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Research Article

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The Effect of Cleft Width on Maxillary Morphology in Newborn with Unilateral Cleft Lip and Palate

Ege DOGAN*

Associate Professor, Ege University, Faculty of Dentistry, Orthodontic Department, Izmir-Turkey

***Corresponding author**
Ege DOGAN, Associate Professor, Ege University, Faculty of Dentistry, Orthodontic Department, Izmir-Turkey.

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Abstract

Objective: *This study aims to investigate the impact of cleft width on maxillary morphology in newborns with unilateral cleft lip and palate (UCLP).*

Materials and Methods: *Plaster models from 35 newborns with unilateral cleft lip and palate (UCLP) (17 boys, 18 girls) and 35 newborns with isolated soft palate cleft (CP) (16 boys, 19 girls) were examined. The measured parameters included C-C' , T-T', arch circumference, arch length, G-L, a-a', and b-b'. Statistical analyses were conducted using an independent samples t-test and Mann–Whitney U test for normally and non-normally distributed data, respectively. Pearson Correlation assessed the correlation between G-L and other measurements. The analysis was performed at a significance level of 0.05 using R software, version 4.0.5.*

Results: *Statistically significant differences were found in C-C' ($p < 0.001$) and T-T' ($p < 0.05$) between the two groups. UCLP newborns showed a significant increase in arch length (28.4 ± 2.9 mm) compared to CP (25.0 ± 2.6 mm, $p < 0.001$). Both (a-a') and (b-b') demonstrated a significant increase in UCLP ($p < 0.001$). A significant correlation was observed between (G-L) and (C-C') and (a-a') ($p < 0.01$), and between (T-T') and (a-a') and (b-b') ($p < 0.01$). The correlation between arch circumference and (b-b') was significant at the 0.05 level.*

Conclusion: *In UCLP newborns with increased anterior cleft width, the anterior alveolar arch width increases, affecting maxillary morphology. While early orthopedic and surgical interventions prove effective in managing severe clefts, the initial severity of the cleft width significantly influences dental arch relationships and treatment outcomes. Consequently, initiating maxillary expansion and protraction interventions during the early primary dentition period becomes crucial.*

Keywords: Cleft size, Maxillary morphology, Unilateral cleft lip and Palate

Introductıon

Cleft lip and palate, a congenital anomaly, significantly impacts craniofacial morphology. Children born with orofacial clefts due to the severity of tissue deficiency observed in the lip and palate usually have dysfunctions such as eating, speaking and hearing. In addition, aesthetic and psychological problems often affect the health of the child [1-4].The severity of the anomaly depends on the degree of tissue deficiency.The size of the cleft changes significantly as a result of early orthopedic treatment and surgical treatments. However, a large cleft may create more scar tissue after surgery, and in this case, it may affect the growth of the maxilla. [5-7].

The maxillary morphology and different cleft size widths of children with CLP clefts affect surgical treatment outcome. The extent and size of the tissue defect observed after birth in patients with CLP and the surgical difficulties required are factors that affect the results of corrective surgery. A large cleft may require further displacement of palatal mucoperiosteal tissue. The larger the cleft width, the larger the scar and consequently the narrowing of the maxilla will be as a result [8-12].

Maxillary arch dimensions reduced in patients with complete clefts than with incomplete clefts. In CLP patients lip repair has a moulding effect on the maxillary segments, which creates a more normal alveolar arch shape. The surgical closure of the palate in these patients influences the growth of the maxillary arch in both the transverse and antero-posterior dimensions [13-17].

In children with UCLP, the method of cleft measurement varies. Some of the researchers measure only the distance between the two anterior segments, while some of them measure the cleft width at various levels of the palate or measure the cleft area relative to the total palate area. Measurements are made both in the clinic and on plaster models [3,9,13]. In these patients, a commonly employed method for assessing the impacts of various treatment protocols involves evaluating maxillary arch dimensions and occlusion using dental casts, particularly during the deciduous and/or mixed dentition period. Different surgical treatment approaches are often compared based on the resulting outcomes in terms of maxillary arch dimensions and occlusion [5,7,14,18-21].

