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Changes in Measurements of Segner-Hasund Analysis in Patients with Mandibular Prognathism after Orthognathic Surgery

Zmiany parametrów analizy Segnera-Hasunda u pacjentów z prognią po zabiegach ortognatycznych

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Abstract

Background. In mandibular prognathism abnormal proportions of the facial part of the cranium are reflected in impaired facial aesthetics. Surgical methods that are currently used in Poland in order to correct mandibular prognathism include bilateral sagittal split ramus osteotomy (BSSO) and extraoral vertical ramus osteotomy (EVRO). There are also different kinds of cephalometric parameters measured on cephalograms used to plan and evaluate the outcomes of surgical and orthodontic treatment concerning mandibular prognathism.

Objectives. The aim of this research was to assess the early treatment outcome observed after vertical and sagittal osteotomy of the mandibular ramus with the use of cephalometric Hasund-Segner analysis.

Material and Methods. Overall, 98 lateral cephalograms, made before surgery and at least 6 months after the surgery, were collected in order to perform the analysis of treatment results. Cephalometric analysis proposed by Hasund and Segner was used to assess bone and soft tissue changes after orthognathic surgeries.

Results. Six months after the orthognathic treatment we observed a relevant improvement in parameters describing the sagittal relationship between the maxilla and the mandible, and between the mandible and the skull base. Positive influence was also noticed in the case of vertical relationship parameters of the Hasund-Segner analysis.

Conclusions. Both methods used in surgical treatment of mandibular prognathism, namely the external vertical ramus osteotomy and the bilateral sagittal split osteotomy, had a positive influence on the anterior-posterior relation of the mandible towards the skull base and the maxilla assessed in Hasund-Segner cephalometric analysis. There are small differences related with the impact that the surgery has on hard and soft tissue profile, depending on the surgical technique. BSSO had greater impact on Holdaway's angle than EVRO (*Dent. Med. Probl.* 2016, 53, 1, 13–21).

Key words: orthognathic surgery, mandibular prognathism, Segner-Hasund analysis, bilateral sagittal split ramus osteotomy (BSSO), extraoral vertical ramus osteotomy (EVRO).

Słowa kluczowe: chirurgia ortognatyczna, prognatyzm żuchwy, analiza Segnera-Hasunda, obustronna strzałkowa osteotomia gałęzi żuchwy (BSSO), pionowa osteotomia gałęzi żuchwy z dostępu zewnętrznego (EVRO).

In mandibular prognathism abnormal proportions of the facial part of the cranium are reflected in impaired facial aesthetics. Moreover, it is associated with abnormalities concerning the alveolar ridge of the mandible and the maxilla,

as well as different types of malocclusion. Functional disorders, such as speech abnormalities, temporo-mandibular joint dysfunction and difficulty in biting and chewing food are also common [1–3].

Surgical methods that are currently used in Poland in order to correct mandibular prognathism include commonly used bilateral sagittal split ramus osteotomy (BSSO) and not yet abandoned extraoral vertical ramus osteotomy (EVRO) [4]. Each of these operations is associated with the risk of early and late complications. Sensation impairment in the area of inferior alveolar nerve and mental nerve stands as the most frequent post-operative complication, both early and late one [5–9]. EVRO and BSSO vary in terms of the course of osteotomy lines; however, these two surgical techniques are performed to set back the mandibular body, and to improve occlusion, as well as maxillo-mandibular relations and facial aesthetics.

Different kinds of cephalometric parameters measured on cephalograms are used to plan and evaluate the outcomes of surgical and orthodontic treatment concerning mandibular prognathism [10]. Many cephalometric analyses were created. Despite the fact that to some extent they are based on identical parameters, each of them reveals their individual and unique characteristics. Nevertheless, all of them play a crucial role – they are tools utilized to efficiently exploit the information contained in radiological images. Furthermore, this information is used for planning and monitoring the treatment, as well as for facilitating the communication between all specialists involved in the therapeutic process.

