InJO (Indonesian Journal of Orthodontics)
Desember 2024; 1(2): 49-57

Original article

The differences of skeletal pattern relations of non-syndromic cleft lip and palate patients between male and female

Cut Myra Angela[1], Avi Laviana[2], Elih Sayuti[2], Ida Ayu Evangelina[2], Endah Mardiati[2]

[1]Post Graduate Program of Orthodontics, Faculty of Dentistry, Universitas Padjadjaran, Bandung, West Java, Indonesia
[2]Department of Orthodontics, Faculty of Dentistry, Universitas Padjadjaran, Bandung, West Java, Indonesia

ABSTRACT

Background: Non-syndromic cleft lip and palate (nsCLP) is a congenital anomaly affecting the craniofacial structures where there is a congenital abnormal cleft that affects the upper lip, alveolous and palate. There are various problems that arise due to cleft lip and palate conditions, one of them is skeletal problems. Inhibited maxillary growth in nsCLP patients can cause differences in skeletal relation patterns. **Objective**: This study aims to assess the pattern of skeletal relationships in nsCLP patients by lateral cephalogram analysis. **Methods**: A cross-sectional study conducted by analyzed 33 lateral cephalograms of nsCLP patients. Analysis was performed using the Steiner and Downs method with the Webceph application. **Results**: Skeletal relation class III type 1 (Salzmann) and class III classification Cluster 3 (Bui) are the most commonly experienced by nsCLP patients, both female (33.33%) and male (27.27%). The pattern of skeletal class I relationships showed a greater difference in the female group (15.15%) than the male group (9.09). Class II skeletal relation patterns were more common in the male group (12.12%) than the female group (3.03%) **Conclusion**: there was no overall difference in skeletal relationship patterns between male and female nsCLP patients at RSGM Unpad. Class III was the dominant skeletal pattern, followed by Class I and Class II, with sex-related differences observed only in Class I and Class II patterns.

Keywords: cephalometry; non-syndromic cleft lip and palate; nsCLP skeletal relation patterns

Correspondence: Avi Laviana, Department of Orthodontics, Faculty of Dentistry, Universitas Padjadjaran, Jl. Sekeloa Selatan 1 Bandung, Indonesia. E-mail: avi.laviana@unpad.ac.id

INTRODUCTION

Cleft lip and palate is a congenital disorder that occurs when the baby's lips or mouth are not formed properly during pregnancy. Cleft lip and palate generally occur in the early 4th week of pregnancy.[1] Cleft lip and palate can occur separately or simultaneously. Clefts can be classified anatomically as cleft lip (CL) alone, cleft palate (CP) alone, and various combinations of these two types based on differences in embryological development. Even though the presence of a cleft lip and palate is not too life-threatening, this condition causes disturbances in facial appearance (especially if no treatment is given), disrupts the communication process, and results in limitations in the social development of individual cleft lip and palate patients.[2,3]

Prevalence of Cleft Lip and Palate (CLP) can vary by gender, ethnic group and geographic location. The difference is between 0.14 -0.7/1,000 live births, while Cleft Palate (CP) occurs between 0.05-0.7 per 1,000 live births.[4,5] Cleft lip and palate have a very variable incidence rate in a population. The highest incidence is in Asians and Native Americans (1/700 live births) and the lowest incidence is in Africans (1/2500 live births).[4,6] Abnormalities reached 0.41%, and 0.12% of them were children with cleft lips based on the 2018 Basic Health Research (Riskesdas).[7] The International Cleft Lip and Palate Training Center estimates that 7,500 children in Indonesia suffer from cleft lip with or without cleft palate per year.[7] The incidence of children aged 24-59 months suffering from one type. The etiology of cleft lip and palate is unknown, but most of the causes are multifactorial due to the interaction of genetic and environmental factors. Genetic factors such as ethnic factors,

race, environmental factors such as: geographic location and socio-economics, the mother's age at the time of pregnancy being more than 35 years or less than 20 years, infections and exposure to chemical substances (for example: pesticides, lead), consuming drugs (for example: anti-convulsant drugs), alcohol, malnutrition and nutritional deficiencies (for example: folic acid, multivitamins), or smoking are also etiologies of cleft lip and palate.[3,7]

