The Palatal Plate by the Application of Thermoplastics for the Neonates with Cleft Lip and Palate

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Abstract : Since 1992, we have been designing the palatal plate for cleft palate neonates by the application of thermoplastics as pre-surgical treatment since 1992.

110 neonatal patients with cleft palate have been treated with this procedure. The average duration for using the plate was the age of from 1.5 months to 12.5 months. Feeding changed from the usage of particular nipple or tube feeding, to normal feeding in all cases, except those with severe systemic disorder. The weaning period was also normal. The cleft-width of the alveolar arch and hard palate decreased significantly. This was caused by the growth of the frontal points and the palatal process of segments, not by the mechanical constriction, itself.

The total time for making each plate was 60 minutes or less. This included taking the impression and setting time. A new plate is made every 2 months to allow for growth of the alveolar arch and hard palate. Our design is an improvement because the plate is water-resistant, thinner, and semi-transparent, It consists of only one layer of material. There is no need for grinding the growth guide.

We conclude that our pre-surgical treatment improved significantly the condition of cleft palate neonates.

Keywords : palatal plate, infant with cleft lip and palate, thermoplastics, pre-surgical treatment for cleft lip and palate

Introduction

Many researches which were related to the palatal plate treatment whether passive plate or active plate for the infant with cleft palate had been reported[1~13]. We have been designing the palatal plate for cleft palate neonates by the application of thermoplastics as pre-surgical treatment since 1992. Clinical results are adequate morphologically and functionally, as the improvement of cleft width, dental arches, hard palate, and feeding conditions. Here, we report our method and would like to discuss

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the problems of early treatments for cleft palate neonates to improve the management system.

Subjects, Materials and Methods

Table 1 indicates the neonatal patients with cleft palates were applied in this procedure. Our method with the thermoplastics is shown in Figures 1 and 2.

We used three kinds of materials with the thermo-pressing machine "Biostar ®" (Scheu-Dental, Germany) ; "Durasoft®" (Scheu-Dental, Germany), "Essix®" (Rain Tree Essix Inc., US), and "Coping material®" (Tru-Tain Inc., US). Those were all effective on the improvement of cleft width, dental arches, hard palate, and feeding conditions. We recommended "Coping material®" for its strength, water resistance, and adequate thickness.

The relief area of the cleft portion was filled with the sticky paste material "Fine solder®" (ASO International, Japan) for soldering fixation in usual usage. It did not melt at the high temperature, did not flow away in the high pressure and it was easy to handle and to remove. "Biostar®"s working temperature/pressure were 220℃/4.0-5.4 bar, when "Coping material®" was employed.

The total elapsed time for making each plate was within 60 minutes or less. This included taking an impression and setting.

A new plate is made every two months to allow for growth of the alveolar arch and hard palate.

The average duration of the plate was from 1.5 to 12.5 months old. The treatment began at the first examination and finished at the palatoplasty. The plate was removed just before the cheiloplasty and set again half a day to one day afterwards.

Table 1. The number of subject in this procedure

type	n
UCLP	73
BCLP	34
C P	3
total	110

UCLP : Unilateral Cleft Lip and Palate
BCLP : Bilateral Cleft Lip and Palate
C P : Cleft Palate (hard and soft palate)

The patients carers were informed that the plate should always be set, except at times of cleaning (the mouth, nasal cavity, and plate itself). The plate should only be removed under exceptional circumstances.

Results

Table 2 indicates number of subjects with the degree of improvement of arch form and hard plate. The cleft-width of the alveolar arch and hard palate decreased.

In case of bilateral cleft lip and palate (BCLP), the protruding premaxilla were retracted with adhesive plaster, or the retraction band with head gear and elastics (shown as Figure 3).

Table 3 shows the degree of the improvement on feeding function. 34% of subjects had been inserted the feeding tube, and all was able to desist in its usage except 14 cases with severe systemic diseases.