The aim of this research was to assess the treatment early outcome observed after vertical and sagittal split mandibular ramus osteotomy with the use of Hasund-Segner cephalometric analysis.

Material and Methods

In this retrospective research we included lateral cephalograms of 49 patients with mandibular prognathism, who underwent surgical treatment in our Department in the years 2006–2013. The group consisted of 25 women and 24 men between 17 and 51 years old (average age 25.3 ± 7.2 years). Twenty-two patients underwent extraoral vertical ramus osteotomy (EVRO) and 27 – bilateral sagittal split ramus osteotomy performed with Obwegeser-Dal Pont's method (BSSO). The number of men and women in the analyzed groups of patients was similar. No statistically significant differences in severity of the maxillo-facial defects were observed among BSSO and EVRO patients. Characteristics of patients enrolled into the study are presented in Table 1. In the case of BSSO technique a rigid internal fixation (miniplate osteosynthesis) was done

and intermaxillary fixation (for 10–14 days). In EVRO patients bone fragments were stabilized with a combination of a wire and intermaxillary fixation (for 4–6 weeks).

Overall, 98 lateral cephalograms (made before surgery and 6 months after the surgery) were collected in order to perform the analysis of treatment results (cephalometric analysis). Only digital radiological images were included in the study. In the case of analog images, digitalization was performed with the use of a special scanner. Cephalometric analysis proposed by Hasund and Segner was used to assess bone and soft tissue changes after orthognathic surgeries. This cephalometric analysis is known as „an individual cephalometry”. This term emphasizes the fact that the standards of measured angles and lengths are specific for a particular patient. Standards related with these cephalometric variables are individual and characteristic for each person. These parameters, expected for a specific type of face, are calculated based on the harmony diagram (harmony box). This diagram determines for an individual patient if the skeletal configuration is harmonious (in sagittal and vertical relations) and enables the identification of the structure/s responsible for the defect. Harmony boxes are created for the following angles: ANB, SNA, NL-NSL, NSBa, ML-NSL, SNB and ML-NL [11]. Cephalometric reference points, lines and parameters are shown in Tables 2 and 3 and presented in Figure 1.

All measurements were performed in the OrthView 0.6 computer program, which was created in cooperation with Technical University of Lodz. The program was written in Python high level programming language, which is characterized by its ability to run on different operating systems (Windows, Linux, OSX), a multitude of standard libraries that facilitate the development of the program, and the high readability of the source code. The WxPython library was used to design the graphical user interface. The main advantage of the program is the fact that it is user-friendly software and it is possible to develop this program in the future (e.g. by adding more analyses). The current version of the program, version 0.6, allows us to perform the following analyses: Segner and Hasund, Hwang, Kim and McNamara, facial contour angle and Reyneke analysis.

Statistical Analysis

The chi² test was used to search for significant differences between the frequencies of analyzed, expected and observed parameters. The mean values of Segner and Hasund parameters noted before and after the surgery were compared with

