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Dental and skeletal changes occurring after orthodontic-surgical treatment of mandibular prognathism

Dentalne i skeletne promene nastale posle ortodontsko-hirurškog lečenja mandibularnog prognatizma

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Abstract

Background/Aim. Mandibular prognathism (MPG) is a severe form of facial and jaw deformity. This kind of anomaly usually requires combined orthodontic-surgical treatment. The aim of this study was to determine the changes in the craniofacial complex after orthodontic-surgical treatment of patients with MPG by analyzing the cephalometric parameters on teleradiography images before and after treatment. **Methods.** The study included a sample of 40 subjects (mean age 24.1 ± 4.1 years) who underwent orthodontic-surgical treatment of MPG. Vertical and sagittal parameters which characterize MPG were measured on profile teleradiography images before and 12 months after treatment. Based on the analysis of cephalometric parameters on preoperative and postoperative teleradiography images, dental and skeletal changes that occurred after treatment were determined. **Results.** After the end of the treatment, most of the parameter values that characterize MPG were significantly reduced. A drop in values was noted in the following parameters: SNB, SNPg, NS/SpP, NS/MP, SpP/MP, NSAr, ArGoMe, Bjork polygon, NMe, NSna, SnaMe, SSnp, I/SpP. There was a statistically significant increase in the values of the following parameters SNA, ANB, GoArNS, SGo and i/MP. No significant changes in values were recorded on the OP/NS and SArGo parameters. **Conclusion.** Orthodontic-surgical treatment of MPG leads to changes in the bone and dental structures of the craniofacial system. As a result of such treatment, there is a functional improvement and an improvement in the appearance of the face.

Key words:
cephalometry; malocclusion, angle class III; mandible; orthognathic surgical procedures; prognathism; treatment outcome.

Apstrakt

Uvod/Cilj. Mandibularni prognatizam (MPG) predstavlja težak oblik deformiteta lica i vilice. Ova vrsta anomalije najčešće zahteva kombinovano ortodontsko-hirurško lečenje. Cilj ove studije bio je da se utvrde promene na kraniofacijalnom kompleksu nakon ortodontsko-hirurškog lečenja osoba sa MPG analizom kefalometrijskih parametara na teleradiografskim snimcima pre i posle lečenja. **Metode.** U istraživanje je uključeno 40 osoba (prosečne starosti 24,1 ± 4,1 godine) kod kojih je sprovedeno ortodontsko-hirurško lečenje MPG. Vertikalni i sagitalni parametri koji karakterišu MPG mereni su na profilnim teleradiografskim snimcima pre lečenja i 12 meseci posle lečenja. Na osnovu analize kefalometrijskih parametara na preoperativnim i postoperativnim teleradiografskim snimcima utvrđene su dentalne i skeletne promene nastale nakon lečenja. **Rezultati.** Nakon završenog lečenja značajno su smanjene vrednosti većine parametara koje odlikuju MPG. Zabeležen je pad vrednosti sledećih parametara: SNB, SNPg, NS/SpP, NS/MP, SpP/MP, NSAr, ArGoMe, Bjork polygon, NMe, NSna, SnaMe, SSnp, I/SpP. Došlo je do statistički značajnog povećanja vrednosti sledećih parametara SNA, ANB, GoArNS, SGo, i/MP. Nisu zabeležene statistički značajne promene vrednosti parametara OP/NS i SArGo. **Zaključak.** Ortodontsko-hirurško lečenje MPG dovodi do promena na koštanim i dentalnim strukturama kraniofacijalnog sistema. Kao rezultat takvog lečenja dolazi do funkcionalnog poboljšanja i do poboljšanja izgleda lica.

Ključne reči:
kefalometrija; malokluzija, klase III; mandibula; hirurgija, ortognatska, procedure; prognatizam; lečenje, ishod.

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Introduction

Mandibular prognathism (MPG) is a severe form of facial and jaw deformity, a hereditary developmental type dominated by disturbed sagittal and vertical intermaxillary relations caused by excessive growth and development of the lower jaw in relation to the upper jaw and cranial base [1].

MPG, one of the most complex and unattractive orthodontic irregularities, is manifested by inadequate size, shape, and position of the lower and often the upper jaw. During growth and development, there is a growing discrepancy in the size of the upper and lower jaw. This deformity often manifests only at puberty and reaches full expression with the end of growth [1].

The frequency of MPG varies depending on the observed population. The highest incidence was observed in the Asian population (about 15%) and the lowest in the Caucasian population (1%) [2]. Recent research has shown an occurrence range of 2% to 6% for the European population, while the most common occurrence of MPG is in the Chinese population [3].

Patients with MPG have a specific facial appearance, occlusal relationships, and a specific craniofacial skeletal structure. Specific characteristics of MPG are the increased total anterior facial height, especially the anterior lower facial height, decreased dimensions of posterior lower facial height and length of the posterior cranial base, increased values of angles defining the anteroposterior and vertical ratio of upper and lower jaw to the anterior cranial base [lower jaw prognathism angle (SNB), gonial angle (ArGoMe), Bjork polygon, mandibular plane (MP) angle relative to the anterior cranial base (NS/MP), ratio of the upper and lower jaw in the vertical plane (SpP/MP)], and negative values of the inter-jaws angle (ANB). MPG is accompanied by specific occlusion: compensatory protrusion of the upper, pronounced retrusion of the lower incisors, large interincisal angle, the large angle between the occlusal and MP, negative incisal step, and often present frontal open bite.

