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Dynamic Changes in Morphometric Analysis in Patients Following Class III Bimaxillary Surgery

Dynamika zmian w analizie morfometrycznej u pacjentów z III klasą szkieletową leczonych metodą BSSO i Le Fort I

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Abstract

Background. Prognathism of the mandible is a skeletal Class III abnormality, caused either by excessive forward growth of the mandible or maxillary underdevelopment.
Objectives. The aim of the study was to assess dynamic changes in morphometric analysis on subjects presenting with Class III malocclusions before orthodontic treatment, before bimaxillary surgery and after surgery.
Material and Methods. The sample consisted of 30 non-growing patients, at the age of 18 to 30, treated with mandibular set-back sagittal split osteotomy and maxillary Le Fort I advancement. Cephalometric analysis by Segner and Hasund was performed. Lateral cephalograms were taken at the beginning of orthodontic treatment (T0), immediately before surgery (T1) and at least 3–6 months after surgery (T2).
Results. The results showed that there was normalization of the cephalometric variables after surgery. In the sagittal plane the following skeletal changes were observed: preoperative anterior mandibular growth confirmed by SNB increased angle was significantly reduced after surgery; preoperative decreased SNA angle largely increased after surgery. Statistically significant GntgoAr mandible angle decreased after surgery in relation to the beginning state. Also, the H angle was increased as a result of orthodontic-surgical treatment which influenced positively on face esthetics.
Conclusions. The results of our study indicate that there was a significant improvement in the correlation between soft and hard tissue change in the facial profiles of the Class III bimaxillary surgery patients, which was improved by the H angle. The face's photographs and cephalometric analysis indicate, after the operation there is a decrease of total face length, but the lower part still remains longer than a middle part of the face (**Adv Clin Exp Med 2012, 21, 1, 93–97**).

Key words: cephalometric analysis, BSSO, Le Fort I surgery.

Streszczenie

Wprowadzenie. Przodożuchwie morfologiczne jest wadą szkieletową III klasy Angle'a, związaną z nadmiernym doprzednim wzrostem żuchwy oraz często niedorozwojem szczęki.
Cel pracy. Ocena dynamiki zmian morfometrycznych z prognacją żuchwy przed leczeniem ortodontycznym, po przygotowaniu ortodontycznym do zabiegu dwuszczękowego i po leczeniu chirurgicznym.
Materiał i metody. Badana grupa składała się z 30 dorosłych pacjentów w wieku 18–30 lat, leczonych metodą BSSO i Le Fort I. Przeprowadzono analizę cefalometryczną według Segnera i Hasunda. Zdjęcia boczne głowy oceniano na początku leczenia ortodontycznego (T0), przed zabiegiem (T1) i 6 miesięcy po leczeniu chirurgicznym (T2).
Wyniki. Analiza morfometryczna przed, podczas i po zabiegu wykazała powrót do wartości prawidłowych pomiarów cefalometrycznych po leczeniu chirurgicznym. Przedoperacyjny doprzedni wzrost żuchwy potwierdzony przez kąt SNB został znacznie zmniejszony po operacji; przedoperacyjne skrócenie (hipoplazja) szczęki zostało znacznie zmniejszone po operacji. Kąt żuchwy zmniejszył się istotnie statystycznie po zabiegu w stosunku do wartości wyjściowej. Również kąt H zwiększył się po operacji, co pozytywnie wpłynęło na estetykę twarzy.
Wnioski. Rezultat badań wskazuje na znaczną poprawę korelacji między miękkimi a twardymi tkankami twarzy u pacjentów z III klasą szkieletową po zabiegu BSSO i Le Fort I, co zostało potwierdzone przez kąt H. Analiza zdjęć

twarzy i cefalometryczna wskazuje na skrócenie całego odcinka twarzy po operacji, dolna część twarzy pozostaje jednak nadal dłuższa niż środkowe piętro twarzy (**Adv Clin Exp Med 2012, 21, 1, 93–97**).

Słowa kluczowe: analiza cefalometryczna, zabieg chirurgiczny BSSO i Le Fort I.

The prognathism of the mandible – *positio mandibulae anterior morphologica* – is a skeletal Class III abnormality. The main characteristic of the defect is the anterior position of the mandible which results from excessive growth in the vicinity of its body and/or branches. Therefore it is a defect of the chewing organ characterized by orthognathic changes. The deformity comprises the whole craniofacial pattern [1, 2]. The occlusion conditions are generally characterized by total Class III malocclusion with a characteristic reverse overjet.

The profile of the patient in the skeletal class III defect is intermediate or set back (the subnasal point in the biometric field or in front of the rear border of the field) – forward oblique (the pogonion point beyond the biometric field), the labiochin groove flattened. A contemporary study of 8-year-old children from Lower Silesia conducted by Kawala [3] revealed an increase in the percentage of anterior occlusion defects to 7.9%. The factors causing skeletal class III are genetically determined while the functional factors (excessive tongue, habit of protruding the mandible) do not play a primary role in the etiology of the defect.

