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The assessment of facial asymmetry in patients with uni- or bilateral cleft lip and palate

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ABSTRACT

Introduction: A cleft is a congenital defect involving a partial or complete disruption of continuity in the anatomical tissues in places associated with the embryological development of the face. The aim of the study was to assess the extent of facial asymmetry in patients with uni- or bilateral cleft lip and palate.

Materials and methods: Sixty-six patients with a cleft lip and palate (unilateral and bilateral) participated in the study. Three anthropometric measurements were examined: the length of the mandibular shaft (gonion-gnathion – go-gn), and the length (nostril anterius-nostril posterius – na-np) and width (nostril laterale-nostril mediale – nl-nm) of the nostrils. The diversity of asymmetry among the defect types and the relationship between sex, age, and type of cleft (bilateral vs. unilateral) were assessed against indicators of asymmetry. The data were statistically analyzed using Statistica PL (ver. 12, Statsoft, Poland).

Results: Patients with a unilateral and bilateral cleft presented an asymmetry of length and width of the nostrils. The sex and age of the patients and the type of cleft did not affect the asymmetry of the evaluated anthropometric parameters.

Conclusions: There was an asymmetry in the width and length of the nostrils, but the direction of this asymmetry had no relation to the location of the defect. The asymmetry of the width of the nostrils decreased with the age of the patient, regardless of the type of cleft. The cleft lip and palate (unilateral and bilateral) did not intensify the asymmetry of the length of the mandibular shaft. However, the direction of asymmetry in the length of the mandible was dependent on the side of the cleft – in unilateral clefts, the mandibular body usually had a slightly longer length on the healthy side of the face.

Keywords: facial asymmetry; cleft lip and palate; anthropometric measurements.

INTRODUCTION

Symmetry is a natural feature of the human body, while large deviations from symmetry relate to pathological factors disrupting the development of structures mainly or only on one side. Many researches have shown a negative correlation between the attractiveness of the face and the degree of asymmetry [1, 2, 3]. Significant disorders in symmetry, especially those that are in the middle of the face, are perceived as unattractive [2, 3]. Due to a congenital disorder of tissue development in the middle part of the face, asymmetry is more visible among patients with a cleft lip and palate, both in newborns and those who have undergone surgical treatment.

The cleft is a congenital defect, involving partial or complete disruption of continuity in the tissues of places typically associated with the embryological development of the face [4]. Cleft lip and/or palate accounts for 14–17% of all body malformations and is the most common birth defect in the craniofacial area [5, 6]. Incidence rates vary among geographical region and race [7, 8]. The average incidence of clefts in live-born children in Łódz in 1981–1990 was 2.00 for 1000 live births, between 1991–2000 this was 1.89 for 1000, and in the 30 year period from 1981–2010 this was 1.93 for 1000 live births [9, 10, 11, 12]. Regardless of population demographics or geographical location, the ratio of cleft lip and palate occurrence is 2:1 (men:women). The etiopathogenesis of this defect includes genetic and environmental factors, with the participation of a genetic component at about 20% [13, 14, 15]. Treatment is complex and requires interdisciplinary care.

The aim of the study was to assess the extent of facial asymmetry in patients with a uni- or bilateral cleft lip and palate.

MATERIALS AND METHODS

After obtaining approval from a local research ethics committee (RNN/183/18/KE), 66 patients were included in the study: 44 males and 22 females. The average age of the participants was 16.63 ±5.83 years and ranged between 6–36 years old. A unilateral defect was diagnosed in 40 participants (right-sided – 13; left-sided – 27), while a bilateral defect was diagnosed in 26. The multicenter research involved patients from the Department of Plastic, Reconstructive and Aesthetic Surgery (Kopcińskiego 22, Łódz) and the Department of Orthodontics (Pomorska 251, Łódz). The inclusion criteria were patients with a unilateral or bilateral cleft lip and palate.

Three anthropometric measurements were examined according to the method of Malinowski and Bożiłow [16] using a linear compass and small calipers: the mandibular shaft length (gonion-gnathion – go-gn), and the length (nostril anterius-nostril posterius – na-np) and width (nostril laterale--nostril mediale – nl-nm) of the nostrils (Fig. 1).