The weaning period varied in most of the patients, according to their ability to eat with the plate.

Table 4 indicates the number of cases with growth problems. Cleft palate cases (CP) include two Pierre-Robin syndrome cases and one chromosome anomaly (18q-), and all indicated retrograde mandible.

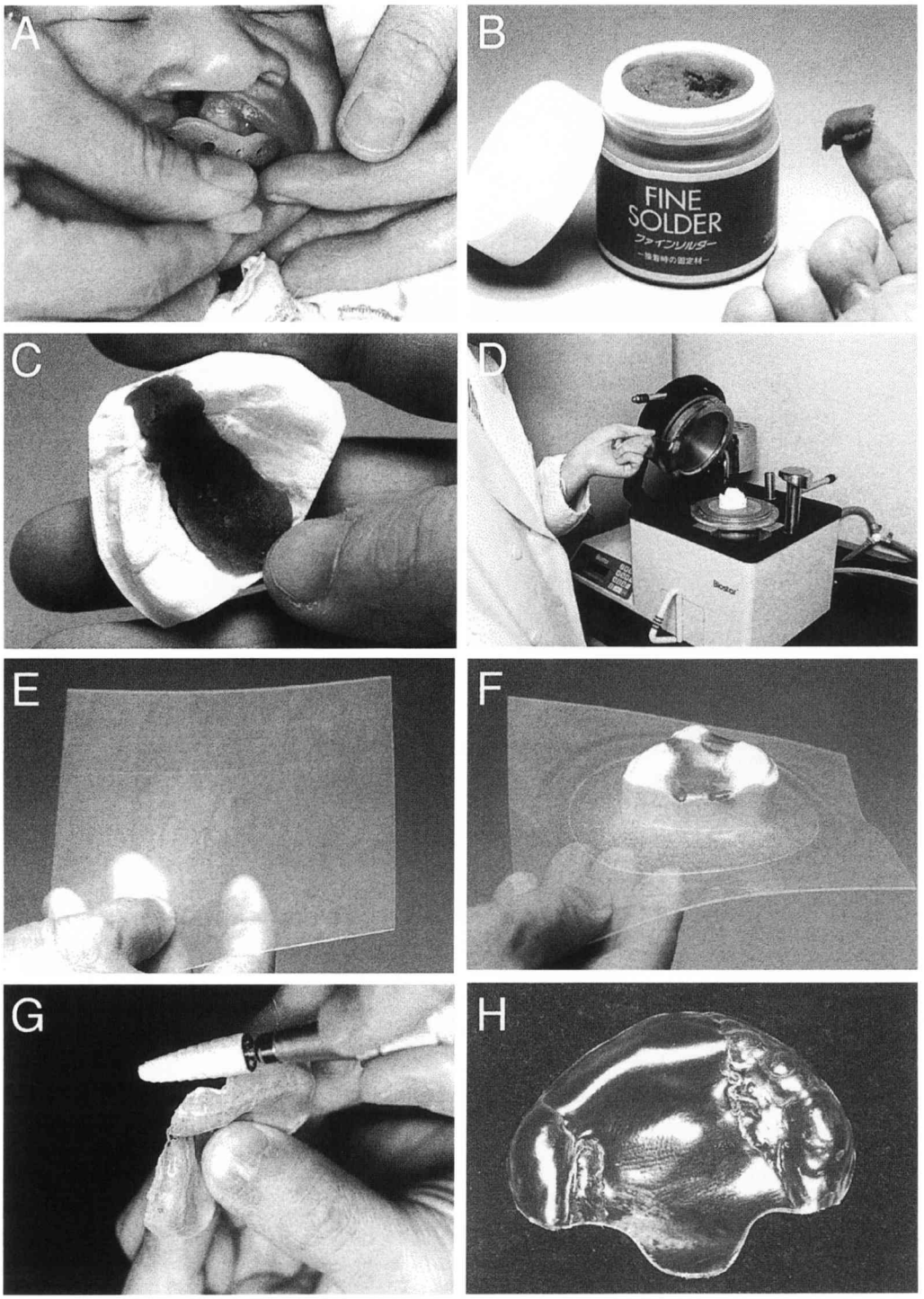

Fig. 1. The procedure of making the palatal plate in our method
A : Taking impression by alginates with special tray, B : "Fine solder®", C : Relief of the cleft portion with "Fine solder®" on the working model, D : "Biostar®" the thermo-pressing machine, E : "Coping material®" the thermoplastic material, F : Pressed "Coping material®" on the working model, G : Cutting and trimming, H : Completed palatal plate (occlusal aspect)