Due to the changed anatomical relationships in such patients, all oral functions and facial appearance are significantly impaired, endangering the psychosocial status of the patient, which has a negative impact on the quality of life.

Treatment of MPG is possible by growth modification during growth and development, orthodontic treatment (dentoalveolar compensation – camouflage), and orthodontic-surgical treatment [4].

The largest number of patients with MPG achieve satisfactory functional and aesthetic results with combined orthodontic-surgical treatment. Surgery is performed after the facial and jaw bones have completed the growth and development phase in order to prevent the negative impact of post-treatment growth on the achieved results [1].

Before the operation, the patient goes through the phase of pre-surgical orthodontic preparation to correct the irregularities of both dental arches, which makes it easier for the surgeon to perform a stable reposition of the bone segments. Orthognathic surgical treatment involves surgical repositioning of the upper and lower jaws, which achieves the correct ratio of bone structures to the base of the skull [5]. The combination of bilateral sagittal split osteotomy and Le Fort osteotomy are the most common surgical procedures used to treat MPG [6]. Surgery on both jaws in the treatment of MPG achieves many advantages, such as better functional results, significantly reduced recurrence rate, significant harmonization of facial dimensions, balanced facial proportions in the sagittal and vertical directions, and greater stability of post-operative results [7, 8]. The surgery is followed by a phase of post-surgical orthodontic treatment, which performs the final movements of the teeth and thus completes the entire therapy [5].

Numerous X-ray cephalometric parameters can confirm MPG. MPG is characterized by negative values of ANB and increased values of angles that determine the anteroposterior and vertical relationship of both jaws to the anterior cranial base: SNB, ArGoMe, Bjork polygon, NS/MP, face profil angle (NAPg).

Analyses of cephalometric parameters on profile teleradiography images of the head are necessary for the diagnosis of MPG, in the planning of appropriate orthodontic and surgical treatment, as well as in the assessment and evaluation of treatment outcomes.

After orthodontic-surgical treatment of MPG, skeletal and soft tissue changes of the craniofacial complex occur [6, 9–11].

Orthodontic-surgical treatment of MPG leads to the establishment of craniofacial balance, changes in facial appearance, improvement of oral functions, and patient’s quality of life.

The aim of this study was to determine the changes in the craniofacial complex after orthodontic-surgical treatment of patients with MPG by analyzing the cephalometric parameters on teleradiography images before and after treatment.

Methods

The patients were treated at the Department of Orthopedics of the Jaws, the Dental Clinic, and the Clinic for Maxillofacial Surgery of the Military Medical Academy in Belgrade, Serbia. All activities and procedures applied in this study were approved by the Ethics Committee of the Military Medical Academy in Belgrade (from 25 December, 2018) and informed consent was obtained from the patients.

A total of 40 patients, 19 (47.5%) males and 21 (52.5%) females, participated in this study. The age of the patients ranged from 19 to 34 years, and the mean value ± standard deviation (SD) was 24.1 ± 4.1 years. All patients were diagnosed with MPG and underwent orthodontic-surgical treatment of this deformity.

The patients in the study were divided into two groups. The first group included patients who underwent surgery on one jaw (monomaxillary group), and the second group consisted of those who underwent surgery on both jaws (bimaxillary group). Out of the total number of patients, 16 (40%) were in the monomaxillary group, while 24 (60%) were in the bimaxillary group.

All patients underwent preoperative orthodontic treatment with the same protocol to achieve adequate and stable postoperative occlusion. After the orthodontic preparation, surgical repositioning of the jaws (mono or bimaxillary type) with rigid fixation was performed. In the area of the lower jaw, a standard sagittal step osteotomy was performed, while in the area of the upper jaw, a Le Fort osteotomy of the middle face was performed. The research included the analysis of cephalometric parameters on teleradiography images before and after orthodontic-surgical treatment.

The following patients were excluded from the study: patients with cleft lip and palate and all other craniofacial deformities; patients with a history of facial trauma or some orthognathic surgery; patients with temporomandibular joint diseases; patients with facial asymmetries, etc.

Angular and linear parameters describing dental and skeletal changes were measured on teleradiography images of 40 patients with MPG before orthodontic preparation (T1) and twelve months after surgical treatment of MPG (T2). Figure 1 shows the cephalometric points and planes used in the analysis of teleradiography images.

Analysis of the facial skeleton in the sagittal direction

Parameters of the facial skeleton in the sagittal direction include the following: upper jaw prognathism angle (SNA), SNB, ANB, lower jaw prognathism angle/facial angle (SNPg), and inclination of the ramus to the cranial base angle (GoArNS).

The first group of parameters in this study includes the analysis of the facial skeleton in the sagittal direction. These are angular measurements (unit of measure is degree) of bone structures that indicate the size and manner of movement of the lower and upper jaws during surgery.