Prevalence of malocclusion in cleft lip and palate patients shows differences in various countries. The most common malocclusion in patients with cleft lip and palate in the Danish population is class III malocclusion (70%) followed by class I malocclusion 30%.[8,9] Class III malocclusion was the most common (72%) followed by class I malocclusion (18.5%) and class II malocclusion (9%) in the South Korean population.[10] Most cleft lip and palate patients have class III malocclusion, large mandibular length and increased vertical growth of the maxilla in the Mexican population.[11] The Spanish study also observed the prevalence of a skeletal Class III pattern in patients with unilateral CLP and a skeletal Class I pattern in patients with bilateral CLP.[12] The results of several studies above show that the highest prevalence of malocclusion in cleft lip and palate patients is class III malocclusion.[13]

MATERIALS AND METHODS

This research is a cross-sectional comparative study which aims to determine the skeletal relationship patterns of non-syndromic cleft lip and palate patients between male and female at Universitas Padjajaran Dental School and Hospital (RSGM Unpad) Bandung, Indonesia. This research has obtained permission from the Padjadjaran University research ethics committee number 531/UN6.KEP/EC/2023.

The population of this study were all lateral cephalogram photographs of non-syndromic cleft lip and palate patients at RSGM Unpad in 2013 – 2023 who have the inclusion criteria. Inclusion criteria for all lateral cephalogram radiographs of non-syndromic cleft lip and palate patients at RSGM Unpad were the chronological age of non-syndromic cleft lip and palate patients above 7 years. The exclusion criteria in this study were samples with a history of orthodontic treatment, the quality of the lateral cephalogram was poor so the cephalogram could not be interpreted. A cross-sectional study conducted by analyzed 33 lateral cephalograms of nsCLP patients. Analysis was performed using the Steiner and Downs method with the Webceph application.

RESULTS

Research was conducted on 33 cephalometric radiographs of non-syndromic cleft lip and palate patients at RSGM UNPAD. The calibration test was carried out by conducting two analyzes by two operators (inter-examiner calibration) with an interval of 5 days on 5 randomly selected lateral cephalogram samples. The results of the calibration test on the five research samples showed a p-value > 0.05 so that there was no significant difference in the lateral cephalogram analysis between the two operators. The p-value in sample 1 was 0.13, the p-value in sample 2 was 0.23, the p-value in sample 3 was 0.22, the p-value in sample 4 was 0.35, the p-value in sample 5 is 0.17 with non-significant results and the conclusion is that there are similarities between the two operators.

Table 1 distribution of cephalometric radiograph research subjects based on gender and cleft type at RSGM UNPAD. The data presented in the table above shows that out of a total of 33 samples, most of the subjects were cephalometric radiographs of 17 female patients (51.52%) while 16 radiographs (48.48%) were male. Based on the non-syndromic type of cleft lip and palate, cephalometric radiographs found in patients with unilateral clefts of 54.55%, more than bilateral clefts of 18.18%, with most of the unilateral clefts occurring on the left side of 54.55%. Left unilateral clefts are the most common clefts found in male and female.

Table 1. Distribution of nsCLP patients based on gender and type of cleft lip and palate (n=33)

Type Sex	Bilateral Clefts		Unilateral Cleft				Total	
			Right		Left			
	f	%	f	%	f	%	f	%
Male	3	9.09	5	15.15	8	24,24	16	48,48
Female	3	9.09	4	12.12	10	30.30	17	51.52
Total	6	18.18	9	27.27	18	54.55	33	100.00

*f : Frequency; %: Percentage

Table 2. Skeletal relationship patterns of nsCLP patients by gender

Class	Female		Male		Total		p-values	Note
	n	%	n	%	n	%		
I	5	15.15	3	9.09	8	24.24	0.3915	Not significant
II	1	3.03	4	12.12	5	15.15	0.3888	Not significant
III	11	33.33	9	27.27	20	60.61	0.3840	Not significant
Total	17	51.52	16	48.48	33	100.00	-	-

Table 3. Distribution of class II nsCLP patients based on class II type and gender

Gender	**Class II**			**Total**
	Type 1	**Type 2**	**Type 3**	
Male	2 (40%)	2 (40%)	0 (0%)	4 (80%)
Female	1 (20%)	0 (0%)	0 (0%)	1 (20%)
Total	3 (60%)	2 (40%)	0 (0%)	5 (100%)