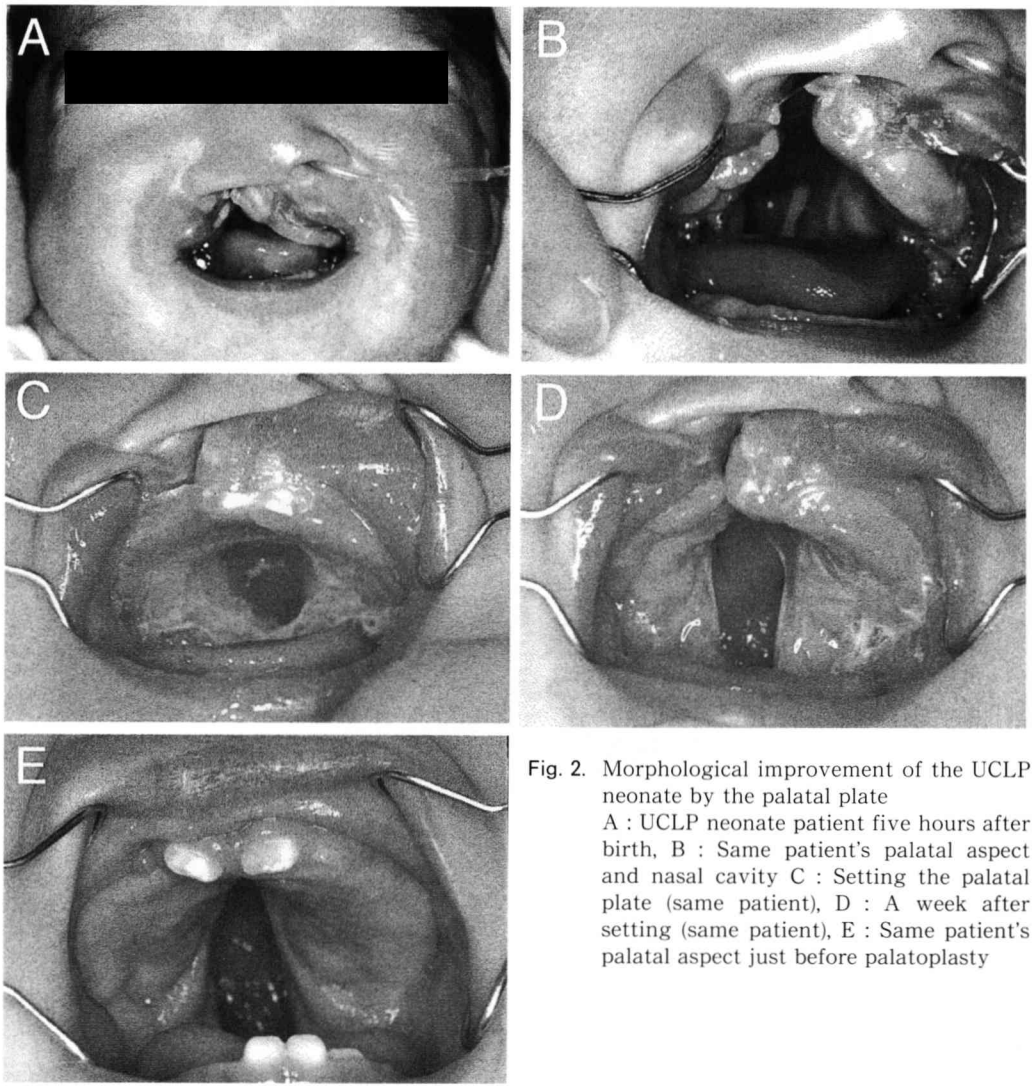

Fig. 2. Morphological improvement of the UCLP neonate by the palatal plate
A : UCLP neonate patient five hours after birth, B : Same patient's palatal aspect and nasal cavity C : Setting the palatal plate (same patient), D : A week after setting (same patient), E : Same patient's palatal aspect just before palatoplasty

Table 2. Percentage of Morphological Improvement

type	++	+	±
UCLP	6 (8.2)	49 (67.1)	18 (24.7)
BCLP	2 (5.9)	24 (70.6)	8 (23.5)

++ : apexes of dental arches attached, and/or both hard palate processes approach each other.
+ : arches closed significantly, and/or the better growth of hard palate processes are observed.
± : the growth of arches and hard palate processes are observed insufficiently

Table 3. Percentage of Functional Improvement

type	++	+	±
UCLP	7 (9.6)	61 (83.6)	5 (6.8)
BCLP	2 (5.9)	26 (76.5)	6 (17.6)
C P	0	0	3 (100.0)

++ : cesation of tube use and the particular nipple for cleft babies, feeding quantity increased rapidly.
+ : feeding quantity increased normally as using normal nipple.
± : feeding quantity increased minutely or continued to use tube and/or particular nipple.

