The correlation between the severity of anterior crossbite and skeletal deformities in post-surgery cleft lip and palate among children

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ABSTRACT

Introduction: Cleft lip and palate is the most common craniofacial malformations, which is a congenital deformity of lip and palate or both. Anterior crossbite is occlusal characteristics that are often found in patients with cleft lip and palate who had surgery, caused by dentoalveolar or skeletal abnormalities, can be distinguished based on the cephalometric analysis. This research was aimed to analyse the correlation between the severity of anterior crossbite and skeletal deformities in post-surgery cleft lip and palate among children. **Methods:** The research design was an analytic correlation with the sample selection based on purposive sampling. The research was conducted from 14 cleft lip and palate patients in the primary dentition (aged 4-6 years old) who had surgery (for 2-3 years) using analysis of study models and cephalometric digital. Statistical analysis was conducted by Spearman Rank Correlation Coefficient test to analyse the relationship between the severity of anterior crossbite with skeletal deformities. **Results:** Statistic test showed that 42.86% of the anterior crossbite in the cleft lip and palate post-surgery in primary dentition had a very high level of severity, thus leading to very poor occlusion. As many as 21.43% had a high level of severity, which leads to poor occlusion, and 35.71% had a moderate level of severity, which leads to fair occlusion. The Spearman Coefficient of Rank Correlation test results showed a weak correlation between the severity of anterior crossbite with skeletal deformities with coefficient relation of 0.13 and p-value of 0.48 ($p<0.05$). **Conclusion:** There is a weak correlation between the severity of anterior crossbite with skeletal deformities in post-surgery cleft lip and palate among children.

Keywords: Anterior crossbite, skeletal deformities, cleft lip and palate.

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INTRODUCTION

Cleft lip and palate (CLP) is a craniofacial malformation categorized as the most common health problem found in humans by the World Health Organization (WHO).[1] According to Kim and Back the frequency of CLP occurrence in Asians is higher than in other races.[2] The incidence of CLP in the United States is estimated at 1 in 700 births.[3] CLP patients in Indonesia are often encountered, but there is not much data on the number of CLP patients in Indonesia that supports this. The number of people with CLP that is not treated in Indonesia reaches 5,000-6,000 cases per year, it is estimated that it will increase by 6,000-7,000 cases per year.[4] CLP based on etiology can be divided into syndromic and non syndromic. Around 70% of CLP cases are non syndromic that is not associated with other disorders.[5] Appropriate CLP etiology is still unknown, but a number of studies have found a possible causative factor. The combination of exogenous factors and gene patterns are the predisposition that causes the greatest number of CLPs. Most cases show no single factor identified as the causes.[6] The severity of CLP at birth varies with the degree of segregation of the maxillary segment and the tissue deficiency that determines the size of cleft in infants.[7] Complex problems can affect a child masticatory function, speech, hearing, dental, facial appearance and psychosocial development.[8]

Treatment performed in CLP patients with labioplasty and palatoplasty surgery has the objective of function and aesthetic improvement. Scar tissue after wound healing post operative inhibit facial growth of the face, causing the occurrence of constriction of the maxilla. Research conducted by Bardach et al.[9] shows there is a facial growth disorder caused by the pressure of lip scar tissue and postoperative palate on rabbits and dogs that have lips, palatum and alveolar defects one side. Wide cleft in infants with cleft lip and palate unilaterally potentially indicates a large degree of tissue deficiency and leads to more difficult surgical closure that tends to result in maxillary constriction characterized by a higher incidence of cross breaking bites.[10]

An anterior crossbite is an occlusion abnormality associated with the position of the maxillary incisive teeth located on the lower incisive mandibular incisors.[11] The method used to assess the frequency and severity of the crossbites is by the Huddart-Bodenham system, the maxillary teeth are valued by their relation to the mandibular teeth. The severity of anterior cross bite according to Huddart-Bodenham is based on the negative distance of the overjet, if the value is -3 then the patient is categorized as having severe anterior crossbite.[12]

An anterior crossbite can be caused by a dentoalveolar or skeletal abnormality, which can be distinguished based on the results of cephalometric photo analysis. Several previous studies have suggested that most CLP patients have a maxilla and mandible relationship with a class III skeletal type at the permanent dental stage. The association between anterior crossbites of class III skeletal type in post-surgical CLP patients in the period of primary teeth has not been studied, therefore the authors want to investigate the presence of anterior cross-bite relationship to class III skeletal type in post-surgery CLP patients in the primary teeth period.

The problem of this study was whether there is an anterior crossbite on CLP patients in the period of deciduous teeth post surgery and how the relationship between the severity of anterior crossbite on the type of skeletal Class III CLP patients in the period of deciduous teeth post surgery. The research objective was to analyse the correlation between the severity of anterior crossbite and skeletal deformities in post-surgery cleft lip and palate among children.

