Original Article

Nasoalveolar Morphology Following Presurgical Orthopedic Treatment in Unilateral Cleft Lip Alveolus and Palate Infants

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ABSTRACT

Aim: The importance of presurgical orthopedic treatment is widely recognized. The objectives are to monitoring function (feeding, tongue posture), aiding speech development. It helps the surgeon to close the floor of the nose, stimulate palatal bone growth, reduce middle infection, and prevent the collapse of the palatal segment. The purpose of this study was to examine characteristics of the nasoalveolar and palatal configurations in the complete unilateral cleft lip and palate (UCLP) patients and to determine the effect of early orthopedic treatment in complete UCLP patients. **Materials and Methods:** A total of 20 infants were included in the study divided into two groups. Group A consisted of 10 infants with non-syndromic cleft lip alveolus and palate and was treated with presurgical orthopedic treatment Hotz appliance for 3 months. Group B comprises 10 infants of 5 months without cleft lip and palate deformity included in the study as the control group. **Results:** The test showed a statistical difference regarding the decrease in cleft alveolus width, the decline in the width of the nostril on the cleft side. The intercanthal distance increased at the end of 3 months following the use of Hotz plate ($P = 0.001$) statistically significant. The alar width decreased at the end of the 3 moths which is statistically significant ($P = 0.001$). **Conclusion:** The alveolar dimensions in children with UCLP can approach the dimensions of non-cleft contemporaries in spite of surgical interventions, but the dimensions are, as a rule, under the mean values of normal. Each alveolar segment grew along the guidance of Hotz's plate, and the growth was found mainly at the edge of the alveolus. The anterior nasal spine and nasal septum did not seem to influence by passive appliances such as Hotz's plate.

Key words: Complete unilateral cleft lip and palate, Hotz's plate, presurgical orthopaedic treatment

INTRODUCTION

The modern concept of the early maxillary orthopedics for infants with clefts was originally introduced by MeNeil in 1950. He advocated that maxillary segments distorted and displaces at birth be repositioned by a series of orthopedic appliances to produce a normal appearing maxilla while reducing the cleft space in the alveolus and palate. This would align the segments in an ideal relationship that would correct the bony deficiency by simulating palatal growth.[1-4]

A number of combined maxillary orthopedic and surgical treatment protocols have been proposed for the initial phase of therapy for infants with a complete cleft lip and palate. Among these protocols, three major variables can be identified: The type of maxillary appliance, the specific surgical approach for the lip, and the timing between the use of the appliance and the performance of surgery with respect both to insertion and discontinuation. In combination with an orthopedic appliance, lip adhesion has the added advantage of acting as a dynamic force in aligning the upper alveolar arch.[5-7] Passive maxillary

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appliances deliver no force and yet act as a fulcrum on which the forces created by the surgical lip closure can contour and mold the alveolar segments in a predictable fashion.

Presurgical orthopedics in infants with cleft lip and palate during the neonatal period have been an issue of debate. Few orthodontist and surgeons recommend passive holding appliance while others recommend application of orthopedic forces such as Latham's pinned premaxillary retraction device.[8,9]

The rationale for the early maxillary arch intervention must be based on an identification of the type of cleft (unilateral or bilateral), the position of the cleft segments (expanded or collapsed) and a planned surgical approach to the correction. In unilateral complete clefts, a combination of osseous defects in both the alveolus and palate will contribute to the instability of the arch and sometimes the collapse of the lateral lesser segments.

The importance of presurgical orthopedic treatment is widely recognized. The objective are to monitor function (feeding, tongue posture), aid speech development. It helps the surgeon to close floor of the nose, stimulate palatal bone growth, reduce middle ear infection, and prevent collapse of the palatal segment. It also helps in reducing the need for further complex orthodontic treatment, guidance of growth potentialities to manifest. Compound plates of soft and hard acrylic were employed, the so-called Hotz's plate. The efficacy of the Hotz's plate in the improvement of feeding, growth, and configuration of the maxillary segments has been previously described.

The purpose of this study was to examine characteristics of the nasoalveolar and palatal configuration in complete unilateral cleft lip and palate (UCLP) patients and to determine the effect of the early orthopedic treatment in complete UCLP patients.

MATERIALS AND METHODS

This prospective study involved 10 infants reported to with UCLP and alveolus patients with below 1 month visiting Nitte Meenakshi Institute of Craniofacial Surgery and A. B. Shetty Memorial Institute of Dental Science, Deralakatte, Mangalore.