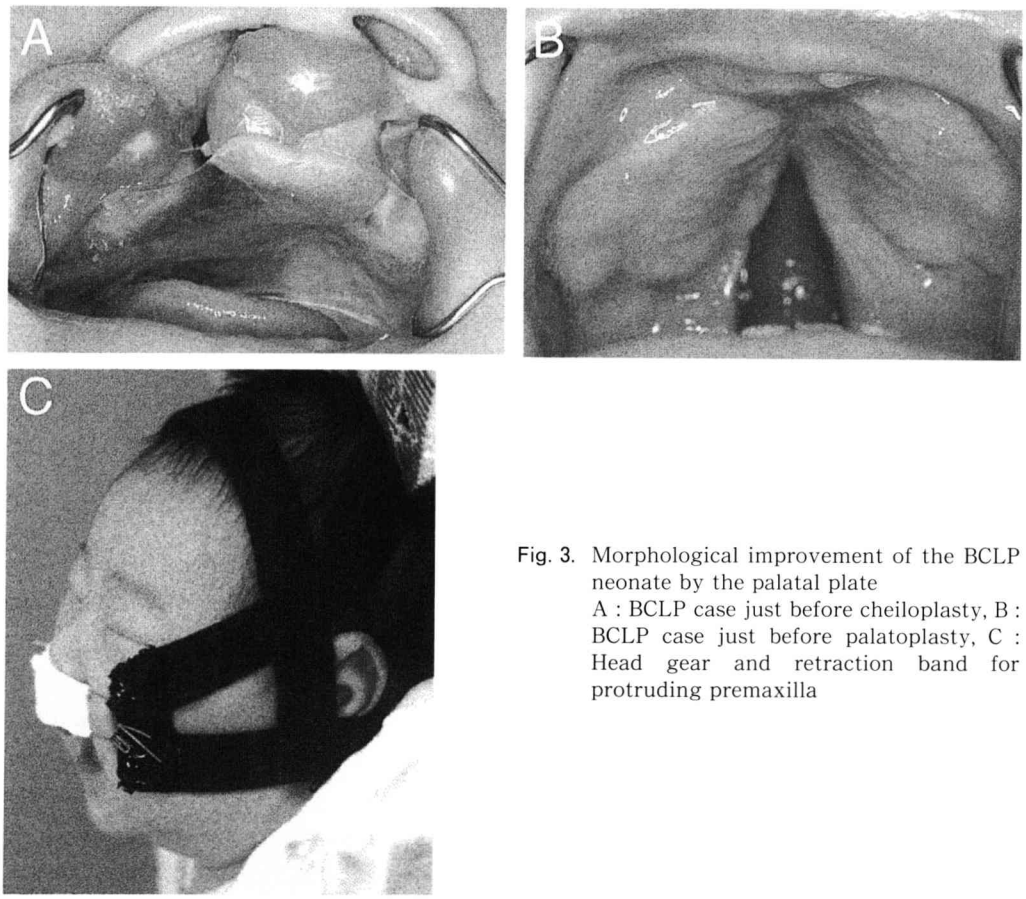

Fig. 3. Morphological improvement of the BCLP neonate by the palatal plate
A : BCLP case just before cheiloplasty, B : BCLP case just before palatoplasty, C : Head gear and retraction band for protruding premaxilla

Table 4. The number of cases with growth problems

type	n (%)
UCLP	12 (16.4)
BCLP	2 (5.9)
C P	3 (100.0)

Discussion

The decrease of the cleft width was caused by the growth of the frontal portions of the dental arches and the processes of the hard plates, not by the mechanical constriction. Ideal results should be caused by functional biomechanics : the pressure of the tongue into cleft is removed, the direction of growth is led by the plate and the muscles around the mouth are controlled by the normal feeding action[14~20].

The feeding tube and/or the successive use of the special nipple depresses the initial reflexes of the feeding action, since we regard that series of reflexes forming feeding as something similar to the

completion of mastication. Using a special nipple, the milk comes too easily with only slight motion of the cheek and/or tongue. Moss' "Functional matrix theory"[21] teaches us that the oral function makes the masticating organ grow. From these points of view we make efforts to remove the feeding tube gradually (within a month), to change from the special nipple to a normal one, or to feed from the mother's breast directly. Furthermore, from the psychological view, breast feeding is the best way. However unhappily only 3.0-5.0% of the patients could achieve breast feeding, because the mothers did not try it soon after the birth of their child and had no idea that such a child can be breast fed.