Table 1. Characteristics of patients included into the study

		BSSO	EVRO	Total	Statistical analysis	p value
Female	n (%)	14 (28.57%)	11 (22.45%)	25 (51.02%)	0.01664	> 0.05
Male	n (%)	13 (26.53%)	11 (22.45%)	24 (48.98%)		
Total	n (%)	27 (55.10%)	22 (44.90%)	49 (100.00%)		
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD		
Age	Female	22.1 $\pm$ 3.76	25.2 $\pm$ 6.3	23.5 $\pm$ 5.25	0.899	> 0.05
	Male	27.6 $\pm$ 9.19	26.7 $\pm$ 7.2	27.2 $\pm$ 8.36		
	Total	24.8 $\pm$ 7.45	26 $\pm$ 6.8	25.3 $\pm$ 7.19		
SNA		82.99 $\pm$ 2.33	82.72 $\pm$ 1.59	82.87 $\pm$ 2.04	0.6506	> 0.05
SNB		87.85 $\pm$ 3.00	87.30 $\pm$ 2.76	87.60 $\pm$ 2.91	0.5237	> 0.05
ANB		-4.85 $\pm$ 2.82	-4.58 $\pm$ 2.94	-4.73 $\pm$ 2.88	0.7463	> 0.05
SNPg		89.04 $\pm$ 3.23	88.79 $\pm$ 3.28	88.93 $\pm$ 3.26	0.7988	> 0.05
NSBa		133.22 $\pm$ 6.87	133.74 $\pm$ 6.39	133.45 $\pm$ 6.67	0.7935	> 0.05
GntgoAr		131.49 $\pm$ 7.59	132.72 $\pm$ 4.86	132.04 $\pm$ 6.53	0.5038	> 0.05
NL-NSL		5.52 $\pm$ 2.31	6.51 $\pm$ 1.98	5.97 $\pm$ 2.22	0.1257	> 0.05
ML-NSL		34.11 $\pm$ 6.66	34.46 $\pm$ 4.37	34.27 $\pm$ 5.75	0.8378	> 0.05
ML-NL		28.59 $\pm$ 6.58	27.95 $\pm$ 4.36	28.30 $\pm$ 5.70	0.7012	> 0.05
H		4.15 $\pm$ 1.88	3.84 $\pm$ 1.72	4.01 $\pm$ 1.82	0.5643	> 0.05
1+:1-		145.96 $\pm$ 11.67	142.49 $\pm$ 7.52	144.40 $\pm$ 10.17	0.2233	> 0.05
1+:NA		23.13 $\pm$ 3.82	23.30 $\pm$ 5.75	23.21 $\pm$ 4.78	0.9107	> 0.05
1-:NB		20.10 $\pm$ 4.15	20.98 $\pm$ 3.43	20.49 $\pm$ 3.87	0.4356	> 0.05
Pg:NB		3.63 $\pm$ 1.73	3.55 $\pm$ 1.80	3.59 $\pm$ 1.76	0.8757	> 0.05
1+:NA{mm}		4.90 $\pm$ 1.67	4.50 $\pm$ 1.79	4.72 $\pm$ 1.74	0.4302	> 0.05
1-:NB{mm}		3.44 $\pm$ 2.77	3.96 $\pm$ 2.51	3.67 $\pm$ 2.67	0.5108	> 0.05
Indeks		71.13 $\pm$ 6.12	70.47 $\pm$ 5.14	70.83 $\pm$ 5.71	0.6968	> 0.05

n – number of patients; SD – standard deviation; EVRO – external vertical ramus osteotomy; BSSO – bilateral sagittal split osteotomy.

Fig. 1. Cephalometric reference points, lines and parameters

Table 2. Reference points of Segner-Hasund analysis

Abbreviation	Name	Definition
S	Sella	The point is located in the center of sella turcica
N	Nasion	Most anterior point of the nasofrontal suture
Sp	Spina nasalis anterior	The most anterior point of spina nasalis anterior
Sp'	Spina'	The point is set by intersection of nasion-gnathion line and spina nasalis anterior-pterygomaxillare line
A	Point A	The most posterior point of the anterior outline of the maxillary alveolar ridge
Iss	Incision superius	Point located at the incisal edge of the foremost medial upper incisor
Isa	Apex of the upper incisor	Point at the root apex of the maxilla foremost medial incisor
Iis	Incision inferius	Point located at the incisal edge of the lower foremost incisor
Iia	Apex of the lower incisor	Point at the root apex of the mandibular foremost incisor
B	Point B	The most posterior point of the anterior outline of the mandibular alveolar ridge
Pg	Pogonion	The most anterior point of the contour of the chin
Gn	Gnathion	The most anterior and inferior point on the contour of the chin
TM*	Tuberositas masseterica	The accessory point, used to determine the mandibular line; localized on the lower contour of the mandibular angle
tgo	Gonion	The point set by intersection of 2 lines – the mandibular line and the tangent line to mandibular ramus. The mandibular line passes through the point of Gn and lower curvature of mandibular angle. The tangent line to mandibular ramus passes through the Ar point and posterior curvature of the mandibular angle
Ar	Articulare	Intersection of the two lines – the outline base of the cranium and posterior border of the mandibular condyle
Ba	Basion	The lowest and the most posterior point of the clivus within the midsagittal plane
Pm	Pterygomaxillare	The point is set by intersection of the edge of the maxilla (the anterior border of pterygo-palatine fossa) with the outline of hard palate
WPg	Skin point pogonion	The most anterior point of soft tissues of the chin
UL	Upper lip point	The most anterior point on the upper lip
Sn	Subnasale	The point between the nasal septum and the upper lip
ctg	Columella	The point where the lower, straight section of the profile of the nose passes into the tip of the nose