The study consisted of 20 subjects who were divided into two groups:

- Group A: Patients with UCLP and alveolus patients aged below 1 month
- Group B: Patients without cleft lip and palate aged below 5 months randomly.

Inclusion Criteria

The patients with non-syndromic cleft with UCLP and alveolus severe cleft defect of more than 8 mm.

Exclusion Criteria

- Uncooperative patient
- Patient with syndromes cleft lip and palate.

Method of Study

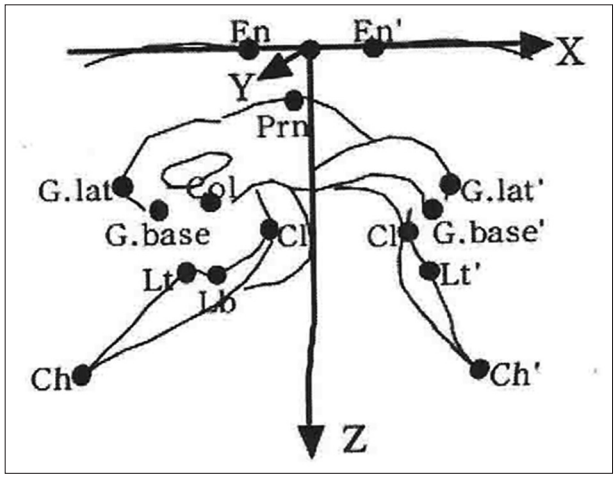
1. Institutional Ethical Committee approval was obtained and informed written consent from the parents was obtained.
2. Infants with UCLP and alveolus at approximately 1 month of age, unless postponed because of medical problems or late presentation were selected and pretreatment measurement made.
3. To normalize feeding a plate of compound soft and hard acrylic is made within 1 month. The impression is made with alginate without anesthesia.
4. On the plaster cast a palatal plate as described by Hotz was fabricated. The first layer of wax covering the whole of the oral and vestibular surface extending to the nasal cavity is so as to relieve the undercut from plate. The palatal vault between the alveolar ridges a layer of self-acrylic is added as a matrix for the hard palate. The tissue contact layer is added with visco-gel soft acrylic.
5. Hotz plate is carefully adjusted on the patient particularly posterior part which has been displaced by impression material; the nasal airway is freed by reducing the nasal extension. The initial adjustment is crucial part of the pre-operative adjustment.
6. Instruction for handling the plate are given (1) the device to worn for 24 h a day, removed after every meal (2) cleaning with the toothbrush and warm water. Checking for the pressure spot in the first 24 h was done.
7. The hard acrylic layer provides stabilization of the segments both anteroposterior and transverse dimensions. The soft acrylic adopts themselves to the underlying structures gradually giving way to increasing the transverse maxillary direction.
8. The arch alignment is induced after the initial acceptance of the appliance by grinding away material in the definite areas; but ends of the both segments (palate-medially for major one, anterolaterally for the lesser one and vertically for both segment). Mesial shifting of the major segment and straightening of the vomer ensue. Margins of the palatal shelves are relived medially and vertically.
9. Alining at a spontaneous development of the maxillary segment, grindings repeated every fortnight. Moreover, at the end of the 3 months the after the initial visit, the cheiloplasty is done by modified millards technique usually 5-6 months. The alveolar cleft has considerably

narrowed by this time as a consequence of the guide and undisturbed maxillary growth.

10. The following records were made
    - Facial photographs
    - Palatal casts
    - Anthropometric measurements.
11. Time was spent with the patient and parents explaining in detail the advantages and procedure so that maximum co-operation can obtain.
12. Data, thus, collected was statistically analyzed using paired test and independent test and in Group 1 the values were compared to pre-treatment value and post-orthopedic treatment value.

Landmarks Used in the Study

Facial landmarks



Medial canthus: The most medial point of the palpebral fissure (En).

Pronasale: The most anterior point of the nose (Pm).

Lateral point of the ala: The most lateral point of the alar groove (G. lat).

Base of the ala: The most concave point anterio posterior near the picked point (G. Bose).

Columella base: The most concave point anterio posterior near the picket point (Col).