Table 4. Distribution of Class III Types by Gender

Gender	**Class III**			**Total (%)**
	Type 1 (%)	**Type 2 (%)**	**Type 3 (%)**	
Male	8 (40%)	1(5%)	0 (0%)	9 (45%)
Female	8 (40%)	2 (10%)	1 (5%)	11 (55%)
Total	**16 (80%)**	**3 (15%)**	**1 (5%)**	**20 (100%)**

Table 5. Class III Phenotype Clusters by Gender

Class III	Gender		Total
	Male (%)	Female (%)	
Cluster 1	0 (0%)	0 (0%)	0 (0%)
Cluster 2	1 (5%)	0 (0%)	1 (5%)
Cluster 3	3 (15%)	6 (30%)	9 (45%)
Cluster 4	1 (5%)	2 (10%)	3 (15%)
Cluster 5	4 (20%)	3 (15%)	7 (35%)
Total	9 (45%)	11 (55%)	20(100%)

Table 2 shows the class III relationship pattern most commonly experienced by non-syndromic cleft lip and palate patients, both female (33.33%) and male (27.27%). Classification of the pattern of skeletal class I relationships shows differences in group female (15.15%) greater than the number group male (9.09%). Class II skeletal relation patterns also show different results in group female and male samples. The pattern of class II skeletal relationships is more in group male (12.12%) compared group female (3.03%). Based on the comparative p-value test in table 2, it can be seen that there is no differences in patterns of skeletal relationships of female and male on nsCLP subject at RSGM Unpad. Class I p-values 0.3915, Class II p-value 0.3888, Class III p-value 0.3840 (p-value > 0.05).

Table 3 describes the most numerous male group in the classification of class II skeletal patterns, 4 (80%) which fall into type 1, 2 (40%)

and type 2 (40%). The female group only got 1 type, namely type 1, 1 (20%).

Table 4 describes the most numerous group of female in the classification of class III skeletal patterns with a total of 11 subjects (55%) which are divided into 3 types (Salzmann Classification), where Type 1 is the most type of 8 (40%) then type 2 is 2 (10 %) and type 3 (5%). There were 9 subjects (45%) who were included in the class III skeletal pattern classification, which were divided into 3 types (Salzmann Classification), where Type 1 was the dominant type by 8 (40%) then type 2 by 1 (5%) and there are no subjects with type 3.

Table 5 shows the skeletal relationship pattern of class III. Cluster 3 is the most common subphenotype in this study at 9 (45%) with the female group being 6 (30%) greater than the male group 3 (15%) followed by Cluster 5 which is 7. (35%), with the female group being 3 (15%) smaller than the male group being 4 (20%). Next Cluster 4 showed results of 3 (15%) with the female group being 2 (10%) larger than the male group 1 (5%). Cluster 2 showed a result of 1 (5%) and no subjects were found that fit into the criteria for cluster 1.

DISCUSSION

This research was conducted to determine skeletal relationship patterns non-syndromic cleft lip and palate patients and the differences between male and female at RSGM Unpad. The study was conducted on 33 subjects, with female subjects (51.51%) and male subjects (48.48%) with different types of clefts, this is not in line with the research which explained that the frequency of nsCLP in male subjects occurred twice as much as in female subjects.[14] Differences in research results can be caused by limited research samples.

Left unilateral cleft type was the most common cleft type experienced by patients with frequency (54.54%), followed by the right unilateral cleft type (27.27%) and the least cleft type was the bilateral cleft type (18.18%). The findings of this study are consistent with previous reports indicating that left unilateral clefts are the most frequently observed type among patients with non-syndromic cleft lip and palate.[8,15] Several studies have shown the same results, unilateral cleft patients were found to be more frequent than bilateral clefts, with most of the unilateral clefts occurring on the left side.[7,8,14,16–18] Most clefts affecting the lip are unilateral in nature, accounting for roughly 75% of cases, with a marked predominance on the left side compared to the right.[14,18] The reason the left side is more impacted than the right side is that the right side of the fetal head has better perfusion because the blood vessels leaving the aortic arch are close to the heart on this side, compared to the left side[3]. The distribution of cleft laterality in a Pakistani population differed by sex, with females demonstrating a left-sided predominance and males exhibiting a right-sided predominance.[3] The prevalence of bilateral nsCLP is more common in male, while unilateral nsCLP are usually more common in female.[3] This study has the same results as this study.