METHODS

The study was conducted using analytic correlational study design to analyze two variables, namely the severity of anterior crossbite and skeletal abnormalities with statistical analysis of Spearman Rank Correlation Coefficient. The sample selection based on purposive sampling depends on the used criteria population. The population of this study were CLP patients in the Cleft Center of Universitas Padjadjaran Dental Hospital and had been treated for labioplasty and palatoplasty surgery. Total population of 40 patients CLP post surgery.

Sample was based on the following inclusion criteria, CLP patients who had surgery for cleft lip

and palate with an age range of 4-6 years, without other accompanying syndrome, in the period of primary teeth, early diagnosis was cleft lip and palate one complete side, has never received orthodontic treatment, can be made of maxillary and mandibular mold, and willing to participate in this study so that from the total population of 40 patients CLP post surgery obtained the number of research samples as many as 14 patients CLP 2-3 years post surgery and performed at the Cleft Center of Universitas Padjadjaran Dental Hospital.

The tools and materials used in this research were stationeries (pencil and eraser), ruler, papers, cephalometric radiographs and dental models. The procedure consisted of the preparation phase, it was collecting samples, licensing, and preparation of tools and materials. The implementation phase in the Cleft Center of Universitas Padjadjaran Dental Hospital was to make maxilla and mandible mold using impression materials-putty, after that, made a model study with a rectangular basis, and cephalometric photo taking. The analysis phase of the research was model analysis to determine the severity of crossbite by Huddart-Bodenham method by assessing six anterior teeth of maxilla and six anterior teeth of mandible. It is expressed on a numerical scale from (-3) to (+1) according to the position of the teeth. Cephalometric analysis by measuring the angle of SNA, SNB and ANB with Steiner analysis to know the skeletal type of CLP patient.

RESULTS

The number of patients who met the inclusion criteria are as many as 14 patients consisting of 10 boys and four girls. The description of the number of patients is described in Table 1.

Table 1. Distribution of patients

Gender	Number of patients	Percentage
Male children	10	71%
Female children	4	29%
Total number	14	100%

The age of CLP patients who participated in the study ranged from 4-6 years. The majority of CLP patients who were the subject of four-year-old research were nine and at least six years old as many as one. The data are shown in Table 2.

Table 2. Age distribution of patients

Age (year)	Number of patients	Percentage
4	9	64.3%
5	4	28.6%
6	1	7.1%
Total number	14	100%

The analysis conducted in this research was the analysis of study models and cephalometric analysis. Study model analysis conducted by scoring Huddart-Bodenham to determine the severity of the crossbite on study model. Lateral cephalometric radiograph of each patient was analyzed by tracing digitally to get great angles SNA, SNB and ANB is used to determine the type of skeletal patients.

The results of the study model analysis using the Huddart-Bodenham scoring method on all teeth. Values are grouped into categories occlusion as displayed in Table 3. The cross-bite scoring results showed no CLP patients were included in the excellent occlusion criteria and as many as six CLP patients fell into the poor occlusion criteria.

Table 3. Category of occlusion based on Huddart-Bodenham scoring

Category	Number of patients	(%)
Excellent occlusion (2 - 10)	0	0
Good occlusion ((-6) – 1)	1	7.14
Fair occlusion ((-14) – (-7))	5	35.71
Poor occlusion ((-22) – (-15))	6	42.86
Very poor occlusion ((-30) – (23))	2	14.29
Total number	14	100.00

A further model value scoring study was conducted to assess the severity of anterior crossed bites. Teeth assessed were six anterior teeth of the maxilla and mandible. The severity of the anterior crossbite with the Huddart-Bodenham score is shown in Table 4. The scores on the severity of anterior crossbite severity in CLP patients showed as many as three patients falling into the bad category and six falling into very bad categories.

The results of cephalometric analysis indicate that the smallest and largest ANB angle is -3^{o} and 11^{o} which belong to skeletal type class III and class II. These results were classified into

3 types, skeletal class 1 with the number of ANB 0-4, skeletal class II >4 and skeletal class III <0 The number of patients included in class I skeletal type is 7 people, class II is five people and class III is two persons as shown in Table 5.

Table 4. Distribution of participants based on the Huddart-Bodenham scoring for anterior crossbites severity

Category	Number of patients	Percentage
Very Good (2 - 6)	0	0
Good (-3 – 1)	0	0
Fair (-8 - -4)	5	35.71
Bad (-13 - -9)	3	21.43
Very Bad (-18 - -14)	6	42.86
Total number	14	100.00

Table 5. Distribution of participants based on the ANB Angle calculation for skeletal types

Skeletal type	Number of patients
Class I	7
Class II	5
Class III	2
Total number	14

Table 6. Spearman rank correlation coefficient of relationship between the anterior crossbite severity and skeletal deformities

r_s	$t_{calculation}$	p_{value}	Significance	%
0.13	0.04	0.48	Not significant	1.57

There is a weak correlation between the severity of anterior crossbite and skeletal deformities in CLP patients in the period of primary teeth with coefficient correlation (rs) 0.13 and p-value 0.48. There is a weak correlation between the severity of the anterior crossbite and skeletal deformities in the CLP patient in the period of primary teeth.