The combination of BSSO and Le Fort surgery is the commonest surgical procedure in the case of severe skeletal class III cases. The surgery may be required in most severe cases presenting syndromes (ex. Binder, Apert, Cruzon, Stickles, etc.) [4]. Much research describes changes in hard tissue, but there are fewer findings concerning changes in soft tissue throughout the treatment – the patient's preparation for the surgery and after the surgery. The dynamics of changes in the morphometric analysis in patients with skeletal class III shall comprise all the issues simultaneously.

The aim of the study was to assess the dynamics of morphometric changes in patients with mandibular prognathism before the orthodontic treatment, after the orthodontic preparation for the bimaxillary surgery and after the surgery on the maxilla and the mandible.

Material and Methods

The control group consisted of 30 adult patients with mandibular prognathism aged 18 to 30, treated with mandibular set-back sagittal split osteotomy and maxillary Le Fort I advancement. In the study, attention was focused on the facial aesthetics, occlusion conditions, punching and chewing possibility, pronunciation and breathing (through the nose or through the mouth). Lateral head cephalograms were assessed after the patient registering for orthodonto-surgical treatment (T0), after the orthodontic preparation for bimaxillary surgery (T1) and 6 months after surgery (T2).

For the achieved values from the analysis of the lateral head cephalograms with Statistica program for Windows version 9.1, the calculation of a series of diagnostic orthodontic indicators was planned. The descriptive parameters such as the average and the standard deviation.

The average values of particular variables were compared in the researched groups by means of t-Student statistics, the criterion of distribution normality was checked by Shapiro-Wilk test. For verification of statistic hypothesis the level of significance $\alpha = 0.05$ was taken.

Results

The morphometric analysis of cephalograms of the examined patients at the beginning of the treatment (T0), before surgery (T1) and 6 months after surgery (T2) is shown in Table 1.

The orthodontic preparation for the surgery worsens the occlusion conditions and the facial appearance of the patient, yet after the surgery the occlusion conditions and the face of the patient improve significantly (Table 1).

The dental changes before the commencement of the orthodontic treatment revealed the protrusion of the upper incisors in the ratio to the NA line which was slightly intensified before the surgery only to remain within the standard threshold (T0 = 22.83°, T1 = 26.72° and T2 = 21.23°, angle standard 1+NA = 21 ± 1°) and the inclination of the lower incisors in the ratio to the NB line before the treatment and their position within the standard threshold before and after the surgery (T0 = 18.6°, T1 = 21.78°, T2 = 20.7°, angle standard 1-NB = 24 ± 4°). The position of the teeth and the lips improves after the orthodonto-surgical treatment (Table 1).

The morphometric analysis before orthodonto-surgical treatment, before surgery and after surgery showed the normalization of cephalometric variables after the completion of the treatment. The preoperative anterior mandibular growth confirmed by SNB increased angle was significantly reduced after surgery, preoperative decreased SNA

Table 1. Selected cephalometric measurements according to Segner and Hasund analysis before, in the middle and after orthodontic-surgery treatment

Tabela 1. Wybrane parametry cefalometryczne wg analizy Segnera i Hasunda przed, podczas i po terapii ortodontyczno-chirurgicznej

Measurements (Pomiary)	Pretreatment (Przed leczeniem) (T0)		Immediately before the surgery (Bezpośrednio przed zabiegiem chirurgicznym) (T1)		Posttreatment (Po leczeniu) (T2)		Statistical significance of difference (Istotność statystyczna różnic)		
	mean	SD	mean	SD	mean	SD	T1–T0	T2–T0	T2–T1
SNA (⁰)	82.21	3.43	79.08	3.43	83.30	3.82	0.0170	0.0318	0.0000
SNB (⁰)	85.71	4.00	85.01	3.69	82.10	3.39	0.6143	0.0006	0.0000
ANB (⁰)	–3.25	2.98	–5.73	3.30	1.40	2.00	0.0490	0.0005	0.0000
GntgoAr (⁰)	132.52	4.24	132.08	4.93	129.23	7.07	0.8186	0.0955	0.0042
H (⁰)	2.12	6.68	–0.14	5.36	8.47	4.56	0.3001	0.0118	0.0000
1+:NA (⁰)	22.83	6.59	26.72	4.93	21.23	5.78	0.0532	0.1736	0.0000
1–:NB (⁰)	18.60	5.37	21.78	8.16	20.70	7.19	0.2579	0.0758	0.4007
Wits (mm)	–12.37	3.88	–14.78	5.16	–4.40	2.61	0.1898	0.0006	0.0000
Mandible body length (Długość trzonu żuchwy)(mm)	87.01	9.18	84.18	5.65	79.79	6.02	0.2593	0.0434	0.0011
Mandible rami length (Długość gałęzi żuchwy) (mm)	67.38	7.82	66.51	4.03	64.71	4.95	0.6356	0.3222	0.0122
Maxilla length (Długość szczęki) (mm)	50.40	7.69	47.14	3.35	51.02	4.16	0.0664	0.6580	0.0000