Analysis of the facial skeleton in the vertical direction

Parameters of the facial skeleton in the vertical direction include the following: palatal plane angle relative to the anterior cranial base (NS/SpP), NS/MP, SpP/MP, occlusal plane angle relative to the anterior cranial base (OP/NS), saddle angle (NSAr), articular angle (SArGo), ArGoMe (for all angular measurements the unit of measurement is degree),

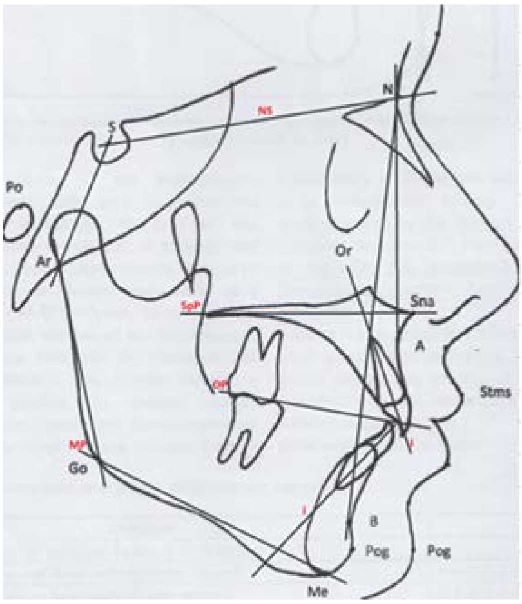

Fig. 1 – Cephalometric parameters.
N – nasion (the most anterior point on the frontonasal suture); S – *sella* (the center of the *sella turcica*); A – subspinale point (the deepest midline point between the anterior nasal spine and prosthion); B – supramentale point (the deepest point in the bony outline between the infradentale and the pogonion); Me – menton (the lowest point on the bony outline of the mandibular symphysis); Or – orbitale (the lowest point on the infraorbital margin); Go – gonion (the most lateral external point at the junction of the horizontal and ascending rami of the mandible); Po – porion (the uppermost point of the bony external auditory meatus); Pog – pogonion (the most anterior point of the bony chin); Stms – most anterior contour point of upper lip; OP – occlusal plane (the denture plane bisecting the posterior occlusion of the permanent molars and premolars and extending anteriorly bisecting the overbite); NS – nasion-*sella* plane (the anterior cranial base formed by projecting a plane from the *sella*-nasion line); SpP – palatal plane (formed by connecting anterior nasal spine to posterior nasal spine, used to measure the vertical tilt of maxilla); Sna – anterior nasal spine (the most prominent point of the upper jaw); Ar – articulare (a point at the junction of the posterior border of the ramus and the inferior border of the posterior cranial base – occipital bone); MP – mandibular plane (the tangent drawn to the inferior border of the mandible); I – inclination of the upper incisors

total front face height (NMe), front upper face height (NSna), front lower face height (SnaMe), total rear face height (SGo), and rear upper face height (SSnp) (for all linear measurements, the unit of measurement is millimeter).

Incisor position analysis

Incisor position analysis assessed the inclination of the upper incisors relative to the palatal plane (I/SpP) and inclination of the lower incisors relative to the MP (i/MP) parameters (unit of measure is degree).

Statistical analysis

The Kolmogorov-Smirnov test was used to examine the layout of a statistical series.

Pearson's Chi-squared test (χ^2) was used to test the relationship between the two qualitative variables. Differences in numerical variables were examined using One-Factor Analysis of Variance (ANOVA) and/or t-test for large independent samples.

To examine the relationship between the two continuous variables, Pearson's correlation coefficient was used as a parametric test, and Spearman's correlation coefficient as a nonparametric substitution. Differences in the values of numerical variables measured in several time intervals were tested by the Repeated measure ANOVA test.

Statistical significance was defined at the level of probability of the null hypothesis of $p < 0.05$. Statistical processing and analysis were done in the computer program SPSS V24 (Statistical Package for the Social Sciences), and graphical and tabular presentations in the software package Microsoft Office (Excel and Word).

Results

The analysis of cephalometric parameters on teleradiography images before and 12 months after the end of treatment revealed the changes in the measured parameters (Table 1). After treatment, statistically significantly higher values were recorded on the parameters SNA, ANB, GoArNS, SGo, SSnp, and i/MP. While the parameters SNB, SNPg, NS/SpP, NS/MP, SpP/MP, NSAr, ArGoMe, Bjork polygon, NMe, NSna, SnaMe, and I/SpP showed statistically significantly lower values after treatment. The value of OP/NS and SArGo parameters did not change significantly 12 months after orthodontic-surgical treatment of MPG.

Table 1

Differences in measured parameters in all patients before (T1) and 12 months after (T2) orthodontic-surgical treatment of mandibular prognathism