DISCUSSION

Patients were 14 CLP patients consisting of 10 boys and four girls (see Table 1). This result was consistent with the research conducted by Jagomagi et al.[6], which stated that that boys are more affected than girls with ratio 2:1, it is in line with the results of research that as much as 71% of patients CLP is male. The Huddart-Bodenham method was used to assess the severity of crossbite in patients with postoperative CLP. Assessment was first performed on all teeth to obtain the occlusion criteria based on the severity of crossbite. Analysis of the anterior cross bite severity was performed by summing the scoring values of the six anterior upper and lower anterior teeth.

Analysis of the anterior cross bite was performed separately in order to obtain a better understanding of the results.[13] The results showed that all post-surgery CLP patients had both anterior and posterior crossbites with different occlusion categories. A total of 42.9% went into the bad category, 35.7% into moderate category, 14.3% into very bad category, and 7.1% in either category.

The results showed that in every CLP patient in the period of primary teeth had anterior cross bite with varying severity (Table 4). It is characterized by a negative Huddart-Bodenham score, if the negative value is so great then it can be concluded that the patient has a severe anterior cross bite and causes poor occlusion. This situation is consistent with Reiser et al.[7] that in the case of unilateral CLP patients with crossbites often occurring mainly on the cleft side. The CLP patient mandible is usually unaffected by the cleft and can grow normally whereas the maxilla does not grow forward and downward as in a normal child. This results in a constriction of the maxilla , a scar that occurs due to surgery on the hard palate allegedly disrupts the growth of the maxilla causing maxillary hypoplasia.[14]

The anterior cross bite that occurs in CLP patients in this period of primary teeth occurs because of the position of the maxillary anterior teeth that are more posterior to the mandibular anterior teeth. This is in line with the explanation from Pereira et al who says that the maxillary incisors are a few millimeters more posterior than normal children because the small maxillary size of the incisive teeth is relatively more retraced to the basal bone.[15]

Examination conducted to determine the cause of anterior cross bite one of them by measuring the angle of SNA, SNB and ANB. Patients with anterior cross bite usually have class III malocclusion that can be divided into true Class III malocclusion derived from skeletal and pseudo class III derived from dentoalveolar.[16] SNA, SNB, and ANB angle measurement show that the majority of CLP patients class I skeletal type I (Table 5). It shows that at a very young age the growth of the

jaw is still normal and has no significant obstacles. The condition is in line with what Pereira et al have said that at an early age, the entire face of the male patient with CLP rotates posteriorly toward the mid-cranial base. The cranial base is normal under these conditions.[15]

Results of cephalometric analysis found that maxillary and mandibular relation mostly still in relatively normal condition that is in skeletal type class I. The difference may be caused by the age factor of CLP patients who become research subjects. This study used a CLP patient research subject in the period of deciduous tooth with age range 4-6 years while Shi et al.[17] used 8-15 years old subject whose growth and development process is more visible progress.

The results of this study show a weak association between the severity of anterior crossbite with skeletal abnormalities. This explains that the anterior crossbite that occurs in most research patients is caused by a dentoalveolar disorder without involving skeletal abnormalities. The condition of this result is consistent with those disclosed by Pereira et al.[15], that is the normal facial profile and both jaws are in a position relatively close to the normal antero-posterior relationship.

Radiographic examination (retrieval of the lateral cephalometric radiograph) influenced the results of the study. This is consistent with the research conducted by Agrawal et al.[18], which stated that if the jaw position moves anteriorly or posteriorly it will change the angle value of SNA or SNB. The analysis of cephalometry used today is using Steiner analysis. Agrawal states that the analysis is actually intended for the Caucasian race but can be used for other races.[18] This study uses Steiner analysis and is done digitally for angle measurements of SNA and SNB.

Successful measurement of SNA and SNB angles with cephalometric radiographs depend on the time of radiograph taking. Cooperative level of children aged 4-6 years is still not good, and at the age of 2-7 years old children are still in the pre occupational stage of thinking about themselves.[19] The condition leads to an approach taken on CLP patients when taking cephalometric radiographs should match their age characteristics resulting in a good radiograph.

CONCLUSION

There is a weak correlation between the severity of anterior crossbite and skeletal deformities in post-surgery cleft lip and palate among children.