* This point has no name in the Segner-Hasund analysis. Its location corresponds to the TM point in other studies.

the t-test (for normal distribution) and the Mann-Whitney test (for other distributions). Significance was indicated for $p < 0.05$.

Results

Six months after the orthognathic surgery, a statistically relevant improvement was observed within the parameters of sagittal relationship between the maxilla and the mandible, as well as between the mandible and the skull base. An average SNB angle equaled 82.23 ($p < 0.001$), ANB angle – 0.63 ($p < 0.001$), and SNPg angle – 86.98 ($p < 0.001$). Surgical treatment influenced the morphology of the mandible. A significant de-

crease in the average value of the mandibular angle was seen ($p < 0.001$) and after the surgery it equaled 129.97. Parameters of vertical relationship, such as the ML-NSL angle and the ML-NL angle, changed significantly 6 months after the surgical treatment. The average value of the H angle of soft tissues increased significantly from 4.01 to 6.19 ($p < 0.001$). Otherwise, the PgNB (mm) distance decreased after the surgery and equaled 3.07 ($p < 0.001$). Parameters defining the position of incisors also changed significantly six months after the treatment. The average value of the anterior facial height index increased considerably and reached 73.78%, reaching the value falling within a standard describing a neutral relation ($p < 0.001$) (Table 4).

Table 3. Angles and distances of Segner-Hasund analysis

Angles	Between lines:	Definition
SNA	<ul style="list-style-type: none"> horizontal NSL line (between points N and S), vertical NA line (between points N and A) 	This angle determines the anterior-posterior position of the A point in relation to the anterior cranial fossa; it determines the sagittal position (the level of maxillary prognathism)
SNB	<ul style="list-style-type: none"> horizontal NSL line (between points N and S), vertical NB line (between points N and B) 	This angle determines the anterior-posterior position of the B point (position of the mandible) in relation to the anterior cranial fossa (the level of mandibular prognathism)
ANB	It is the result of a subtraction of SNA and SNB angle	This angle determines the position of the jaw in relation to the mandible within the sagittal plane
SNPg	<ul style="list-style-type: none"> horizontal NSL line (between points N and S), vertical NPG line (between points N and Pg) 	The SNPg angle determines the sagittal position of the mandible
NSBa	<ul style="list-style-type: none"> horizontal NSL line (between points N and S), auxiliary sella – basion line (between points S and Ba) 	This angle determines the relation between the clivus and the anterior cranial fossa, and simultaneously specifies the location of the temporo-mandibular fossa
Gn-tgo-Ar	<ul style="list-style-type: none"> horizontal ML line (between points Gn and tgo), auxiliary articulare – gonion line (between points Ar and tgo) 	This angle specifies the angle between the ramus and the body of the mandible
NL-NSL	<ul style="list-style-type: none"> horizontal NL line (between points Sp and Pm), horizontal NSL line (between points N and S) 	This angle determines the degree of the slope/tilt of the jaw in relation to the anterior cranial fossa
ML-NSL	<ul style="list-style-type: none"> horizontal ML line (between points Gn and tgo), horizontal NSL line (between points N and S) 	This angle evaluates the inclination (slope) of the mandible in relation to the anterior cranial fossa
ML-NL	<ul style="list-style-type: none"> horizontal ML line (between points Gn and tgo), horizontal NL line (between points Sp and Pm), 	This parameter determines the degree of the slope/tilt of the mandible in relation to the base of the maxilla
H angle	<ul style="list-style-type: none"> horizontal H line (between points WPg and UL), vertical NB line (between points N and B) 	This angle evaluates the soft-tissue AP relationship
$\angle$ -	<ul style="list-style-type: none"> Iss – Isa line, Iia – Iis line 	This angle determines the slope of the axis of the upper and lower long incisors
$\angle$ -NA°	<ul style="list-style-type: none"> vertical NA line (between points N and A), auxiliary Iss – Isa line (between points Iss and Isa) 	This angle specifies the anterior-posterior position of the upper incisors in relation to the base of the maxilla, and simultaneously informs about the inclination of the long teeth axis towards the NA line
-NB°	<ul style="list-style-type: none"> vertical NB line (between points N and B) auxiliary Iss – Isa line (between points Iss and Isa) 	This angle indicates the anterior-posterior position of lower incisors in relation to the base of the mandible
PgNB(mm)	The distance between a point Pg and a line NB	This measurement estimates chin tuberosity and indicates the position of the anterior – posterior alveolar part of the mandible. It informs about the morphology of bones within this area of the jaw and about the setting of lower incisors
$\angle$ -NA(mm)	The distance $\angle$ -NA(mm)	This angle specifies the distance between the incisal edge of upper incisors and the NA line. Standards range from 1.7 to 5.7 mm
-NB(mm)	The distance -NB(mm)	This angle specifies the distance between the incisal edge of lower incisors and the NB line. Standards range from 1.2 to 8.8 mm
Index	The ratio of the length of segments N-Sp' and Sp'-Gn	This angle specifies the percentage relation between the middle and the lower anterior segment of the face