	Parameters	T1	T2	*p*
Sagittal direction	SNA	79.4 ± 5.0	81.2 ± 4.5	**0.012**
	SNB	8.9 ± 4.8	81.5 ± 4.2	**0.000**
	ANB	-5.6 ± 2.6	-0.2 ± 2.3	**0.000**
	SNPg	87.2 ± 4.1	84.3 ± 3.6	**0.000**
Vertical direction	GoArNS	82.2 ± 5.1	83.9 ± 7.7	0.159
	NS/SpP	8.0 ± 2.5	6.8 ± 2.4	**0.036**
	NS/MP	33.9 ± 4.8	31.1 ± 4.6	**0.002**
	SpP/MP	28.8 ± 4.3	25.4 ± 3.8	**0.000**
	OP/NS	14.69 ± 4.39	13.5 ± 4.02	0.114
	NSAr	121.6 ± 3.9	121.2 ± 3.9	0.383
	SArGo	141.1 ± 3.0	140.9 ± 3.0	0.779
	ArGoMe	133.9 ± 4.9	130.8 ± 4.9	**0.015**
	Bjork	396.6 ± 4.5	392.9 ± 4.2	**0.000**
	NMe	99.6 ± 15.2	90.1 ± 11.5	**0.004**
	NSna	42.0 ± 5.7	37.8 ± 5.4	**0.001**
	SnaMe	57.7 ± 9.9	52.4 ± 6.9	**0.020**
	SGo	57.6 ± 6.8	65.1 ± 10.3	**0.000**
	SSnp	33.9 ± 6.9	35.3 ± 6.0	0.432
Incisors position analysis	I/SpP	116.7 ± 4.0	113.1 ± 5.4	**0.003**
	i/MP	77.2 ± 6.3	81.1 ± 6.2	**0.001**

SNA – upper jaw prognathism angle; SNB – lower jaw prognathism angle; ANB inter – jaws angle; SNPg – lower jaw prognathism angle or facial angle; GoArNS – inclination of the ramus to the cranial base angle; NS/SpP – palatal plane angle relative to the anterior cranial base; NS/MP – mandibular plane angle relative to the anterior cranial base; SpP/MP - ratio of the upper and lower jaw in the vertical plane; OP/NS – occlusal plane angle relative to the anterior cranial base; NSAr – saddle angle; SarGo – articular angle; ArGoMe – gonial angle; Bjork – Bjork polygon angles; NMe – total front face height; NSna – front upper face height; SnaMe – front lower face height; SGo – total rear face height; SSnp – rear upper face height; I/SpP – inclination of the upper incisors relative to the palatal plane; i/MP – inclination of the lower incisors relative to the mandibular plane.

Results are presented as arithmetic mean ± standard deviation; bolded values are statistically significant; the *t*-test of repeated measurements was applied.

Differences between measured and reference values of cephalometric analysis parameters

Table 2 shows the differences between the reference and measured values of the parameters before and after orthodontic-surgical treatment.

Apart from the SArGo parameter, the values of all other parameters measured before treatment differ statistically significantly in relation to the reference values. After the completion of the treatment, the analysis established that the parameters SNA, SNB, NS/MP, OP/NS, and I/SpP are in the reference values, while in the other parameters, there is a statistically significant difference concerning the reference values. Despite the deviations, their values are close to the reference values in relation to the condition before treatment, which leads to the harmonization of skeletal and dental structures, improvement of oral function, and the appearance of the patient's face.

Differences in cephalometric analysis depending on the type of surgical procedure

Based on the analysis of cephalometric parameters conducted before and after treatment, statistically significant differences were found between patients of the monomaxillary and bimaxillary groups in the period before and after treatment.

Before treatment, patients from the bimaxillary group had higher values of the following parameters: NS/MP, SpP/MP, ArGoMe, NMe (NSna, SnaMe), and SGo. The exception is the I/SpP parameter, which showed higher values in patients from the monomaxillary group before treatment.

The established differences in the values of the mentioned parameters before treatment were essential for choosing the operative procedure. Considering that both in the monomaxillary and bimaxillary groups, the values of the measured parameters after the treatment approached the reference values, this proved to be justified (Table 2).

In patients with a more pronounced form of MPG, both in the sagittal and vertical directions, better functional and aesthetic results are achieved by surgical intervention on both jaws.

After completing the treatment, all patients, regardless of the type of surgery, had significantly lower measured values of parameters. The difference measured on the parameters before the treatment remained even after treatment, with their values approaching the reference values. The parameters NS/MP, NMe, NSna, and SnaMe are statistically significantly higher after treatment in patients from the bimaxillary group, except for the parameter I/SpP, which is higher after treatment in patients from the monomaxillary group.

Differences between linear and angular parameters before (T1) and 12 months after orthodontic-surgical treatment (T2) of patients from the monomaxillary group and patients from the bimaxillary group

In patients from the monomaxillary group, in whom sagittal split osteotomy of the ramus was performed by analysis of cephalometric parameters before orthodontic-surgical treatment, larger deviations of parameters in the sagittal direction compared to reference values were observed. The vertical parameters also deviated from the reference values, but to a much lesser extent compared to the patients from the bimaxillary group. After the completion of orthodontic-surgical treatment, the reference values of the parameters SNA, SNB, NS/MP, OP/NS, and I/SpP were achieved. Other parameters have been improved but not completely corrected. At the end of the treatment, the parameters in both groups of patients were close to the reference values, which speaks in favor of a well-chosen method of treatment (Table 3). Significantly larger deviations before treatment in both sagittal and especially vertical parameters in relation to reference values were noted in patients from the bimaxillary group, in contrast to patients from the monomaxillary group (Table 4). These deviations speak in favor of a more severe form of deformity, but the orthodontic-surgical treatment succeeded in at least ameliorating, if not completely correcting, even these bigger declinations.