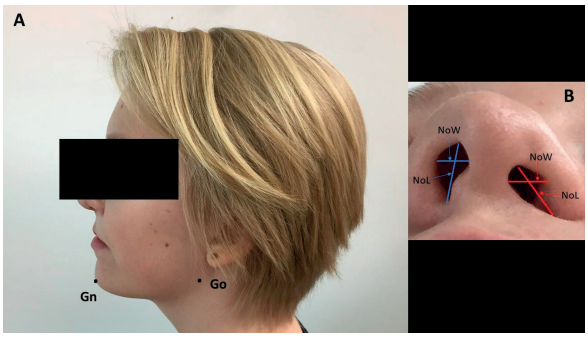

FIGURE 1. The anthropometric measurements: A) the mandibular shaft length (gonion-gnathion – go-gn); B) the nostrils: NoW – nostril width (nostril laterale-nostril mediale – nl-nm), NoL – nostril length (nostril anterius-nostril posterius – na-np), red – cleft side

The obtained data were used to calculate the asymmetry index (AI), according to the formula proposed by Swaddle et al. [17]:

$$AI = \frac{|R - L|}{(R + L) * 0.5}$$

AI – asymmetry index; R – right; L – left

However, the formula only allows an assessment of the size of asymmetry, not its direction, so the differences between right and left (R-L) measurements have also been considered. A positive value in this difference indicates that the direction of asymmetry is to the right, while a negative value to the left side. The value 0 means total symmetry. According to the results, the patients were classified into 3 groups: symmetrical in terms of a given feature (R-L = 0), right-handed asymmetry (R-L > 0) or left-handed asymmetry (R-L < 0). The above classification was used to assess the relationship between the direction of asymmetry and the location of the cleft lip and palate (bilateral, right-sided or left-sided defect).

The obtained data were then statistically analyzed. One-way ANOVA was used for evaluation of diversity related to the defect types in the AI. The Tukey's HSD *post-hoc* test was performed when the ANOVA showed statistically significant differences. The connection between the location of the defect and the direction of asymmetry was tested with the $\chi 2$. For 2 x 2 contingency tables, the $\chi 2$ test with the Yates correction was used. In this part of the analysis, due to repeated tests based on the same data, the Bonferroni correction was applied.

A p-value of <0.05 (or $p < 0.0167$ in tests with the Bonferroni correction) was considered statistically significant. All calculations and statistical analyses were performed using Statistica PL computer software (ver. 12, Statsoft, Poland).

RESULTS

Differentiation in the size of asymmetry of individual facial structures in uni- and bilateral clefts

The average of the indicators proved that in patients with a unilateral cleft, asymmetry mainly affects the nostrils (nl-nm, na-np), but is not observed in the length of the mandibular shaft (go-gn) – Table 1. All 3 indicators of asymmetry were statistically significant with the strongest asymmetry concerning the width of the nostril (nl-nm). In patients with a bilateral cleft lip and palate, asymmetry applies to the length (na-np) and width of the nostrils (nl-nm) – Table 2. Statistical analysis confirmed that the differences in asymmetry are greater for the length and width of the nostrils than for the length of the mandibular shaft ($p = 0.0088$ and $p = 0.0002$, respectively). At the same time, no statistically significant differences were found in the extent of asymmetry between the length and width of the nostrils ($p = 0.3941$).

TABLE 1. Statistical characteristics of facial asymmetry indicators in patients with unilateral cleft lip and palate

Indicator	Unilateral cleft						
	$\bar{x}$	SD	M	Q1	Q3	min.	max.
AI go-gn	0.04	0.03	0.03	**0.02**	0.06	0.01	0.10
AI na-np	0.14	0.10	0.12	**0.08**	0.17	0.00	0.44
AI nl-nm	0.21	0.11	0.19	**0.13**	0.29	0.00	0.40

AI – asymmetry index; go-gn – gonion-gnathion; na-np – nostril anterius-nostril posterius; nl-nm – nostril laterale-nostril mediale; $\bar{x}$ – mean; SD – standard deviation; M – median; Q1 – lower quartile; Q3 – upper quartile; min. – minimum; max. – maximum

TABLE 2. Statistical characteristics of facial asymmetry indicators in patients with bilateral cleft lip and palate