REFERENCES

1. de Souza Freitas JA, Garib DG, Oliviera TM, Lauris RDCMC, de Almeida ALPF, Neves LT, et al. Rehabilitative treatment of cleft lip and palate: Experience of the Hospital for Rehabilitation of Craniofacial Anomalies – USP (HRAC-USP) – Part 2: Pediatric Dentistry and Orthodontics. J Appl Oral Sci. 2012; 20(2): 268-81. DOI: 10.1590/S1678-77572012000200024
2. Tai K, Park JH, Tanino M, Sato Y. Orthodontic treatment of a bilateral cleft lip and palate patient with bilateral tooth transpositions and congenitally missing teeth. J Clin Pediatr Dent. 2010; 35(2): 225-31. DOI: 10.17796/jcpd.35.2.q2t5735873357p47
3. Yilmaz HN, Ozbilen EO, Ustun T. The prevalence of cleft lip and palate patients: A single-center experience for 17 years. Turk J Orthod. 2019; 32(3): 139-44. DOI: 10.5152/TurkJOrthod.2019.18094
4. Apriani A, Saptarini R, Kasim A, Oscandar F. Assessment of nasopharynx area and level of severity posterior crossbite on children with cleft lips and palate postpalatoplasty. Padjadjaran J Dent. 2020; 32(2): 142-8. DOI: 10.24198/pjd.vol32no2.17951
5. Murthy J, Bhaskar LVKS. Current concepts in genetics of nonsyndromic clefts. Indian J Plast Surg. 2009; 42(1): 68-81. DOI: 10.4103/0970-0358.53004
6. Jagomagi T, Soots M, Saag M. Epidemiologic factors causing cleft lip and palate and their regularities of occurrence in Estonia. 2010; 12: 105-8.
7. Reiser E, Skoog V, Gerdin B, Sobocki AA. Association between cleft size and crossbite in children with cleft palate and unilateral cleft lip and palate. Cleft Palate Craniofacial J. 2010; 47(2): 175-81. DOI: 10.1597/08-219_1
8. Wangsrimongkol T, Jansawang W. The assessment of treatment outcome by evaluation of dental arch relationship on cleft

lip/palate. J Med Assoc Thai. 2010; 93 (Suppl 4): S100-6.
9. Bardach J, Roberts DM, Yale R, Rosewall D, Mooney M. The influence of simultaneous cleft lip and palate repair on facial growth in rabbits. Cleft Palate J. 1980; 17(4): 309-18.
10. Reiser E. Cleft Size and Maxillary Arch Dimensions in Unilateral Cleft lip and Palate and Cleft Palate [dissertation]. Uppsala: Uppsala Universitet; 2011.
11. Zakariassen A, Notkevich M, Vevik I, Mandal IS. Treatment outcome in patients with anterior crossbites in the student clinic in Tromso. [research report]. Tromso: Universitetet I Tromsø; 2012.
12. Chalmers EV. Intra-oral Three Dimensional Scanning for Assessment of Surgical Outcome in Patients with Unilateral Cleft Lip and Palate [dissertation]. Dundee: 2015
13. Tothill C, Mossey PA. Assessment of arch constriction in patients with bilateral cleft lip and palate and isolated cleft palate: A pilot study. Eur J Orthod. 2007; 29(2): 193-7. DOI: 10.1093/ejo/cjm006
14. Yen SLK. Protocols for late maxillary protraction in cleft lip and palate patients at Childrens Hospital Los Angeles. Semin Orthod. 2011; 17(2): 138–48. DOI: 10.1053/j.sodo.2011.01.001
15. Pereira RMR, De Melo EMC, Coutinho SB, Do Vale DM, Siqueira N, Alonso N. Evaluation of craniofacial growth in patient with cleft lip and palate undergoing one-stage palate repair. Rev Bras Cir Plást. 2011; 26(4): 624-30. DOI: 10.1590/S1983-51752011000400015
16. Choi HJ, Kim JY, Yoo SE, Kwon JH, Park K. Cephalometric characteristics of Korean children with class III malocclusion in the deciduous dentition. Angle Orthod. 2010; 80(1): 86-90. DOI: 10.2319/120108-605.1
17. Shi B, Losee JE. The impact of cleft lip and palate repair on maxillofacial growth. Int J Oral Sci. 2015; 7(1): 14–7. DOI: 10.1038/ijos.2014.59
18. Agrawal D. Cephalometric analysis for diagnosis and treatment of orthodontic patients. J Oral Health Comm Dent. 2013; 7(2): 75-79. DOI: 10.5005/johcd-7-2-75
19. Joubish MF, Khurram MA. Cognitive development in Jean Piaget's work and its implications for teachers. World Appl Sci J. 2011; 12(8): 1260-5.