The aim of this study was to investigate the effect of cleft width size on maxillary morphology and to evaluate the effect of anterior cleft width on maxilla in newborns with UCLP. The null hypothesis was that cleft size was not effective on the maxillary morphology in newborn babies with UCLP.

Materials and Methods

The study was carried out on plaster models obtained from the 35 newborn babies with unilateral cleft lip and palate (UCLP) (17boys,18 girls) and 35 newborn babies with soft palate cleft (CP) (16 boys,19 girls), in the Department of Orthodontics, Faculty of Dentistry, Ege University. All infants were Caucasian, had no known syndrome and had no Simonart's band present. Alginate impressions were taken at the first appointment mean age of 1.6 months. UCLP group constituted the study group, the CP group with izole cleft in soft palate was taken as the control group. Considering that it is not ethically correct to take measurements from a normal newborn, only the group with isolated cleft in the soft palate, which did not include the hard palate and did not affect the measurements of the maxillary structure, was considered as the control group.

The reference points and linear measurements were carried out on plaster models using a measuring device. Cleft width, arch circumference, anterior and posterior arch width, and arch length were measured with a caliper by a single operator. The methodology employed in this study has been previously outlined [3,9,13]. Cleft dimensions are defined in terms of cleft widths, with anterior cleft width along the crest of the ridge, middle cleft width at the intersection of the inter-canine point line, and posterior cleft width at the intersection of the intertuberosity line.

The reference points marked on the study casts are as follows [Figure 1]:
G: Midpoint of the margin of the alveolar process medial to the cleft
L: Midpoint of the margin of the alveolar process lateral to the cleft
I: Point of intersection between the alveolar ridge and the groove of the median labial frenum
C,C': Anterior arch width; point of intersection between the alveolar ridge and the groove of the lateral labial frenum
T,T': Posterior arch width; tuberosity points, junction of the alveolar ridge with the outline of the tuberosity

Measurements marked on the study casts are as follows [Figure 1]:
C-C': Anterior alveolar arch width (cuspid region)
T-T': Posterior alveolar arch width (tuber area)
Arch circumference = T-C-I-G + L-C'-T'
Arch length = G perpendicular to T-T' line
Cleft wide:
G-L: Anterior
a-a': Middle
b-b': Posterior

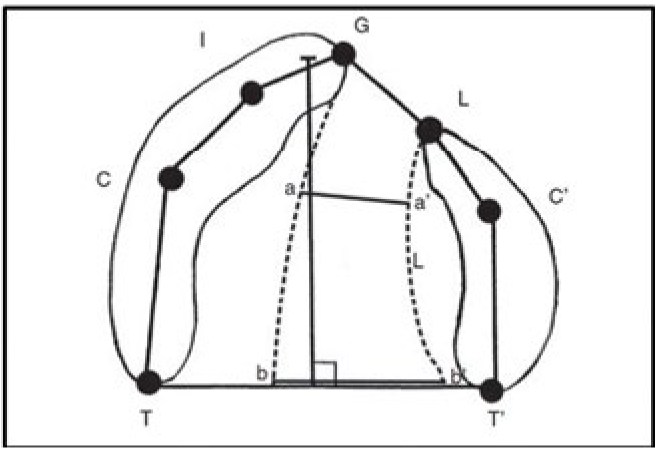

Figure 1: Reference points marked on the study casts

All subjects provided informed consent to participate, and the Declaration of Helsinki was strictly adhered to throughout the study. Written informed consent for participation and publication was obtained from the parents of each patient, following the ethical principles of the Helsinki Declaration.

Statistical Analysis

The number of participants in the study was determined through Power analysis using G Power analysis software, maintaining a significance level of 0.05. Descriptive statistics, including mean, standard deviation (SD), and range (minimum-maximum), were reported. An independent samples t-test was employed for normally distributed data, while the Mann–Whitney U test was used for non-normally distributed data. Pearson Correlation assessed the correlation between GL and other measurements. To ensure intra-examiner reliability, the examiner reanalyzed 20 measurements in 15 randomly selected plaster models from each group after a 2-week interval.

Results

The Intraclass Correlation Coefficient (ICC) values for the measurements were highly acceptable, ranging from 0.817 to 0.896, with a mean ICC of 0.865.

Table I shows the mean, standard deviation, range and the differences between UCLP and CP which was evaluated as a control group.