Indicator	Bilateral cleft						
	$\bar{x}$	SD	M	Q1	Q3	min.	max.
AI go-gn	0.05	0.03	0.04	**0.02**	0.05	0.01	0.15
AI na-np	0.12	0.09	0.10	**0.08**	0.12	0.00	0.40
AI nl-nm	0.15	0.12	0.15	**0.00**	0.25	0.00	0.40

AI – asymmetry index; go-gn – gonion-gnathion; na-np – nostril anterius-nostril posterius; nl-nm – nostril laterale-nostril mediale; $\bar{x}$ – mean; SD – standard deviation; M – median; Q1 – lower quartile; Q3 – upper quartile; min. – minimum; max. – maximum

Determinants of asymmetry in individual facial structures in patients with cleft lip and palate

The sex and age of the patients and the type of cleft do not affect asymmetry in the length of the mandibular shaft (go-gn) and the length and the width of the nostrils (na-np). However, a negative correlation was observed between the age of patients with a cleft and asymmetry in the width of the nostrils, which means that with an increase in age, the amount of asymmetry decreases. An interaction analysis has shown that this effect (relationship between age and WA nl-nm) is not modified by gender ($p = 0.8919$) and defect type ($p = 0.4933$), therefore the reduction in the asymmetry of the width is not connected with these factors.

The relationship between the direction of asymmetry of individual facial structures and the side of occurrence of cleft lip and palate

In the case of the length of the mandibular shaft (go-gn), there is no symmetry found in the examined group. Among participants with bilateral defects, 53.9% of participants had a dominant left-sided measurement, while in 46.1% the right-sided measurement was higher. Almost all people with a defect located on the right side had a longer mandibular shaft on the left (92.3%), while 55.6% of patients with a left-sided cleft had a longer mandibular shaft on the right. There was a statistical difference between the cleft location and the direction of the asymmetry in the mandibular length ($p = 0.0144$). In patients with a defect located on the right side, in relation to patients with a left-sided defect, the length of the mandibular shaft on the left side dominates ($p = 0.0108$). At the same time, it was shown that none of the unilateral clefts differ in terms of the direction of the mandibular shaft length asymmetry from bilateral clefts (right-sided vs. bilateral $p = 0.0412$, left-sided vs. bilateral $p = 0.6821$).

In the case of the length of nostrils (na-np), the presence of symmetry was noted in 5 people. This feature was symmetrical in 1 individual with a bilateral defect (3.9%), 1 patient with a right-sided defect (7.8%) and 3 people with a left-sided defect (11.1%). A higher right-sided measurement over left-sided measurement was found in 46.1% of patients with a bilateral defect and patients with a right-sided defect, and 37.0% of people with a left-sided defect. A left-sided asymmetry of the length of the nostrils was shown in 50% of people with a bilateral defect, 51.9% of people with a left-sided defect and 46.1% of people with a right-sided defect. There was no statistically significant relationship between the cleft location and the direction of the asymmetry in the length of the nostrils (na-np; right-sided vs. bilateral $p = 0.8710$, left-sided vs. bilateral $p = 0.5487$, right-sided vs. left-sided $p = 0.8429$).

A symmetrical width of the nostrils occurred in 9 patients, including 7 (26.9%) with a bilateral defect and 2 (7.4%) with a left-sided defect. A greater width of the right-hand nostril was found in 77.8% of patients with a left-cleft, 61.5% of patients with a right-cleft and 53.9% of patients with a bilateral cleft. On the left nostril, a greater width was found in 38.5% patients with a right-sided defect, 19.2% of patients with a bilateral defect, and in 14.8% with a left-sided defect. There was no statistically significant relationship between the location of the cleft defect and the direction of asymmetry of the width of the nostrils (nl-nm) – right-sided vs. bilateral $p = 0.0889$, left-sided vs. double-sided $p = 0.1182$, right-sided vs. left-sided $p = 0.1770$.

DISCUSSION

Various methods are used to assess facial asymmetry, including direct measurements of anthropometric points on patients' faces or indirect measurements taken from photographs, video stills, 3D scans or plaster models of human faces [18]. In the present study, direct face measurements were measured with the use of a linear compass and small calipers. The advantages of this method are the ease of reconstruction of measurements, the possibility of conducting the experiment in outpatient conditions, the lack of invasiveness as well as a higher level of acceptance by patients and parents [18, 19].

The study evaluated the facial asymmetry of the mandibular shaft and nostrils in patients with uni- and bilateral cleft lip and palate.