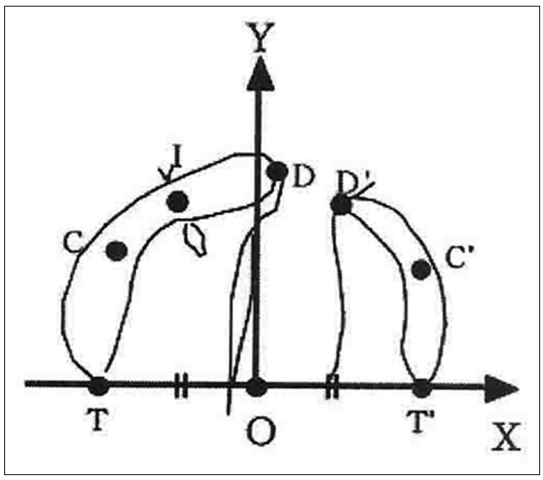
Border of cleft lip: The most medial point of cleft margin of the lip (CI).

Top of the cupids bow: The highest point of the vermilion border (Lt).

Bottom of the cupids bow: The lowest point the vermilion border medial from the top of the cupids bow on the non-left side (Lb).

Cheilion: The most lateral point of the angle of the month (Ch).

Palatal landmarks



Tuberosity point: The crossing point of the hamular sulcus and alveolar ridge (T).

Incisal point: The crossing point of the line of the incisive papilla and alveolar ridge (I).

Canine point: The crossing point of canine grove and alveolar ridge (C).

Edge point: The edge of the alveolar ridge facing the cleft (D).

RESULTS

In our study, 10 patients with cleft lip, alveolus and palate underwent presurgical orthopedics using Hotz palatal plate made up of hard acrylic and soft palate for 3 months followed by cheiloplasty by Millards technique. All the patients were managed on outpatient basis.

In our study of the 9 patients who underwent presurgical orthopedics were left sided cleft and one was right sided. The patients selected with wide cleft more than 8 mm, and most of the clefts were in the range of 15 mm (8-18 mm).

The width of the cleft (D to D') in UCLP patient was found to be mean 15.2 mm and at the end of the 3 months the mean 9.3 mm decreased from 1 month to end of the 3 months (Figures 1 and 2, Table 1) following the use of Hotz plate ($P = 0.001$) which is statistically significant. This shows that patients have a wide cleft of birth also if not guided can become event larger and further make the surgery more difficult and also the scar after the surgery by unsightly.

The inter cantal distance (En to En') (Tables 1 and 2) which was found to be average of 26.2 mm at the 1st month was found to be increased to 27.8 mm at the end of the 3 months following the use of Hotz plate ($P = 0.001$) statistically significant. This implies that there is slight of the mid face intercanthal area. When analyzed with controls group implies that the growth essentially remains the same at the inter canthal area.

