곡에 의하여 전상악골의 후방이동과 회전이 발생하였다.

구순성형술을 시행하기 전에 PNAM 장치를 사용하여 양측성 순구개열 신생아 환자의 파열부 폐쇄에 대한 좋은 결과를 얻을 수 있었다.

주요 단어 : 양측성 순구개열, 비치조 정형장치