Many studies, regardless of the method of measurement, did not find statistically significant differences between the asymmetry of the mandible in patients with cleft and patients without this defect [20, 21, 22]. Abuhijleh et al. did not find any asymmetry in patients with a unilateral cleft lip and palate, however they observed greater asymmetry in patients from the control group with Angle's 1st class. Moreover, they noticed that in cleft patients the mandible was shorter, retruded and anteriorly rotated, which may be associated with a shorter skull base in cleft patients and the mandible adapting to the underdeveloped maxilla. In our study, the congenital defect did not increase the asymmetry of the mandibular length, however the direction of asymmetry depended on the side of the cleft. In a unilateral cleft, the mandibular shaft usually had a longer length on the healthy side of the face, which is consistent with the observations of Abuhijleh et al. [20]. Some studies concluded that the cleft did not affect growth and development of the mandible [23, 24].

The next facial structure subjected to anthropometric evaluation was the nose. Our research confirmed the presence of a large asymmetry of the nostrils in patients with unilateral and bilateral cleft. It was found that the width of the nostrils is more asymmetrical than the length in patients with a unilateral defect. Choi et al. analyzed cone beam computed tomography scans of patients with unilateral cleft lip and palate and only found statistically significant asymmetry in the nasolabial part of the face and in the alveolar process [22].

The authors pointed out that the nasal region related to large vertical face disturbances. Hoh and Sulaiman demonstrated a coherent connection between preoperative and postoperative asymmetry of lip and nose height [18]. The postoperative asymmetry was worse in more severe clefts than those with less serious initial deformities. In our study, we observed that as patients grow older, the asymmetry of the width of the nostrils in patients with a unilateral or bilateral cleft is reduced, which is the result of surgical treatment. Feijo et al. in a systematic review of morphological changes of nostrils in patients undergoing corrective surgery found that there is a significant improvement in nostril asymmetry. The main changes observed after surgery were a reduction of the nasolabial angle, a decrease of width and an increase in the height of the nostrils on the cleft side [25]. Linden et al. evaluated the symmetry of the nose using 3D photogrammetry in patients with a unilateral cleft lip and palate and compared them with a control group without a defect. They concluded that cleft patients had significantly greater nose asymmetry. The research results and our own observations suggest that surgery may diminish symmetry disorders in the nose area, but do not reduce them to a level characteristic of healthy people [26].

CONCLUSIONS

To sum up, the following conclusions can be drawn:

- there is an asymmetry in the width and length of the nostrils in people with uni- and bilateral cleft. The direction of this asymmetry is not related to the location of the defect (bilateral, right-sided, left-sided);
- asymmetry in the width of the nostrils decreases as patients get older, regardless of the type of cleft;
- a cleft lip and palate (uni- and bilateral) does not intensify the asymmetry of the length of the mandibular shaft. The direction of asymmetry depends on the side of the cleft – in unilateral cleft, the mandibular shaft usually has a slightly longer length on the healthy side;
- the sex of the participants does not affect the asymmetry of the length of the mandible and length and width of the nostrils.