Measurements	UCLP (n=35)	CP (n=35)	p-value
Anterior alveolar arch width (C-C')			< 0.001 ***
Mean (SD)	26.9 ± 4.1	21.1 ± 2.4	
Range	20.0 - 34.0	16.0 - 25.0	
Posterior alveolar arch width (T-T')			0.020 *
Mean (SD)	33.7 ± 5.8	30.8 ± 2.0	
Range	18.0 - 44.0	27.0 - 35.5	
Arch circumference (T-C-I-G + L-C'-T')			0.253
Mean (SD)	57.1 ± 5.2	55.6 ± 4.2	
Range	45.0 - 66.0	45.0 - 62.5	
Arch length (G/T-T')			< 0.001 ***
Mean (SD)	28.4 ± 2.9	25.0 ± 2.6	
Range	22.0 - 34.0	21.0 - 30.0	
Anterior cleft width (G-L)			NA
Mean (SD)	10.0 ± 3.7	0.0 ± 0.0	
Range	4.0 - 17.0	0.0 - 0.0	
Middle cleft width (a-a')			< 0.001 ***
Mean (SD)	13.5 ± 3.4	2.3 ± 2.3	
Range	7.5 - 19.0	0.0 - 6.0	
Posterior cleft width (b-b')			< 0.001 ***
Mean (SD)	14.9 ± 3.6	3.6 ± 2.3	
Range	7.0 - 22.5	0.0 - 9.0	

***p<0.05, **p<0.01, ***p<0.001**

Differences in Anterior alveolar arch width C-C'(mm), Posterior alveolar arch width T-T'(mm),Arch circumference (T-C-I-G + L-C'-T') (mm), Arch length (G/T-T') (mm), Middle cleft width(a-a') (mm), Posterior cleft width (b-b') measurements were calculated by Independent sample t-test while Anterior cleft width (G-L) was measured with Mann Whitney U test.

Table 1: Comparison of the measurements (mm) between UCLP and CP

The difference in the C-C'(Anterior alveolar arch width in the cuspid region) was statistically significant between the two groups (p< 0.001). The mean (SD) was 26.9 ± 4.1 mm in UCLP group, while it was 21.1± 2.4 mm in the CP group. The difference in T-T' (Posterior alveolar arch width in the tuber area) was also statistically significant between the two groups (p< 0.05). It was 33.7± 5.8 mm for UCLP, 30.8± 2.0 mm for CP group. UCLP group demonstrated a 28.4±2.9 mm increase in Arch length (G/T-T'), which was statistically significant, while this increase was 25.0± 2.6 mm in CP (p< 0.001). Arch circumference (T-C-I-G + L-C'-T') demonstrated 57.1± 5.2 mm in UCLP group, and 55.6± 4.2 mm in CP group which was not statistically significant. Results for Middle cleft width (a-a') showed a statistically significant increase for UCLP (13.5 ± 3.4 mm), and it was 2.3± 2.3 mm in CP groups (p< 0.001). In addition, Posterior cleft width (b-b') presented statistically significant increase for UCLP (14.9± 3.6 mm), and it was 3.6± 2.3 mm in CP groups (p< 0.001) (Table I).

Table II shows the corelation between anterior cleft width (GL) and other measurements, and correlation between the other measurements in themselves in UCLP.