Table 2

Differences between reference and measured values of cephalometric analysis parameters before (T1) and 12 months after (T2) orthodontic-surgical treatment of mandibular prognathism

Parameters	Reference values	Measured values T1		*t*	*p*	Measured values T2		*t*	*p*
		mean	SD			mean	SD		
SNA	82	79.0	5.1	-3.696	**0.001**	81.8	4.9	-0.191	0.849
SNB	80	85.3	5.7	5.873	**0.000**	81.3	5.2	1.605	0.116
ANB	2	-6.3	3.2	-16.143	**0.000**	0.5	2.3	-4.059	**0.000**
NS/SpP	12	7.9	3.3	-7.903	**0.000**	6.7	2.8	-12.087	**0.000**
NS/MP	32	37.2	8.0	4.120	**0.000**	33.8	7.1	1.634	0.110
OP/NS	14	16.0	6.2	2.105	**0.042**	15.0	5.6	1.156	0.255
NSAr	123	120.9	5.1	-2.588	**0.013**	120.4	5.4	-3.080	**0.004**
SArGo	143	141.8	4.0	-1.879	0.068	141.2	3.8	-3.030	**0.004**
ArGoMe	130	135.9	5.1	7.386	**0.000**	131.9	4.8	2.463	**0.018**
Bjork	396	398.7	6.3	2.719	**0.010**	393.4	5.4	-3.069	**0.004**
I/SpP	110	112.8	6.9	2.556	**0.015**	110.3	6.1	0.309	0.759
i/MP	90	75.4	8.6	-10.788	**0.000**	80.0	8.1	-7.831	**0.000**

For abbreviations see under Table 1; *t* − *t*-test for one sample; bolded values are statistically significant.

Table 3

Differences between patients from the monomaxillary group and patients from the bimaxillary group in the cephalometric analysis of teleradiography images before (T1) and 12 months after (T2) orthodontic-surgical treatment of mandibular prognathism

Parameters	T1		*p*	T2		*p*
	monomaxillary	bimaxillary		monomaxillary	bimaxillary	
SNA	79.4 ± 5.0	78.8 ± 5.3	0.711	81.2 ± 4.5	82.2 ± 5.3	0.539
SNB	84.9 ± 4.8	85.5 ± 6.3	0.748	81.5 ± 4.2	81.2 ± 5.9	0.865
ANB	-5.6 ± 2.6	-6.8 ± 3.6	0.247	-0.2 ± 2.3	1.0 ± 2.2	0.081
SNPg	87.2 ± 4.1	87.3 ± 6.1	0.981	84.3 ± 3.6	82.9 ± 5.9	0.42
GoArNS	82.2 ± 5.1	79.5 ± 7.5	0.209	83.9 ± 7.7	83.8 ± 9.1	0.964
NS/SpP	8 ± 2.5	7.9 ± 3.7	0.907	6.8 ± 2.4	6.6 ± 3.1	0.892
NS/MP	33.9 ± 4.8	39.5 ± 8.9	**0.029**	31.1 ± 4.6	35.7 ± 7.9	**0.042**
SpP/MP	28.8 ± 4.3	32.8 ± 6.7	**0.044**	25.4 ± 3.8	28.8 ± 6.4	0.063
OP/NS	14.7 ± 4.4	16.9 ± 7.0	0.259	13.5 ± 4.0	16.0 ± 6.3	0.163
NSAr	121.6 ± 3.9	120.5 ± 5.7	0.523	121.2 ± 3.9	119.8 ± 6.3	0.434
SArGo	141.1 ± 3.0	142.2 ± 4.6	0.395	140.9 ± 3.0	141.4 ± 4.3	0.69
ArGoMe	133.9 ± 4.9	137.4 ± 4.8	**0.032**	130.8 ± 4.9	132.6 ± 4.8	0.26
Bjork	396.6 ± 4.5	400.1 ± 6.9	0.1	392.9 ± 4.2	393.8 ± 6.1	0.619
NMe	99.6 ± 15.2	113.5 ± 19.5	**0.021**	90.1 ± 11.5	104.0 ± 18.2	**0.01**
NSna	42 ± 5.7	47.6 ± 8.1	**0.022**	37.8 ± 5.4	43.6±7.8	**0.013**
SnaMe	57.7 ± 9.9	65.5 ± 11.9	**0.037**	52.4 ± 6.9	60.5 ± 11.2	**0.014**
SGo	57.6 ± 6.8	65.1 ± 11.9	**0.029**	65.1 ± 10.3	70.8 ± 12.6	0.143
SSnp	33.9 ± 6.9	36.2 ± 6.4	0.082	35.31 ± 6.0	39.1 ± 6.8	0.296
I/SpP	116.7 ± 4.0	110.2 ± 7.2	**0.002**	113.1 ± 5.4	108.5 ± 5.9	**0.018**
i/MP	77.2 ± 6.3	74.4 ± 9.7	0.259	81.1 ± 6.2	79.3 ± 9.2	0.504

For abbreviations see under Table 1.
Results are presented as arithmetic mean ± standard deviation; bolded values are statistically significant; the *t*-test of repeated measurements was applied.