Skeletal relationship patterns that have been analyzed using the Steiner and Downs method in this study generally show that the SNA values indicate a good retrognathic maxilla in group boy and girl. The SNB scores of both, are good at group both males and females showed normal mandibles. ANB values in male and female both showed skeletal class III classification. Occlusal Value-SN on group female and male show normal facial growth patterns. GoGn-SN value on group both females showed normal mandibular rotation. This research is in line with research in the Mexican population.[11]

Results of the SNA value indicate a retrognathic maxilla. Based on the theory that patients with cleft lip and palate experience delayed maxillary growth leading to maxillary retrusion.[11] Many authors agree that delayed development of the maxilla is a consequence that occurs due to the presence of clefts and it is also certain that the malformation occurs

from the beginning, not as a result of surgery. The development and position of the maxilla is due to several factors such as genetics, severity of cleft lip and palate, individual growth ability, scar formation, surgical management and patient cooperation.[11]

The results demonstrated a normal mandibular position based on the mean SNB value, which is inconsistent with earlier studies in the Indian population that identified mandibular retrognathism among patients with cleft lip and palate.[6,19,20] The ANB values in this study indicated similar skeletal Class III relationships in both male and female subjects. This skeletal pattern was primarily associated with maxillary retrognathism and is consistent with findings reported in previous studies.[6] Class II cases with anteroposterior skeletal discrepancy were characterized by large ANB angles and Wits Appraisal, reflecting the malrelationship between maxilla and mandible. Anteroposterior skeletal differences may also be accompanied by vertical differences, for example, relatively long or short anterior faces.[21]

The pattern of skeletal relationships in this study showed that the most common class III relationship pattern was experienced by non-syndromic cleft lip and palate patients, both female (33.33%) and male (27.27%). This research is in line with several studies conducted Several studies have reported that the predominant skeletal relationship pattern observed was skeletal Class III.[9,15,22,23] Children born with cleft lip and palate commonly present with Class III malocclusion, predominantly resulting from maxillary deficiency. Other research stated that craniofacial changes in the middle face and mandible were previously related to the presence of a cleft which was related to dentofacial deformity caused by the cleft itself. Maxillary deficiency in subjects during the growth and development period which, if left untreated, can cause severe functional, aesthetic, respiratory and psychological problems.[13,24,25]

Patients with cleft lip and palate mostly experience class III skeletal malocclusion, this is not only caused by maxillary deficiency but also due to scar tissue that appears after surgery.[15,26,27] In addition, patients with cleft lip and palate are known to have a more vertical growth pattern than normal patients without clefts and will maintain their initial vertical pattern throughout the growth process.[26] Maxillary growth disorders, changes in mandibular morphology, and adaptation of mandibular growth to maxillary growth are also causes of nsCLP patients experiencing class III skeletal patterns.[10]

There are differences in the skeletal relationship patterns of class I and class II group boy and girl. Class I skeletal relationship patterns show differences in group female (15.15%) greater than the number group male (9.09). Class II skeletal relation patterns also show different results in group female and group male. Class II skeletal relation patterns are more common in group male (12.12%) compared group female (3.03%). This research is different from research conducted by Qadeer et al.[3] who in his research stated that in the Pakistani population with cleft lip and palate, class II skeletal relationship patterns were more common than class I.[3]

Salzmann skeletal classification class I is defined as the relationship of the mandible to the maxilla which is in a harmonious or ideal position at the time of occlusion, so there is no additional type for skeletal classification. However, Salzmann then added a class I skeletal division, namely, Division 1: inappropriate incisor, canine and premolar relationships. Division 2: Protrusive maxillary incisors. Division 3: retrusive maxillary incisors. Division 4: Bimaxillary protrusion. The division is added by looking at the relationship of dental relations. Results of this study found that class I skeletal pattern was the most common skeletal pattern after class III, in the female group it was seen more in the left unilateral cleft type, but in male it was seen more in the right unilateral cleft type. This study is in line with research conducted on Pakistani populations. The south Indian population the highest prevalence in nsCLP patients was a class II skeletal relationship pattern, although the results of his study found

that the position of the maxilla and mandible was mostly retrognathic and retropositioned. The prognosis for the treatment outcome of patients with nsCLP with a skeletal Class I relationship is good. The propensity for post-hospital relapse in patients with a skeletal class I pattern is low.[6]