Measurements UCLP N:35		Anterior cleft width (G-L)	Anterior alveolar arch width (C-C’)	Posterior alveolar arch width (T-T’)	Arch circumference (T-C-I-G+L-C’-T’)	Arch length (G/T-T’)	Middle cleft width (a-a’)	Posterior cleft width (b-b’)
Anterior cleft width (G-L)	Pearson Correlation	1	,742**	0,283	0,072	-0,003	,632**	0,213
	Sig (2-tailed)		0,000	0,162	0,727	0,987	0,001	0,296
	N	26	26	26	26	26	26	26
Anterior alveolar arch width (C-C’)	Pearson Correlation	,742**	1	0,200	0,094	-0,025	,581**	0,173
	Sig (2-tailed)	0,000		0,328	0,649	0,903	0,002	0,397
	N	26	26	26	26	26	26	26
Posterior alveolar arch width (T-T')	Pearson Correlation	0,283	0,200	1	0,338	0,359	,701**	,542**
	Sig (2-tailed)	0,162	0,328		0,091	0,072	0,000	0,004
	N	26	26	26	26	26	26	26
Arch circumference (T-C-I-G + L-C’-T’)	Pearson Correlation	0,072	0,094	0,338	1	0,182	0,289	,412*
	Sig (2-tailed)	0,727	0,649	0,091		0,373	0,152	0,036
	N	26	26	26	26	26	26	26
Arch length (G/T-T’)	Pearson Correlation	-0,003	-0,025	0,359	0,182	1	-0,017	-0,171
	Sig (2-tailed)	0,987	0,903	0,072	0,373		0,933	0,403
	N	26	26	26	26	26	26	26
Middle cleft width (a-a’)	Pearson Correlation	,632**	,581**	,701**	0,289	-0,017	1	,656**
	Sig (2-tailed)	0,001	0,002	0,000	0,152	0,933		0,000
	N	26	26		26	26	26	26
Posterior cleft width (b-b’)	Pearson Correlation	0,213	0,173	,542**	,412*	-0,171	0,933	1
	Sig (2-tailed)	0,296	0,397	0,004	0,036	0,403	0,000	
	N	26	26	26	26	26	26	26

***Correlation is significant at the 0.01 level*

** Correlation is significant at the 0.05 level*

Table 2: Corelation between anterior cleft width (GL) and other measurements

Anterior cleft width (GL) shows statistically significant corelation between anterior alveolar arch width in the cuspid region (C-C’) and in the middle cleft width (a-a’) (p<0.01). Posterior alveolar arch width in the tuber area (T-T’) shows statistically significant corelation between in the middle (a-a') and in the posterior cleft wide (b-b') (p<0.01). The corelation between Arch circumference (T-C-I-G+L-C'-T') and posterior cleft wide (b-b') is significant at the 0.05 level (Table II).

Discussion

While there are few studies on the effect of cleft size on maxillary morphology in newborn, there are many studies on the primary and permanent dentition period in patients with unilateral cleft lip and palate [14,18, 22-25]. In this study, we evaluated totaly 70 plaster models obtained from the 35 newborn babies with unilateral cleft lip and palate (UCLP) (17boys,18 girls) and 35 newborn babies with soft palate cleft (CP) (16 boys,19 girls).

UCLP group were compared with CP group who has only izole cleft in soft palate. It is not ethically correct, to take impression from a normal newborn, so we considered CP group with isolated cleft in the soft palate as a control group, which did not include the hard palate and did not affect the measurements of the maxillary structure.

Heliovaara, et al. discovered that larger palatal clefts resulted in narrower palatal intercanine widths [14]. Suzuki, et al. demonstrated a significant correlation between the width of the palatal cleft at birth and the posterior arch width at 4 years of age in UCLP children [15]. In contrast, Johnson, et al. did not observe any correlation between the severity of the initial cleft and dental arch relationships at 6 years of age in patients with UCLP [10]. Hellquist, et al. found a relationship with the smallest intercanine and intermolar dimensions, as well as the highest frequency of crossbite, in patients with large palatal clefts during the deciduous dentition period [11].

According to Peltomäki, et al., there was an associations between the initial cleft width and maxillary growth in patients with UCLP [3]. They reported that the severity of initial deformity are not the same at birth while compared with at the deciduous dentition stage. They proposed that UCLP patients with a small cleft and a large arch circumference may experience different outcomes in terms of maxillary growth compared to children with a large cleft and a small arch circumference Chiu, et al., found that, there is a significant relationship between initial cleft severity and maxillary growth in patients with complete UCLP [13]. There was more protruded maxilla in patients with a small cleft area when compared with a larger cleft area at the age of 9 years.