This process should be attained gradually, especially on the patients with particular reasons : premature birth, multiple (or chromosomal) anomaly, etc. Some patients have a very weak ability for feeding. It is absolutely necessary for them to feed with the tube or the special nipple. And we must activate the initial reflex of spontaneous sucking movement is activated by touching around the mouth.

Not only the palatal plate, but also the adhesive plaster should be employed to achieve continuity of the orbicular muscle of the upper lip (adhesive plaster : "Micropore®" 《3 M, US》 should be recommended for the skin). After observing that the volume and the pace of feeding has improved, the nipple was changed from the special one to the normal one. We set the criterion of minimum feeding volume/pace as 80 ml/30 min regularly in one feeding (with any nipple). We recommend "Bean stalk®" (Pigeon, Japan) the particular nipple designed for the guiding of mastication.

Between the first cheiloplasty and the palatoplasty, the difficulty of using palatal plate increases for the finger sucking habit, tongue thrusting, and the eruption of deciduous teeth.

The handicap of difficulties of feeding will cause the successive failure of oral function : mastication and speech. And it is more important to let them understand some basic conditions for further treatment in the future : (1) foods, (2) bad habits, (3) oral hygiene, (4) speech disorder, (5) related diseases.

The following cases were regarded as complicated : 1) wide cleft or mesio-distal gap of both arches, in Unilateral cleft lip and palate, 2) protruding maxilla with narrow width of bilateral dental arches or the discrepancy of size between premaxilla and the frontal cleft width, 3) deviated premaxilla.