Table 4

Differences in the cephalometric analysis of teleradiography images before (T1) and 12 months after (T2) orthodontic-surgical treatment of mandibular prognathism within the monomaxillary and bimaxillary groups

	Parameters	Monomaxillary group			Bimaxillary group		
		T1	T2	*p*	T1	T2	*p*
Sagittal direction	SNA	79.4 ± 5.03	81.2 ± 4.5	**0.012**	78.8 ± 5.3	82.2 ± 5.32	**0.000**
	SNB	84.9 ± 4.8	81.5 ± 4.2	**0.000**	85.5 ± 6.3	81.2 ± 5.9	**0.000**
	ANB	-5.6 ± 2.6	-0.2 ± 2.3	**0.000**	-6.8 ± 3.6	1.0 ± 2.2	**0.000**
	SNPg	87.2 ± 4.1	84.3 ± 3.6	**0.000**	87.3 ± 6.1	82.9 ± 5.9	**0.000**
	GoArNS	82.2 ± 5.1	83.9 ± 7.7	0.159	79.5 ± 7.5	83.8 ± 9.1	**0.005**
Vertical direction	NS/SpP	8 ± 2.5	6.8 ± 2.4	**0.036**	7.9 ± 3.7	6.6 ± 3.1	**0.029**
	NS/MP	33.9 ± 4.8	31.1 ± 4.6	**0.002**	39.5 ± 8.9	35.7 ± 7.9	**0.000**
	SpP/MP	28.8 ± 4.3	25.4 ± 3.8	**0.000**	32.8 ± 6.7	28.8 ± 6.4	**0.000**
	OP/NS	14.7 ± 4.4	13.5 ± 4.0	0.114	16.9 ± 7.0	16.0 ± 6.3	0.223
	NSAr	121.6 ± 3.9	121.2 ± 3.9	0.383	120.5 ± 5.7	119.8 ± 6.3	0.064
	SArGo	141.1 ± 3.0	140.9 ± 3.0	0.779	142.2 ± 4.6	141.4 ± 4.3	0.085
	ArGoMe	133.9 ± 4.9	130.8 ± 4.9	**0.015**	137.4 ± 4.8	132.6 ± 4.8	**0.000**
	Bjork	396.6 ± 4.5	392.9 ± 4.2	**0.000**	400.1 ± 6.9	393.8 ± 6.1	**0.000**
	NMe	99.6 ± 15.2	90.1 ± 11.5	**0.004**	113.5 ± 19.5	104.0 ± 18.2	**0.000**
	NSna	42 ± 5.7	37.8 ± 5.4	**0.001**	47.6 ± 8.1	43.6 ± 7.8	**0.000**
	SnaMe	57.7 ± 9.9	52.4 ± 6.9	**0.020**	65.5 ± 11.9	60.5 ± 11.2	**0.000**
	SGo	57.6 ± 6.8	65.1 ± 10.3	**0.000**	65.1 ± 11.9	70.8 ± 12.6	**0.000**
	SSnp	33.9 ± 6.9	35.31 ± 6.0	0.432	36.2 ± 6.4	39.1 ± 6.8	**0.001**
Incisors position analysis	I/SpP	116.7 ± 4.0	113.1 ± 5.4	**0.003**	110.2 ± 7.2	108.5 ± 5.9	0.065
	i/MP	77.2 ± 6.3	81.1 ± 6.2	**0.001**	74.4 ± 9.7	79.3 ± 9.2	**0.000**

For abbreviations see under Table 1.
Results are presented as arithmetic mean ± standard deviation; bolded values are statistically significant; the *t*-test of repeated measurements was applied.

Discussion

Facial and jaw deformities are irregularities in the shape, size, and structure of the jaws that lead to significant facial asymmetry, mutilation, and functional problems [12]. MPG, as the most common deformity of the face and jaws, causes not only aesthetic problems in patients but also has psychosocial consequences associated with impaired masticatory and speech functions [13, 14].

The most common motive for patients to decide to correct this deformity is to improve dentofacial aesthetics [15], while for some patients, the primary goal is to improve masticatory function [16]. Therefore, many kinds of research were focused on determining the changes in the bone and soft tissue structures of the face after the completion of orthodontic-surgical treatment of patients with MPG.

Combined orthodontic-surgical treatment is the best possible treatment for MPG [13, 17].

Treatment of MPG aims to correct dental anomalies, improve facial appearance, and harmonize a patient's facial profile [10]. This type of treatment establishes functional occlusion, facial and dental symmetry, improvement of all oral functions [6, 18, 19], reduction of psychological and social problems of patients [20], as well as improvement of self-confidence and quality of life of patients in general [21].

Recognition of the aesthetic problem of deformity and correct prediction of post-treatment changes in soft and hard tissues is an important part of the diagnosis and planning of treatment of MPG with orthodontic surgery therapy [11, 22].

The results of our study showed, apart from the SArGo parameter, a significant difference in the measured parameters in all patients with MPG before orthodontic-surgical treatment in relation to the reference values. After the treatment, the analysis showed that the parameters SNA, SNB, NS/MP, OP/NS, and I/SpP are within the reference values, while significant differences remained in other parameters in relation to the reference values. Despite the remaining deviations from the reference values, they were significantly corrected in relation to the condition before treatment, which leads to the harmonization of skeletal and dental structures, improvement of oral function, and appearance of the patient's face. The selection of the appropriate type of surgical procedure in orthognathic surgery is based on the type and degree of manifestation of dentofacial deformity.