Class II classification according to Salzmann there are 3 types, Salzmann distinguishes the type from class II based on the position of the mandible. Type 1: normal maxilla, retrognathic mandible, type 2: prognathic maxilla, normal mandible, type 3: prognathic maxilla, retrognathic mandible. The results of this study explained that in male subjects experiencing a pattern of skeletal class II relationships type 1 (50%) and type 2 (50%), in type 3 there were no research subjects. The same is true for female subjects, only found in type 1 (normal maxilla, retrognathic mandible) (20%), types 2 and 3 did not have research subjects. When associated with the type of cleft lip and palate, right unilateral is the most common type found in the class II skeletal relationship pattern. The results of this study are in line with research conducted by Romanini et al.[27] demonstrated a skeletal class II pattern to have a high frequency in patients with unilateral cleft type in a Brazilian population. However, the research in class II was different from the research which states that the bilateral cleft type is the most dominant type in class II skeletal relations in the Pakistani population.[3]

Salzmann also differentiated skeletal class III into 3 types, Type 1: retrognathic maxilla, normal mandible. Type 2: Maxilla normal, mandible prognathism. Type 3: prognathic maxilla, retrognathic mandible. The results of this research showed that Type 1 was the most dominant type in both male and female groups. Almost all nsCLP patient subjects with skeletal class III had retrognathic maxillae, normal mandible, and the left unilateral cleft type was the most dominant in this skeletal class III classification. This research is in line with research that has been conducted by many researchers which states that the skeletal class III relationship pattern is most commonly found in nsCLP patients with unilateral cleft type.[9,15,22,23]

Results in this study showed that class III was the most dominant pattern of skeletal relationships, so the researchers divided it based on sub-phenotypes according to Bui, conducted a systematic cluster analysis to determine the classification of subjects to describe skeletal Class III malocclusions and divided class III into 5 clusters. This study shows the results of the pattern of skeletal relationships class III Cluster 3 (maxillary deficiency, high angle) is the most numerous subphenotype (45%) with the female group being larger (30%) than the male group (15%), followed by Cluster 5 (combination or normal), Cluster 4 (moderate mandibular prognathism – normal), Cluster 2 (Maxillary deficiency, low angle) and no subjects were found who fit into the criteria for cluster 1 (Prognathi mandibles, long face). This research is in line with the research which stated that cluster 3 had the highest number of subjects, while cluster 1 had the least.[28]

Results of this study showed that in the male subject group the left unilateral cleft type was the most common type of cleft in the class III relationship pattern with the most cluster 3 grouping (15%) followed by Cluster 5 (10%). The types of right bilateral and unilateral clefts showed the same results, both of them showed results (10%) for each type of cleft, but there were differences in the distribution of clusters. The right unilateral cleft type was divided into Cluster 4, 1 (5%), and cluster 5, 1 (5%). The bilateral cleft type was divided into Cluster 2, 1 (5%), and Cluster 5, 1(5%). Research on the Korean population showed that in unilateral nsCLP patients most often found a class III skeletal pattern.[10] A predominance of skeletal Class III in both males and females was observed and was associated with unilateral non-syndromic cleft lip and palate, although classification of cleft types into Class III subphenotypes has not been previously investigated.[3,15]

Class III skeletal relationship pattern type 1 (retrognathic maxilla, normal mandible) and Clusters 3 (maxillary deficiency, high

angle) is the most common division of skeletal relationship patterns in this study. The unilateral cleft type is also the most common type of cleft found in skeletal Class III relationship patterns. This research relating the type of cleft to skeletal classification is in accordance with research which states that the skeletal class III classification is dominant in both sexes, both male and female and in the unilateral cleft type with a female class III skeletal relationship pattern has more impact.[3] This is in accordance with the study which said that patients with CLP showed delays in maxillary growth, which resulted in maxillary retrognathism, and in their next study proved that in nsCLP patients retroposition of the maxilla occurred.[6]

The Author realizes that the weakness of this study is the limited number of lateral cephalogram radiograph samples, although there are many nsCLP subjects, not all of them take lateral cephalometric radiographs. More samples can be selected according to the type of cleft lip and palate so that the results of the study can produce more accurate and comprehensive conclusions.