Our appliances for such cases are indicated as Figure 4 to 5. We employed the set up plate or the reduction plate with a screw for the wide cleft case. Therefore, the bilateral case is more difficult than the unilateral case, and requires both orthopedic and mechanical forces. We placed a retrdction band which covered the most of premaxilla.

In the case of alveolar with complete/ incomplete lip cleft, it becomes more difficult to improve the overlap of the alveolar processes. We use two methods : the first is the expansion plate with a screw which pushes the lesser segment laterally to the buccal side, and the second is the plate with the buccal space for the lateral shift of the lesser segment.

Two cases of a risk of suffocation with the plate were encountered in a decade. These

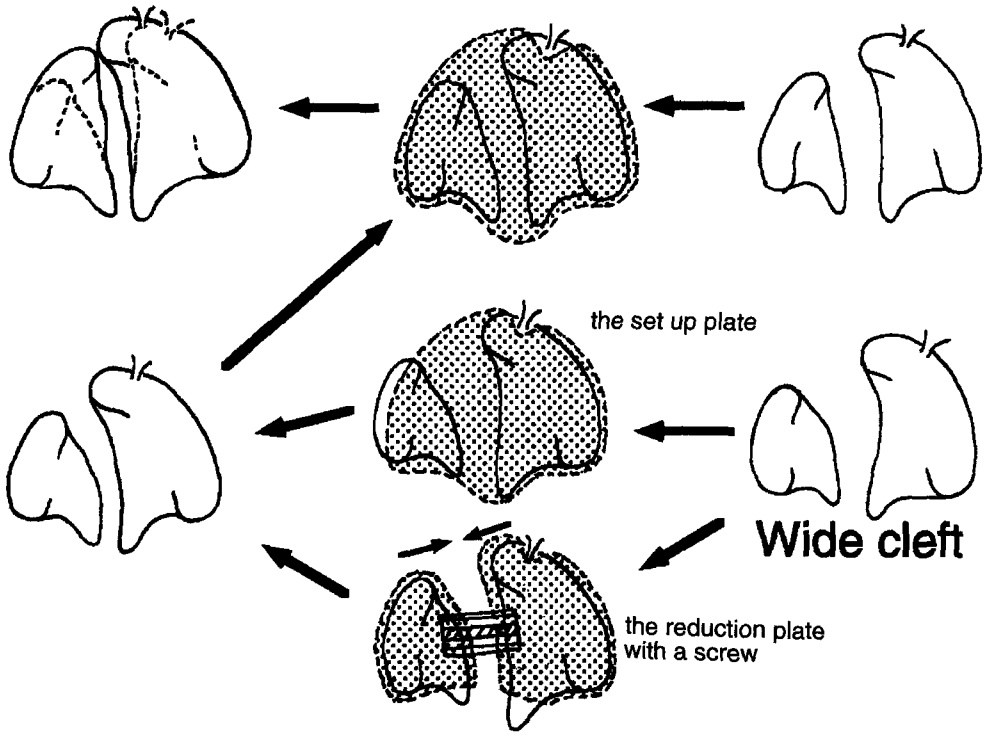

Fig. 4. Practical ways for the wide cleft cases

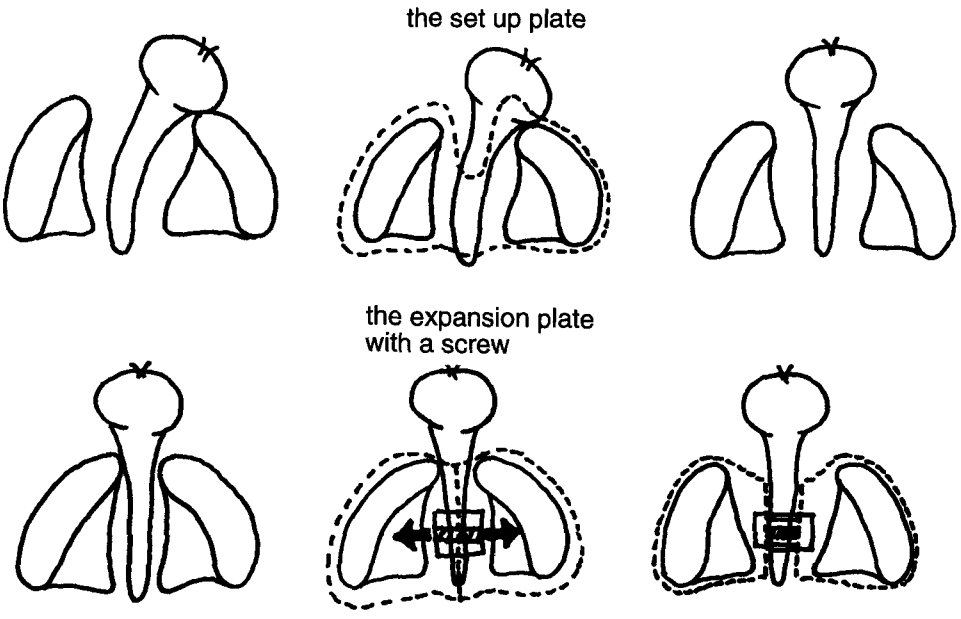

Fig. 5. Design for the deviated premaxilla and narrow arches

were caused by the patient's finger sucking and the careless feeding by a parent. Both cases were discovered soon after the accidents occurred and treated by nurses and emergency rescue staff immediately.

Conclusion

This plate is different from Hotz's plate[7,8], but the basic idea is the same. Our method is simpler, less skill intensive and more economical. When we employ "Coping material" with "Biostar", the differences are as follows ; water resistancy, easy to clean, thinner (0.4mm overall), semi-transparent, only one layer, no need for grinding the guide and having shorter soft palate portion.