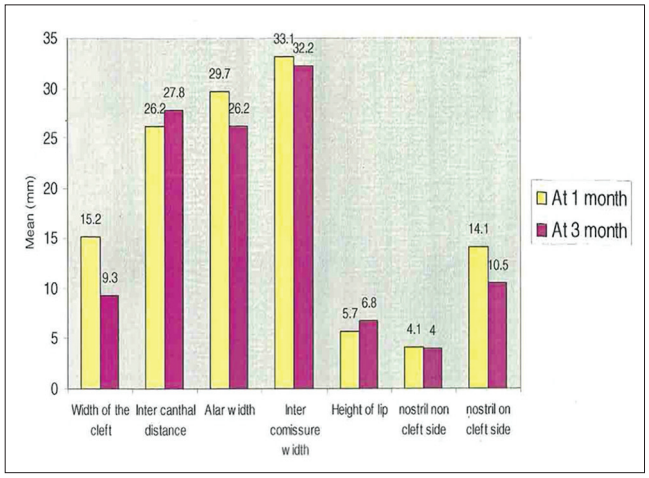


Figure 1: Comparison of measurements during the first and third month

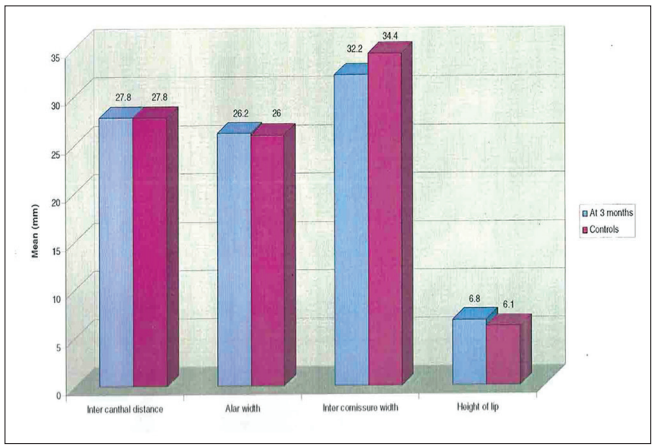


Figure 2: Comparison of measurements after 3 months and with the control group

The alar width (G. Base to G. Base') is at the start of the treatment was mean 29.7 mm, decreased to 26.2 mm at the end of the 3 months following the used of the Hotz plate is statistically significant and shows that this decrease toward normal when compared to control group. This decrease is helpful for molding of the alar cartilage and subsequent more esthetic and functional nostril on the cleft side.

The intercommissural width (Ch to Ch') which was found to be average of 33.1 mm at the start of the treatment decreases to 32.1 mm at the end of the 3 months, shows that there is molding of upper lip and subsequent approximation of the upper lip also is slight shorter when compared to normal individual of the same group without cleft lip. This can be attributed to molding the alveolar segment which provides the support and growth of maxilla.

The height of the lip (Col to Lt) which found to be average of 5.7 mm at the start of the treatment increase to 6.8 mm at the end of the orthopedic treatment, which is statistically significant ($P = 0.001$) and explains that it has movement of lip to be placed more vertically and thus more esthetic outcome after surgery, also when compared to normal control group it is little more than that of the normal individuals.

The nostril width (G. Base to Col) on the non-cleft side is found to be mean 4.1 mm at the 1 month and decrease to 4 mm at the end of the 3 months. It statistically not significant ($P = 0.343$) and shows there is not much change in with to the nostril width of non-cleft side.

Table 1: Paired samples test

Landmarks used	Paired differences				t	df	Significant (two-tailed)
	Mean±SD	SEM	95% CI of the difference				
			Lower	Upper			
Pair 1							
Width of the cleft 1 - Width of the cleft 3	5.90±1.37	0.43	4.92	6.88	13.615	9	0.0001
Pair 2							
Inter canthal distance 1 - Inter canthal distance 3	−1.60±0.84	0.27	−2.20	−1.00	−6.000	9	0.0001
Pair 3							
Alar width 1 - Alar width 3	3.50±2.22	0.70	1.91	5.09	4.977	9	0.001
Pair 4							
Inter commissural width 1 - Inter commissural width 3	0.90±2.73	0.86	−1.05	2.85	1.044	9	0.324
Pair 5							
Height of lip 1 - Height of lip 3	−1.10±0.57	0.18	−1.51	−0.69	−6.128	9	0.0001
Pair 6							
Nostril on non-cleft side 1 - Nostril on non-cleft side 3	0.10±0.32	0.10	−0.13	0.33	1.000	9	0.343
Pair 7							
Nostril on cleft side 1 - Nostril on cleft side 3	3.60±1.96	0.62	2.20	5.00	5.823	9	0.0001

SD: Standard deviation, SEM: Standard error of mean, CI: Confidence interval

The width of nostril on the cleft side (Tables 1 and 2) (G. Base' to Col) shows significant change from the start of the treatment and mean 14.1 mm from the 1st month to average of the 1.5 mm at the end of 3 months which is statistically significant ($P = 0.001$) shows there is molding of the lower lateral cartilage and more esthetic outcome and adopts a favorable position for the surgery for rhinoplasty. This treatment also increases the symmetry of the nose significantly.

The growth of the nasoalveolar maxillary complex is similar to growth in non-cleft individuals. Intercanthal distance after presurgical neonatal maxillary orthopedics has no significant change to the non-cleft counterparts, which implies growth is independent of the use of Hotz appliance in cleft individuals. The independent sample test shows it not statistically significant ($P > 0.05$).

The alar width after the treatment (Tables 1 and 2) and the controls shows that there is slight increased width in the cleft individuals than the controls of the same age group. The value of alar width when compared by independent sample test shows it not statistically significant ($P > 0.05$). This can be attributed to cleft defect and malformed lower lateral cartilage and lack of bony support for cartilage.