Norm (Norma): SNA 82±3, SNB 80±3, ANB 2±2, GntgoAr 122±7, H 9±3, 1+:NA 21±1, 1+:NB 24±4, Wits 0±2, Mandible – individual (indywidualne), Mandible – individual (indywidualne), Maxilla – individual (indywidualne).

angle largely increased after surgery. The angle of the mandible also significantly decreased after surgery in the ratio to the output value (Table 1).

The morphometric analysis of soft tissue revealed a significant improvement of H angle (Table 1), which positively influenced the face aesthetics.

Discussion

The authors researched 30 cases of patients with a diagnosed skeletal class III defect who underwent surgical treatment. The study was intended from the very beginning to be a cephalometric analysis, therefore the evaluation of many other factors such as patient satisfaction with the surgery were deliberately disregarded.

The aim of the orthodonto-surgical treatment is the normalization of the dental and skeletal proportions and facial aesthetics and therefore a cephalometric analysis assessing the result of the conducted therapy is suitable in this case.

Only patients aged 18–30 were qualified for the research. The possible effect of residual growth of the facial bone was excluded in the research since the minimum age of the sample group was 17.

The main aim of the orthodontic preparation for the surgery is the correction of the inclination of incisors to the correct value in order to make surgical correction possible [5]. The values of the position of the upper and lower incisors before, during and after surgery are shown in Table 1. Current observations overlap with the findings of Cho [6]. The observations are not confirmed, however, by Collins and Poulton [7], whose T1 values of both parameters decrease in the ratio to T0 (although the research was based on an isolated case).

The result of the surgery indicates a significant change in skeletal angles, that is SNA, SNB, ANB, GntgoAr.

The input values of SNA angles (connected with the anterior protrusion of the maxilla during the surgery), SNB (connected with the surgical backward dislocation of the stem of the mandible after surgery), ANB and Wits suggest that the choice of orthodonto-surgical treatment is the most appropriate available therapy.

Patients selected for bimaxillary surgery have a bigger discrepancy in the range of ANB angle resulting from the values of the SNA and SNB angles. Recently an increase in the number of bimaxillary surgeries has been observed as they have been considered to be more stable procedures in comparison to single maxillary surgery [8]. The output value and preoperative ANB were below the standard due to the setting of the maxilla to the mandible typical of mandibular prognathism. After surgery the values significantly increased due to the dislocation of the osteotomic fractions. As a result of the bimaxillary surgery, an ideal ANB angle is achieved at the end of the treatment. Most authors give its value as a statistically significant value [6–8].

Although the correction of ANB angle seems minimally smaller than expected, the shaping of the soft tissue H angle profile aesthetics shows that patients after the completion of treatment remain within the standard. The change of the parameters twice (T0 = 2.1° and T1 = –0.1°) highlights a significant deterioration of soft tissue profile during the preparation for the surgery and improvement of the facial profile after the surgery (T2 = 8.5°). Johnston and others are of the same opinion [8]. The value of the GntgoAr angle varied beyond the standard (AT0 = 132.5° and T1 = 132.1°), while after the surgery the angle reached the top standard threshold (T2 = 129.2°). The postoperative change of GntgoAr angle is connected with its surgical reduction.

In current study the mandibular body and branch length after the operation are reduced while the length of the maxilla increases, which overlaps with the aim of the conducted treatment and the findings of other authors [7, 11]. It is worth noting that the findings of the authors who have assessed the length of the mandibular branches are scarce and the study focuses rather on the length of the mandibular body, however, in present authors opinion, they are of key importance for the analysis of other cephalometric parameters. The fact that in professional literature there are more references to the parameter changes observed in isolated cases than in a bigger group of patients shall be emphasized.

The aim of Le Fort maxillary surgery is the protrusion of the maxilla, the result of which is the upper airways broadening and deeper breathing [12]. The same effect was observed in studied sample group although the only meter was the subjective feelings of the patient. Present patients paid attention to the improved breathing through the nose. The patients also had the feeling that chewing and punching improved, while in objective research, it concerned occlusion conditions and pronunciation.

In conclusion, the orthodonto-surgical treatment is considered to contribute to the achievement of the statistically significant dental-skeletal changes. The result of the research indicates a slight improvement of the correlation between soft and hard tissue of the face in patients with a skeletal class III after BSSO and Le Fort I surgery, which was confirmed by the H angle. The cephalometric analysis indicates a reduction of the lower facial section after surgery, although it still remains longer than the middle part of the face.

Further long-term research is required in order to prove the stability of the changes.

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