Table 4. Comparison of the results of the Hasund-Segner analysis before and 6 months after surgery in the whole group of patients

Parameters	Calculated parameters						Statistical test value.	p value
	Before the surgery			After the surgery				
	x	Me	SD	x	Me	SD		
SNA	82.87	82.91	2.04	82.86	82.51	2.17	0.602	p > 0.05
SNB	87.60	87.23	2.91	82.23	82.13	2.33	6.093	p < 0.001
ANB	−4.73	−4.70	2.88	0.63	0.92	2.08	6.093	p < 0.001
SNPg	88.93	88.59	3.26	86.98	86.11	3.53	5.934	p < 0.001
NSBa	133.45	133.51	6.67	132.96	132.32	6.67	1.388	p > 0.05
Gn-tgo-Ar	132.04	132.22	6.53	129.97	131.37	6.96	4.939	p < 0.001
NL-NSL	5.97	5.12	2.22	6.33	5.82	2.15	2.158	p < 0.05
ML-NSL	34.27	34.79	5.75	32.82	33.11	5.87	6.071	p < 0.001
ML-NL	28.30	28.34	5.70	26.48	26.16	5.75	6.154	p < 0.001
H	4.01	2.98	1.82	6.19	5.66	1.98	6.093	p < 0.001
<u>1</u> -	144.40	142.47	10.17	143.42	140.98	8.95	0.959	p > 0.05
<u>1</u> -NA°	23.21	22.55	4.78	23.00	23.25	4.69	1.777	p > 0.05
-NB°	20.49	20.00	3.87	21.64	21.10	3.66	5.665	p < 0.001
PgNB(mm)	3.59	3.41	1.76	3.07	3.01	1.50	5.097	p < 0.001
<u>1</u> -NA(mm)	4.72	4.80	1.74	5.97	5.64	4.47	2.656	p < 0.01
-NB(mm)	3.67	3.56	2.67	3.22	3.17	2.75	6.775	p < 0.001
Index	70.83	71.28	5.71	73.78	74.60	5.12	6.514	p < 0.001

x – arithmetic mean; Me – median; SD – standard deviation.