Table 2: Group statistics

Group	*N*	Mean±SD	SEM
Inter canthal distance			
At 3 months	10	27.80±2.25	0.71
Controls	10	27.80±1.75	0.55
Alar width			
At 3 months	10	26.20±2.70	0.85
Controls	10	26.20±3.13	0.99
Inter commissural width			
At 3 months	10	32.20±2.66	0.84
Controls	10	34.40±2.07	0.65
Height of lip			
At 3 months	10	6.80±0.92	0.29
Controls	10	6.10±0.74	0.23

SD: Standard deviation, SEM: Standard error of mean

The inter-commissural width which is found to be mean 32.2 mm, at the end of the treatment is shorter than the control which is found to be 34.4 mm shows that that there is decreased inter-commissural width in cleft individuals. The independent sample test shows is not statistically significant ($P > 0.05$). There is slight growth disturbance in the cleft individuals at the commissural area.

The height of the lip (Table 3) in test group and controls is variable and in the study it is found to be slightly more than control this may due to imbalance of the muscular rings attachments, independent sample test shows it no statistically significant ($P > 0.05$).

DISCUSSION

The efficacy of presurgical orthopedics remains a subject of considerable debate in the cleft literature at present. McNeil[1] description of using series of the orthopedic baby plates for presurgical orthopedic infant with cleft lip and palate was followed by Rosenstein[2] wherein he advocated the plate would cover segment to covers only back two-thirds of the larger palatal segment up to the alveolar ridge the action of surgically repaired lip will move this segment to end relationship with the lesser segment.[10-13]

In our study, complete UCLP the appliance covers both the major and minor segments completely and effectively separate the nasal and oral cavity as in comparison to study done by Rosenstein[2] wherein he advocated the plate would cover segment to covers only back two-thirds of the larger palatal segment up to the alveolar ridge the action of surgically repaired lip will move this segment to end to end relationship with the lesser segment. This complete covering of the segments would give better control over the guiding the growth of the major the minor segments.[14-18]

In our study, it has noted that lateral displacement of the tip of the inter-dental papilla between the central incisors and increased anterior arch width are common features in UCLP

Table 3: Independent samples test

Landmarks used	*t*-test for equality of means						
	t	df	Significant (two-tailed)	Mean difference	SE difference	95% CI of the difference	
Inter canthal distance							
Equal variances assumed	0.000	18	1.000	0.00	2.25 1.75	−1.89	1.89
Alar width							
Equal variances assumed	0.15	18	0.880	0.20	2.70 3.13	−2.54	2.94
Inter commissural width							
Equal variances assumed	−2.067	18	0.53	−2.20	2.66 2.07	−4.44	0.04
Height of lip							
Equal variances assumed	1.878	18	0.077	0.70	0.92 0.74	−0.08	1.48

SD: Standard deviation, SEM: Standard error of mean, CI: Confidence interval, SE: Standard error

and alveolus newborns. Their characteristics may result from the presence of the discontinuous alveolar arch and rotation of the segments secondary to asymmetric muscle pull, tongue posture, or asymmetric nasal septal growth.

Mishima *et al.*[11] did a study comparing the segments in Hotz (−) and Hotz (+) group they found that Hotz (−) the major and lesser segments shifted anteriorly and laterally, and Hotz (+) both segments shifted medially. They found that the degree of curvature of the palatal curved surfaces in Hotz (+) and smaller than Hotz (−) group. In our study, we have found that both the major segments and the minor segments have moved move medially to decrease the alveolar cleft that is line with above study, and we found the growth to be near normal to the non-cleft counterpart.

CONCLUSIONS

The alveolar dimensions in children with UCLP can approach the dimensions of non-cleft contemporaries in spite of surgical interventions, but the dimensions are, as a rule, under the mean values of normal. They also indicate that UCLP children who are nose breathers and have retained a proper resting posture of the oral cavity attain dimensions of normal contemporaries more often than those who are nose and mouth breathers and do not have proper oral posture. Early maxillary orthopedic treatment is commonly applied to improve feeding, to create optimal conditions for normalizing tongue positioning and configuration of the maxillary segments, and to guide normal growth.

To prove that the obtained results are the consequence of the presurgical treatment, comparison to a group without it but with the same surgical protocol would be necessary. Presurgical orthopedics can reduce alveolar cleft width, and lip width relative to the growth of face taking the advantage of intrinsic growth potential in maxilla. This may make subsequent surgery easier.

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