As part of orthodontic-surgical treatment, the bimaxillary surgery is performed most frequently because this method offers a higher probability of achieving sufficiently good anteroposterior and vertical intermaxillary relations [7]. Studies have shown that the bimaxillary surgery gives much more stable results during longer follow-up after treatment than in patients who underwent the monomaxillary surgery [23]. The monomaxillary surgery has its own indications; these are primarily patients with MPG in whom the vertical dimensions of the face are not increased, as shown by our study [24].

As facial appearance is one of the main motives for patients to undergo this type of treatment, a large number of studies have focused on predicting changes in facial appearance due to changes in hard tissues after orthodontic-surgical treatment of MPG. These predictions have become an integral part of therapy planning. Our study showed that the analysis of cephalometric parameters is still a good enough standard for assessing and predicting the outcome of orthodontic-surgical treatment. The results of our study, as well as the Rustemeyer and Martin [25, 26] studies, showed that both monomaxillary and bimaxillary jaws reposition favorably affect changes in bone structures, leading to improved facial convexity and approximation to aesthetic norms if primary differential diagnosis of MPG and selection of treatment types were correct.

In our study, we obtained objective data on the type of MPG based on the results of the analysis of cephalometric parameters. Based on those results the future treatment plan was built and treatment results monitored.

By analyzing the parameters of the sagittal direction (SNA, SNB, ANB, SNPg, and GoArNS), we established how much and in which way the jaws were moved during the orthodontic-surgical treatment. SNA angle values were statistically significantly higher after treatment compared to pre-treatment values. The increase in the value of the SNA angle is due to the forward movement of the upper jaw during the operation. The SNB angle was statistically significantly reduced after treatment due to the backward movement of the lower jaw during treatment. As a direct consequence of changes in the values of the SNA and SNB angles, there is a change in the value of the ANB angle, which represents their difference and shows statistically significant increased values after treatment. Increasing the SNA angle and decreasing the SNB angle led to the normalization of the anteroposterior relationship between the lower and upper jaw, as well as the relationship of the lower jaw to the anterior cranial base.

There was a decrease in the SNPg parameter after treatment compared to preoperative measurement as a consequence of lower back jaw movement, while the GoArNS parameter was significantly higher after orthodontic-surgical treatment for the same reasons.

The results of our study for this group of parameters are in line with the findings of Aydil et al. [9], who also did not find a statistically significant difference at the end of the treatment between patients with monomaxillary or bimaxillary surgery.

By analyzing the parameters of the vertical direction (NS/SpP, NS/MP, SpP/MP, OP/NS, NSAr, SArGo, ArGoMe, NMe, NSna, SGo, and SSnp) before treatment, a significant deviation from the reference values was observed in patients from the bimaxillary group in relation to patients from the monomaxillary group. Increased vertical parameters were the reason for the decision on the necessity of bimaxillary surgery [24]. After the completion of the treatment, the approximation of the reference values was noticed in both the monomaxillary and bimaxillary groups of patients, which only confirms that a correct decision on the type of surgical procedure was made.

The NS/SpP parameter, which represents the ratio of the upper jaw base to the cranial base in the vertical plane, shows a slight decrease compared to preoperative measurement. That means that during the orthodontic-surgical treatment of MPG, there was a slight rotation of the upper jaw in the cranial direction. Since the values of this parameter after treatment in patients from the bimaxillary group are lower than in patients from the monomaxillary group, it means that during the operation, the upper jaw, in addition to being moved forward, is also rotated cranially.

The NS/MP parameter, which represents the ratio of the mandibular base to the cranial base in the vertical plane, is statistically significantly lower after treatment in patients from the monomaxillary and bimaxillary groups. Changes in this parameter occur as a result of a change in the position of the lower jaw (back and up) during surgery on the lower jaw.

The values of the parameter SpP/MP are significantly lower after the treatment due to the rotation of the central fragment of the lower jaw cranially. The base of the upper jaw was also slightly changed in the vertical plane (rotated cranially), which confirms the values of the NS/SpP angle. Reduction of NS/MP angle and SpP/MP angle after treatment indicate that the operation normalized the ratio of the lower jaw in the vertical direction, which significantly reduced the total anterior height of the patient's face.

The NSAr and SArGo parameters indicate changes in the position of the articular head of the lower jaw. The values of the NSAr parameter are slightly lower after treatment but without statistical significance, while the SArGo parameter does not show statistically significant changes after treatment. These results show that there are no significant changes in the anteroposterior position of the articular process of the lower jaw during the surgical procedure of the MPG treatment. The findings for this group of parameters are consistent with the findings of Jacobsone et al. [27] and Becker et al. [28]. The ArGoMe angle decreased significantly after treatment due to backward jaw movement. These results indicate one of the basic goals of surgery, which is to reduce the length of the body and the angle of the lower jaw.

Twelve months after the orthodontic-surgical treatment, the sum of the angles that make up the Bjork polygon shows a significant drop in value. The decrease in the value of the ArGoMe angle and the entire Bjork polygon after treatment is a consequence of the anterior rotation of the proximal segment of the mandible during bilateral sagittal osteotomy of the ramus of the mandible. In this way, the skeletal ratio of the jaws in the sagittal direction and the ratio of the anterior and posterior height of the face were corrected, and so was the overall profile of the face in these patients.