CONCLUSION

The conclusions from this research are: There is no differences in patterns of skeletal relationship between groups of female and male on nsCLP subject at RSGM Unpad. The most common pattern of skeletal relationships in nsCLP subject is a class III skeletal type 1 (Salzmann) retrognathic maxilla, normal mandible and classification class III Cluster 3 (Bui) maxillary deficiency, high angle. This relationship pattern is most common in the left unilateral cleft type.

REFERENCES

1. Ma K, Du M, Luo C, Liu Q, Wei Q, Liao M.The relationship between cleft lip and palate children with their trace elements in serum. Int J Clin Exp Pathol. 2016; 9(5): 5665-5672 https://e-century.us/files/ijcep/9/5/ijcep0018836.pdf
2. Dewi PS. Management of cleft lip and palate (Literature Review). Interdental Jurnal Kedokteran Gigi. 2019; 15 (1): 25-29. doi: 10.46862/interdental.v15i1.340
3. Qadeer M, Jaafar S, Khamis MF, Khan H, Khan T, Saeed MQ. Assessment of skeletal relationships in cleft palate with or without cleft lip: A cone-beam computed tomography study in a Pakistani population. Niger J Clin Pract. 2022; 25(10): 1699-1703. doi: 10.4103/njcp.njcp_177_22
4. Srivastav S, Tewari N, Duggal R, Goel S, Rahul M, Mathur VP, et al. Cone-Beam Computed Tomographic assessment of maxillary sinus characteristics in patients with cleft lip and palate: A systematic review and meta-analysis. Cleft Palate Craniofac J. 2023; 60(6): 742-751. doi: 10.1177/10556656221080359
5. Yılmaz HN, Özbilen EÖ, Üstün T. The prevalence of cleft lip and palate patients: A single-center experience for 17 years. Turk J Orthod. 2019; 32(3): 139-144. doi: 10.5152/turkjorthod.2019.18094
6. Johnson M, Kuriakose M, Varma NS, Ajith V, Subash P. Cephalometric evaluation of skeletal base relationship in patients with cleft lip and palate in a tertiary hospital in South India. J Cleft Lip Palate Craniofacial Anomalies. 2020; 7(2): 89. doi: 10.4103/jclpca.jclpca_2_20
7. Ni Fitrie R, Hidayat M, Dahliana L. Incidence rate of cleft lip with or without cleft palate at foster foundation for patients with cleft lip and palate (YPPCBL). J of Medicine and Health. 2022; 4(1): 12. doi:10.28932/jmh.v4i1.3396
8. Yılmaz HN, Özbilen EÖ, Üstün T. The prevalence of cleft lip and palate patients: A single-center experience for 17 years. Turk J Orthod. 2019; 32(3): 139-144. doi: 10.5152/turkjorthod.2019.18094
9. Paradowska-Stolarz A, Kawala B. Occlusal disorders among patients with total clefts of lip, alveolar bone, and palate. Biomed Res Int. 2014: 1-6. doi: 10.1155/2014/583416