REFERENCES

1. Oinonen K, Mazmanian D. Facial symmetry detection ability changes across the menstrual cycle. Biol Psychol 2007;75(2):136-45.
2. Springer IN, Wannicke B, Warnke PH, Zernial O, Wiltfang J, Russo PAJ, et al. Facial attractiveness: visual impact of symmetry increases significantly towards the midline. Ann Plast Surg 2007;59(2):156-62.
3. Meyer-Marcotty P, Kochel J, Boehm H, Linz C, Klammert U, Stellzig-Eisenhauer A. Face perception in patients with unilateral cleft lip and palate and patients with severe Class III malocclusion compared to controls. J Craniomaxillofac Surg 2011;39(3):158-63.
4. Bardach J. Rozszczepy wargi górnej i podniebienia. Warszawa: Państwowy Zakład Wydawnictw Lekarskich; 1967.
5. Antoszewski B, Fijałkowska M. The prevalence of cleft lip and/or palate in children from Łódź in years 2001–2010. Pol Przegl Chir 2013;85(6):329-32.
6. Jagomagi T, Soots M, Saag M. Epidemiologic factors causing cleft lip and palate and their regularities of occurrence in Estonia. Stomatologija 2010;12(4):105-8.
7. Shapira Y, Lubit E, Kuftinec MM, Borell G. The distribution of clefts of the primary and secondary palates by sex, type, and location. Angle Orthod 1999;69(6):523-8.
8. Wójcicka K, Kobus K, Wójcicki P. Epidemiology of lip, alveolar process and palate clefts in the material of hospital and clinic of plastic surgery in Polanica Zdrój. Pol Przegl Chir 2009;81(1):4-11.
9. Antoszewski B, Fijałkowska M. Distribution of lip and/or palate clefts types among children form Lodz during years 1981–2015. Pol Przegl Chir 2018;90(3):1-6.
10. Antoszewski B, Fijałkowska M. Prevalence of cleft lip and/or palate in children from Lodz between years 1981–2010. Congenit Anom 2016;56(2):60-4.
11. Antoszewski B, Kruk-Jeromin J. Częstość występowania rozszczepów wargi i (albo) podniebienia u dzieci łódzkich w latach 1982–1991. Pol Merkur Lek 1997;3:10-2.
12. Antoszewski B, Kruk-Jeromin J. Częstość występowania rozszczepów wargi i/lub podniebienia u dzieci łódzkich w latach 1991–2000. Ann Acad Medicae Lodz 2002;43:13-6.
13. Birnbaum S, Ludwig KU, Reutter H, Herms S, de Assis NA, Diaz-Lacava A, et al. *IRF6* gene variants in Central European patients with non-syndromic cleft lip with or without cleft palate. Eur J Oral Sci 2009;117(6):766-9.
14. Cobourne MT. The complex genetics of cleft lip and palate. Eur J Orthod 2004;26(1):7-16.
15. Kot M, Kruk-Jeromini J. Analysis of family incidence of cleft lip and/or palate. Med Sci Monit 2007;13(5):231-4.
16. Malinowski A, Bożiłow W. Podstawy antropometrii. Metody, techniki, normy. Warszawa: Wydawnictwo Naukowe PWN; 1997.
17. Swaddle JP, Witter MS, Cuthill IC. The analysis of fluctuating asymmetry. Anim Behav 1994;48(4):986-9.
18. Hoh E, Sulaiman W. Analysis of preoperative measurements in unilateral cleft lip patients toward the outcome of secondary cleft deformities. J Cleft Lip Palate Craniofac Anomal 2019;6(2):93-8.
19. Meyer-Marcotty P, Alpers GW, Gerdes ABM, Stellzig-Eisenhauer A. Impact of facial asymmetry in visual perception: a 3-dimensional data analysis. Am J Orthod Dentofacial Orthop 2010;137(2):168.e1-8.
20. Abuhijleh E, Aydemir H, Toygar-Memikoğlu U. Three-dimensional craniofacial morphology in unilateral cleft lip and palate. J Oral Sci 2014;56(2):165-72.
21. Kurt G, Bayram M, Uysal T, Ozer M. Mandibular asymmetry in cleft lip and palate patients. Eur J Orthod 2010;32(1):19-23.
22. Choi YK, Park SB, Kim YI, Son WS. Three-dimensional evaluation of midfacial asymmetry in patients with nonsyndromic unilateral cleft lip and palate by cone-beam computed tomography. Korean J Orthod 2013;43(3):113-9.
23. Capelozza Filho L, Normando ADC, da Silva Filho OG. Isolated influences of lip and palate surgery on facial growth: Comparison of operated and unoperated male adults with UCLP. Cleft Palate Craniofac J 1996;33(1):51-6.
24. da Silva OG Jr, Normando AD, Capelozza L Jr. Mandibular morphology and spatial position in patients with clefts: intrinsic or iatrogenic? Cleft Palate Craniofac J 1992;29(4):369-75.
25. Feijo MJF, Brandão SR, Pereira RMR, Santos MB, da Silva HJ. Nostril morphometry evaluation before and after cleft lip surgical correction: clinical evidence. Int Arch Otorhinolaryngol 2014;18(2):192-7.
26. Linden OE, Taylor HO, Vasudavan S, Byrne ME, Deutsch CK, Mulliken JB, et al. Three-dimensional analysis of nasal symmetry following primary correction of unilateral cleft lip nasal deformity. Cleft Palate Craniofac J 2017;54(6):715-9.