This method is effective on UCLP, BCLP, and CP cases. Most of the cases were improved morphologically and functionally. On the cases with severe systemic diseases and growth problems, the same method was less effective. This was not a reflection on, or failure of the plate itself.

We conclude that our pre-surgical treatment improved the conditions of cleft palate neonates sufficiently.

The summary of this paper was presented at the 23rd meeting of the Japanese Cleft Palate Association, Izumisano (Osaka), July, 1999, and the first meeting of World Cleft Congress, Zürich (Switzerland), July, 2000.

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加熱成形プレートを用いた口蓋床の設計

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抄録：我々は1992年以来，唇顎口蓋裂を有する乳児の手術前処置としての口蓋床に熱可塑性プラスチックを応用してきた。

110名の様々な裂型を有する乳児にこの方法が適応された。口蓋床使用の平均的期間は生後1.5か月から生後12.5か月までであった。授乳は，重篤な全身疾患を有する場合を除き，初診時の口蓋裂用の特殊な乳首や経鼻栄養管の使用から通常の乳首使用への移行がほとんどの症例で可能だった。また離乳も順調であった。歯槽部顎裂幅と口蓋部の裂幅は顕著に減少した。この効果は裂隙に面した歯槽部の先端と口蓋突起の発育自体によるもので，機械的な拘縮によるものではない。ひとつの口蓋床を作るのにかかる時間は印象から装着まで含めて一時間以内である。２か月に一回の割合で歯槽部と口蓋の発育にあわせて新しい口蓋床が製作された。

我々の方法は従来のものに比較して簡単であり，技術的にも易しく，経済的である。また口蓋床自体の違いとして，吸水性がなく，薄く，半透明で，一層だけであり，発育誘導のための削合は不要で，軟口蓋への延長部が小さい。

以上より我々の手術前処置の方法は唇顎口蓋裂を有する乳児の状態を十分に改善できるものであるという結論を得た。

キーワード：口蓋床，唇顎口蓋裂乳児，熱可塑性プラスチック，手術前処置