The results of cephalometric measurements performed before and after the treatment were compared with standards anticipated for each individual patient, which resulted from the harmony boxes. Ranges of individual norms before the surgery differed from the ones obtained after the operation. This is due to the fact that parameters affecting the creation of individual standards/norms (obtained from the harmony diagrams) preceding and following the treatment were different. An improvement of cephalometric parameters of sagittal plane in all patients was observed in relation to the norms derived from the harmony boxes. However the values within the range of population mean were accomplished in 18.37% in case of SNB angle, and in 69.39% in case of ANB angle.

Among the parameters whose values changed significantly only in the case of ANB and SNB angles an increase in the number of patients achieving the norm, resulting from the harmony box, after the surgery was seen (Figure 2). In the group of patients who underwent EVRO, measurements performed before the surgery revealed that almost all ANB values were below the individual norms derived from harmony boxes (in 21 out of 22 patients, the fraction equaling 0.96), whereas measurements done after the surgery, showed that most of the obtained results were within the ranges of individual

norms (in 14 out of 22 people, the fraction equaling 0.64). Similar observations were made for patients after BSSO. The difference in the number of patients who achieved ANB results falling within the range of individual norms (derived on the basis of the harmony diagram), before and after surgery, was statistically significant ($\chi^2 = 14.566$, $p < 0.001$ for EVRO and $\chi^2 = 30.171$, $p < 0.001$ for BSSO, respectively) (Figure 2). The SNB angle was seen as another parameter that changed significantly after the surgery within the BSSO group. Before the surgery, the vast majority of patients had results exceeding the standard (in 26 of 27 patients, the fraction was 0.96), while after the treatment the frequency of such results decreased significantly ($\chi^2 = 7.174$, $p < 0.05$). However, a significant group of patients had values of the SNB angles still exceeding the norms derived from harmony boxes (17 out of 27 patients, the fraction reaching 0.63) (Figure 2). What concerns other parameters, the distribution of preoperative and postoperative results in relation to the individual norms remained statistically insignificant ($p > 0.05$).

After comparing the average change (subtraction values of analyzed parameters before and after the treatment) we found one statistical correlation and several tendencies. The average subtraction values for the ANB angle in the group of patients

Fig. 2. Comparison of parameters in relation to the norms

who underwent EVRO equaled -4.77 ± 1.94 and in the BSSO group: -5.84 ± 2.05 . Although these differences did not present a statistical value, we observed a certain tendency, namely that BSSO affected a greater change of ANB value ($p = 0.0575$).

A comparison of average H angle value, which altered after the treatment, in both operated groups, disclosed a relevant correlation. Holdaway's angle revealed a more significant change in patients after sagittal split osteotomy ($p < 0.05$) (Table 5).

Table 5. Changes of parameters after surgery treatment

Parameters	BSSO		EVRO		Statistical test value	p value
	x	SD	x	SD		
SNA	-0.11	0.49	0.15	0.37	0.748	$p > 0.05$
SNB	5.73	2.03	4.92	1.86	1.226	$p > 0.05$
ANB	-5.84	2.05	-4.77	1.94	1.900	$p > 0.05$
SNPg	2.04	1.70	1.84	1.56	0.271	$p > 0.05$
NSBa	0.70	2.92	0.23	1.62	0.537	$p > 0.05$
Gn-tgo-Ar	2.45	2.48	1.59	1.77	1.417	$p > 0.05$
NL-NSL	-0.27	1.17	-0.48	1.14	0.754	$p > 0.05$
ML-NSL	1.65	1.52	1.21	1.85	0.663	$p > 0.05$
ML-NL	1.93	2.06	1.69	2.13	0.332	$p > 0.05$
H	-2.63	1.66	-1.64	0.73	2.342	$p < 0.05$
$\perp$ -	0.34	6.46	1.75	7.67	1.113	$p > 0.05$
$\perp$ -NA°	0.28	0.87	0.12	0.75	0.852	$p > 0.05$
-NB°	-1.35	1.26	-0.89	0.91	1.367	$p > 0.05$
PgNB(mm)	0.46	0.74	0.60	0.69	0.904	$p > 0.05$
$\perp$ -NA(mm)	-0.53	1.16	-2.13	6.91	0.472	$p > 0.05$
-NB(mm)	0.52	0.46	0.37	0.47	0.704	$p > 0.05$
Index	-2.93	3.44	-2.97	2.88	0.352	$p > 0.05$

x – arithmetic mean; SD – standard deviation.