In our study, the difference in the C-C'(Anterior alveolar arch width in the cuspid region) and the difference in T-T' (Posterior alveolar arch width in the tuber area) were statistically significant ($p< 0.001$) between the groups. Besides, middle cleft width (a-a') and posterior cleft width (b-b') presented statistically significant increase for UCLP when compared with CP groups ($p< 0.001$). So, UCLP group demonstrated an increase in arch length (G/T-T') ($p< 0.001$). But, arch circumferences (T-C-I-G + L-C'-T') were the same in two groups.When we evaluated correlations between the measurements in UCLP group; anterior cleft width (GL) shows statistically significant corelation between anterior alveolar arch width in the cuspid region (C-C') and in the middle cleft width (a-a') ($p<0.01$). So, initial cleft width severity affect anterior maxillary morphology.The differences at the posterior alveolar arch width in the tuber area (T-T') had statistically significant corelation between in the middle (a-a') and in the posterior cleft wide (b-b') ($p<0.01$). The severity of the middle and posterior cleft wide affect posterior maxillary morphology.

The results revealed a significant variation in the severity of deformities at birth and in maxillary arch dimensions between the UCLP and CP groups with isolated clefts in the soft palate. The size of the cleft in newborns is determined by tissue deficiency and the degree of separation of the maxillary segments. Treatment protocols may vary based on the severity of the initial cleft deformity. Anticipating the outcomes of treatments and maxillary growth may be linked more closely to the initial severity of the cleft rather than the specific treatment administered.

Conclusıons

Within the study's limitations, the following conclusions were drawn:

The null hypothesis was rejected, suggesting that the initial severity of the deformity may impact dental arch relationships and treatment outcomes.

Evaluation of initial cleft severity is crucial for treatment planning and predicting maxillary growth.

As anterior cleft width increases in UCLP, anterior alveolar arch width also increases.

The assessment and measurement of the initial cleft size along with the dimensions of the maxillary arch are crucial components in the process of treatment planning.

Initial treatment, comprising infant orthopedics plus cheiloplasty, influences maxillary arch dimensions. Therefore, maxillary expansion and protraction treatment should commence in the early primary dentition period, especially in cases where operations may negatively affect a wider maxillary arch. This study emphasizes the importance of considering initial cleft severity in treatment planning for patients with UCLP, guiding interventions to optimize dental arch relationships and achieve favorable treatment outcomes.

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References

1. Andersson, E. M., Sandvik, L., Abyholm, F., & Semb, G. (2010). Clefts of the secondary palate referred to the Oslo Cleft Team: epidemiology and cleft severity in 994 individuals. Cleft Palate Craniofac J, 47, 335-342.
2. Garrahy, A., Millett, D. T., & Ayoub, A. F. (2005). Early assessment of dental arch development in repaired unilateral cleft lip and unilateral cleft lip and palate versus controls. Cleft Palate Craniofac J, 42, 385-391.
3. Peltomaki, T., Vendittelli, B. L., Grayson, B. H., Cutting, C. B., & Brecht, L.E. (2001). Associations between severity of clefting and maxillary growth in patients with unilateral cleft lip and palate treated with infant orthopedics. Cleft Palate Craniofac J, 38, 582-586.
4. Han, B. J., Suzuki, A., & Tashiro, H. (1995). Longitudinal study of craniofacial growth in subjects with cleft lip and palate: from cheiloplasty to 8 years of age. Cleft Palate Craniofac J, 32, 156-166.
5. Normando, A. D., da Silva Filho, O. G., & Caplelozza Filho, L. (1992). Influence of surgery on maxillary growth in cleft lip and/or palate patients. J Craniomaxillofac Surg, 20, 111-118.
6. Bartzela, T., Leenarts, C., Bronkhorst, E., Borstlap, W.,

& Katsaros, C., et al. (2011). Comparison of two scoring systems for evaluation of treatment outcome in patients with complete bilateral cleft lip and palate. Cleft Palate Craniofac J, 48, 455-461.