10. Seo YJ, Park JW, Kim YH, Baek SH. Initial growth pattern of children with cleft before alveolar bone graft stage according to cleft type unilateral cleft lip and alveolus, unilateral cleft lip and palate, and cleft palate. Angle Orthodontist. 2011; 81(6): 1103-1110. doi: 10.2319/030411-159.1
11. Burak MY, Ponglertnapakorn A, Calderón EGG. Analysis of the cephalometrics skeletal and dental characteristics of adult patients with cleft lip and palate who received orthopedic, orthodontic and or surgical treatment during their childhood and adolescence. Revista Mexicana de Orthodontia. 2015; 3(1): 22-32. doi: 10.1016/j.rmo.2016.03.008
12. López-Giménez A, Silvestre-Rangil J, Silvestre FJ, Paredes-Gallardo V. Craniofacial cephalometric morphologies in different cleft types: a retrospective cross-sectional study of 212 patients. Oral Radiology. 2018; 34(2): 127-135. doi: 10.1007/s11282-017-0290-z
13. Deeksheetha AN kareem. Prevalence of Class I, II, III Malocclusion in patients with bilateral cleft lip and palate. European Journal of Molecular & Clinical Medicine. Published online 2020. Accessed April 15, 2023. https://ejmcm.com/?_action=xml&issue=71
14. Leslie EJ, Marazita ML. Genetics of cleft lip and cleft palate. Am J Med Genet C Semin Med Genet. 2013; 163(4): 246-258. https://www.jscimedcentral.com/jounal-article-info/JSM-Dentistry/Genetics-of-Cleft-Lip-and-Palate-%E2%80%93--Is-it-still-patchy-10236#
15. Yang IH, Choi JY, Baek SH. Characterization of phenotypes of skeletal Class III malocclusion in Korean adult patients treated with orthognathic surgery using cluster analysis. Angle Orthodontist. 2022; 92(4): 537-546. doi: 10.2319/081421-635.1
16. Alam MK, Haque S, Khursheed M. Common dental anomalies in cleft lip and palate patients. Malays J Med Sci. 2015; 22(2): 55-60.
17. Vyas T, Gupta P, Kumar S, Gupta R, Gupta T, Singh H. Cleft of lip and palate: A review. J Family Med Prim Care. 2020; 9(6): 2621. doi: 10.4103/jfmpc.jfmpc_472_20
18. Gallagher ER, Collett BR, Barron S, Romitti P, Ansley T, Wehby GL. Laterality of oral clefts and academic achievement. Pediatrics. 2017; 139(2). doi: 10.1542/peds.2016-2662
19. Bishara SE, Orth D, William MS, Iversen W.Cephalometric Comparisons on the Cranial Base and Face in Individuals with Isolated Clefts of the Palate. Journal of Cleft Palate. 1974; 11: 162-75.
20. Dahl E, Kreiborg DDSS, Leth Jensen DDSB, Fogh-Andersen DDSP. Comparison of Craniofacial Morphology in Infants with Incomplete Cleft Lip and Infants with Isolated Cleft Palate; 1982.
21. Bishara SE. Class II malocclusions: Diagnostic and clinical considerations with and without treatment. Semin Orthod. 2006; 12(1): 11-24. doi: 10.1053/j.sodo.2005.10.005
22. López-Giménez A, Silvestre-Rangil J, Silvestre FJ, Paredes-Gallardo V. Craniofacial cephalometric morphologies in different cleft types: a retrospective cross-sectional study of 212 patients. Oral Radiol. 2018; 34(2): 127-135. doi: 10.1007/s11282-017-0290-z
23. Khanna R, Tikku T, Verma S, Verma G, Dwivedi S. Comparison of maxillofacial growth characteristics in patients with and without cleft lip and palate. J Cleft Lip Palate Craniofacial Anomalies. 2020; 7(1): 30. doi: 10.4103/jclpca.jclpca_22_19
24. Liberton DK, Verma P, Almpani K, Fung PW, Mishra R, Oberoi S, et al. Craniofacial Analysis May Indicate Co-Occurrence of Skeletal Malocclusions and Associated Risks in Development of Cleft Lip and Palate. J Dev Biol. 2020; 8(1): 2. doi: 10.3390/jdb8010002
25. Steegman RM, Klein Meulekamp AF, Dieters A, Jansma J, van der Meer WJ, Ren Y. Skeletal changes in growing cleft patients with class III malocclusion treated with bone anchored maxillary protraction—a 3.5-year follow-up. J Clin Med. 2021; 10(4): 1-13. doi: 10.3390/jcm10040750

26. da Silva Filho OG, Valladares Neto J, Capelloza Filho L, de Souza Freitas J. Influence of Lip Repair on Craniofacial Morphology of Patients with Complete Bilateral Cleft Lip and Palate. The Cleft Palate Craniofacial Journal. 2003; 40(2): 144-153.
doi: 10.1597/1545-1569_2003_040_0144_iolroc_2.0.co_2
27. Romanini RCS. Craniofacial features of operated unilateral complete cleft lip and palate children: a case control study. RGO - Revista Gaúcha de Odontologia. 2014; 62(4): 383-388. https://www.scielo.br/j/rgo/a/9MKqNRY44FQ3zDt5RTYrNrJ/?format=pdf&lang=en
28. Bui C, King T, Proffit W, Frazier-Bowers S. Phenotypic characterization of class III patients a necessary background for genetic analysis. 2006; 76.
doi: 10.1043/0003-3219(2006)076[0564:pcocip]2.0.co;2