Discussion

Both of the orthognathic surgeries that are currently used in Poland to correct mandibular prognathism led to similar changes in cephalometric parameters, and simultaneously resulted in comparable bone and soft tissue changes. Sagittal and vertical osteotomies proved to favorably affect facial aesthetics.

Six months after the orthognathic treatment we observed a relevant improvement in parameters describing the sagittal relationship between the maxilla and the mandible, and between the mandible and the skull base in comparison to individual norms. A positive influence was also noticed in the case of vertical parameters of relationship of the Hasund-Segner analysis in relation to norms derived from harmony boxes. The obtained results were similar to those presented in the literature.

Mean post-operative values of the SNB angle reported by other authors were similar to ours and ranged between 80° and 82° [12, 13]. The significant decrease in the SNPg angle was also observed. In the cited articles, all patients reveal an important improvement in the value of the ANB angle after the surgery [12, 14, 15]. What was also observed was a significant decrease in vertical disproportion. It should be emphasized that in the case of mandibular prognathism the values of ML-NSL, ML-NL angles exceed standard ranges calculated for these parameters. Some authors emphasize that significant changes in the parameters of the ML-NSL that can be seen after the surgery are associated with significant changes in the ML-NL angle [12].

Decrease in sagittal and vertical disproportion was reflected in the number of patients whose values of cephalometric parameters fell within the range of individual standards after the performed orthognathic treatment. We found that statistically relevant changes in SNB values observed after the EVRO did not affect the number of patients with this parameter falling within the standard resulting from harmony box. In the case of vertical ramus osteotomy changes in ANB values associated with the orthognathic procedure influenced the possibility to obtain an individual standard of this parameter. A different situation took place in case of BSSO. Sagittal split ramus osteotomy led to

statistically significant differences in values of the SNB and ANB angles and also to a statistically increased number of patients who achieved their individual standards anticipated for these angles resulting from harmony box.

Despite the fact that both of the discussed surgical methods led to improvement in facial aesthetic, some differences in soft and hard tissue changes could be seen. A tendency towards a greater change in the ANB angle following the sagittal split osteotomy was noticed. Also Holdaway's angle improvement was greater in the group of patients who underwent BSSO. These observations can be explained by the fact that vertical ramus osteotomy enables reposition of the proximal osteotomized mandibular fragment in anterior-posterior direction only with minimal distortions in vertical direction. Whereas the bilateral sagittal split osteotomy makes it possible to freely move the bone fragment in all directions, including its rotation. Osteotomy lines affect bone changes within the maxillo-facial skeleton, which is reflected in cephalometric measurements. It is known that the value of Holdaway's angle is influenced by the sagittal relation of the mandible and the maxilla (ANB angle), the prominence of chin tuberosity, the thickness of soft tissue in the chin and the lower lip, as well as by the position of incisors [11]. It can be assumed that a greater change of Holdaway's angle following the BSSO can be partially explained by a greater change in the ANB angle. Changes in cephalometric parameters and improvement in their values in relation to norms derived from harmony box not always mean that these parameters reach values close to the population mean. The positive effect on the aesthetics of the face is shown by positive change of Holdaway's angle.

Both methods used in surgical treatment of mandibular prognathism, namely the external vertical ramus osteotomy and the bilateral sagittal split osteotomy posed a positive influence on the anterior-posterior relation of the mandible towards the skull base and the maxilla assessed in Hasund-Segner cephalometric analysis. There are small differences related to the impact that the surgery has on hard and soft tissue profile, depending on the surgical technique. BSSO had greater impact on Holdaway's angle than EVRO.

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