7. Braumann, B., Keilig, L., Stellzig-Eisenhauer, A., Bourauel, C., & Berge, S., et al. (2003). Patterns of maxillary alveolar arch growth changes of infants with unilateral cleft lip and palate: preliminary findings. Cleft Palate Craniofac J, 40, 363-372.
8. Fudalej, P., Janiszewska-Olszowska, J., Wedrychowska-Szulc, B., & Katsaros, C. (2011a). Early alveolar bone grafting has a negative effect on maxillary dental arch dimensions of pre-school children with complete unilateral cleft lip and palate. Orthod Craniofac Res, 14, 51-57.
9. Harıla, V., Ylıkontıola, L. P., Palola, R. & Sándor, G. K. (2013). Maxillary arch dimensions in cleft infants in Northern Finland. Acta Odontologica Scandinavica, 71, 930-936.
10. Johnson, N., Williams, A., Singer, S., Southall, P., & Sandy, J. (2000) Initial cleft size does not correlate with outcome in unilateral cleft lip and palate. Eur J Orthod, 22, 93-100.
11. Hellquist, R., Ponten, B., & Skoog, T. (1978). The influence of cleft length and palatoplasty on the dental arch and the deciduous occlusion in cases of clefts of the secondary palate. Scand J Plast Reconstr Surg, 12, 45-54.
12. Reiser, E., Skoog, V., Gerdin, B., & Andlin-Sobocki, A. (2010). Association between cleft size and crossbite in children with cleft palate and unilateral cleft lip and palate. Cleft Palate Craniofac J, 47, 175-181.
13. Chiu, Y. T., Liao, Y. F., & Chen, P. K. (2011). Initial cleft severity and maxillary growth in patients with complete unilateral cleft lip and palate. Am J Orthod Dentofacial Orthop, 140, 189-195.
14. Heliovaara, A., & Ranta, R. (1993). One-stage closure of isolated cleft palate with the Veau- Wardill-Kilner V to Y pushback procedure or the Cronin modification. III. Comparison of lateral craniofacial morphology. Acta Odontol Scand, 51, 313-321.
15. Suzuki, A., Mukai, Y., Ohishi, M., Miyanoshita, Y., & Tashiro, H. (1993). Relationship between cleft severity and dentocraniofacial morphology in Japanese subjects with iso- lated cleft palate and complete unilateral cleft lip and palate. Cleft Palate Crani- ofac J, 30, 175-181.
16. da Silva Filho, O., Valladares Neto, J., Capelozza Filho, L., & de Souza Freitas, J. (2003). Influence of lip repair on craniofacial morphology of patients with complete bilateral cleft lip and palate. Cleft Palate Craniofac J, 40, 144-153.
17. Dahl, E., Kreiborg, S., Jensen, B. L., & Fogh-Andersen, P. (1982). Comparison of craniofacialmorphologyin infants within complete cleft lip and infants with isolated cleft palate. Cleft Palate J, 19, 258-266.
18. Johnson, N., Williams, A., Singer, S., Southall, P., & Sandy, J. (2000). Initial cleft size does not correlate with outcome in unilateral cleft lip and palate. Eur J Orthod, 22, 93-100.
19. Hermann, N. V., Darvann, T. A., Jensen, B. L., Dahl, E., & Bolund, S., et al. (2004). Early craniofacial morphology and growth in children with bilateral complete cleft lip and palate. Cleft Palate Craniofac J, 41, 424-438.
20. Mazaheri, M., Athanasiou, A. E., Long, R. E., & Jr. Kolokitha, O. G. (1993). Evaluation of maxillary dental arch form in unilateral clefts of lip, alveolus, and palate from one month to four years. Cleft Palate Craniofac J, 30, 90-93.
21. Stellzig, A., Basdra, E., Hauser, C., Hassfeld, S., & Komposch, G. (1999). Factors influencing changes in maxillary arch dimensions in unilateral cleft lip and palate patients until six months of age. Cleft Palate Craniofac J, 36, 304-309.
22. Nystrom, M., & Ranta, R. (1989). Sizes of dental arches and interdental space in 3-year-old children with and without cleft lip/palate. Eur J Orthod, 11, 82-88.
23. Parwaz, M. A., Sharma, R. K., Parashar, A., Nanda, V., & Biswas, G., et al. (2009). Width of cleft palate and postoperative palatal fistula--do they correlate? J Plast Reconstr Aesthet Surg, 62, 1559-1563.
24. Eichhorn, W., Blessmann, M., Vorwig, O., Gehrke, G., & Schmelzle, R., et al. (2011). Heiland M. Influence of lip closure on alveolar cleft width in patients with cleft lip and palate. Head and Face Medicine, 7, 3.
25. Reiser, E., Skoog, V., & Andlin-Sobocki, A. (2013). Early dimensional changes in maxillary cleft size and arch dimensions of children with cleft lip and palate and cleft palate. Cleft Palate-Craniofacial Journal, 50, 481-490.