After the completed treatment, the total anterior facial height NMe and the lower anterior facial height SnaMe were significantly reduced, while the values of the posterior facial height SGo were increased compared to preoperative measurement.

The values of the angles I/SpP and i/MP, which represent the ratio of the axes of the upper and lower central incisors to the base of the upper and lower jaws, respectively, changed statistically significantly. The value of the angle I/SpP is significantly lower 12 months after the end of treatment compared to preoperative measurement, while the angle i/MP recorded a significant increase after the end of the treatment. This result shows that orthodontic-surgical treatment greatly affects the inclination of the upper and lower incisors in relation to the basic planes of the face. More precisely, this is the result of adequate preoperative orthodontic positioning of the upper and lower incisors (retrusion of the upper and protrusion of the lower). Appropriate orthodontic preparation creates the possibility for adequate surgical correction and repositioning of bone segments, which achieves stable functional and aesthetic results.

Based on our results, the inclination of the lower incisors in relation to the basic plane of the lower jaw MP was increased, which reduced their retro inclinations typical of MPG. The ratio of the lower incisors to the basic plane of the lower jaw, even after treatment, deviates from the biometric norm and is typical for MPG. That means that a certain degree of retrusion of the lower incisors is maintained even after orthodontic-surgical treatment.

Johnston et al. [7] observed that, after treatment, lower incisors remain in retrusion below normal values in 46% of patients. This incomplete decompensation is associated with possible extractions of teeth in the lower jaw during the presurgical orthodontic phase, incomplete orthodontic treatment phase, inadequate labial bone for incisor displacement, the resistance of the lower lip muscles to mandibular incisor displacement as well as values of cephalometric parameters before treatment: high values of SNA angle, greater inverse overlap, and greater retrusion of the lower incisors.

All changes that occur on bone and dental structures as a result of orthodontic-surgical treatment lead to changes in the surrounding facial structures (nose, zygomatic bones, infraorbital areas, and chin), which significantly affects the appearance of the patient's face [6, 9–11]. The bimaxillary surgery has a greater impact on the vertical relationships of the upper and lower face, nose, lower jaw, and chin [29]. In connection with these bone changes – a decrease in SNB and ANB angles and an increase in SNA angle values – the profile and appearance of the patient's face improved due to backward movement of the chin and lower lip protrusion, thus increasing facial convexity.

Baherimoghaddam et al. [30] analyzed teleradiography images before and after bimaxillary surgery in patients with MPG and found a decrease in SNB angle and an increase in SNA and ANB angles as in our study. Moreover, in this study, a significant difference was noted between the lower anterior height of the face before and after treatment. Due to changes in the above parameters, as well as consequent changes in the mentolabial angle, facial convexity angle, and upper lip protrusion, the basic features of MPG have been significantly corrected.

Marsan et al. [10] confirmed that the bimaxillary surgery in people with MPG improves both the vertical and horizontal proportions of the face and corrects the concave profile of the face. Due to the increase in the SNA angle and the decrease in the SNB angle, there was a decrease in the convexity angle of the face as well as the protrusion of the upper lip. The values of the ANB angle and incisal step were improved, and the soft tissue profile of the face was significantly changed. That study, as well as ours, confirmed that the reposition of the upper and lower jaw during the bimaxillary surgery has a significant effect in both horizontal and vertical directions, leading to increased nasolabial angle, decreased mentolabial angle, improved lip posture, and tooth appearance, which leads to improved orthognathic facial profile in patients with MPG.

In contrast to our study, Downarowicz et al. [6] analyzed teleradiography images of patients at the beginning of orthodontic treatment, immediately before surgery, and 3 to 6 months after the end of treatment. Their results also showed the normalization of cephalometric parameters. Similar to our results, the SNB angle was significantly reduced after the treatment, the SNA angle was significantly increased, while the ARGoMe angle was reduced compared to the initial condition, and the total height of the face was reduced, although the lower part of the face is still more dominant than the middle part. After surgery, both the occlusion and the patient's appearance improved significantly.

Chew [31] investigated the changes in hard tissues after orthodontic-surgical treatment of patients with MPG They performed the analysis of cephalometric parameters on teleradiography images immediately before the operation and 6 months after the end of treatment. The results showed there was a change in the cephalometric parameters after the end of the treatment, such as the values of the ANB angle and the overlap of the incisors. At the beginning of the study, all patients had a concave profile of the face with a protruded lower lip. Bimaxillary surgery has improved facial convexity, nasolabial angle, and protrusion of the upper and lower lip according to appropriate aesthetic norms.

Bone tissue changes after orthodontic-surgical treatment of MPG were examined by Aydil et al. [9]. They analyzed teleradiography images before treatment and 1.5 years after completion of the treatment. After treatment, the upper incisors were protruded, and the lower incisors were retruded.

Similar to our study, the study by Johnston et al. [7] confirmed that patients who underwent planned bimaxillary surgery had higher negative values of ANB angle before treatment, as well as lower values of SNA angle, while patients who underwent planned monomaxillary surgery had higher initial values of the SNB angle. After the end of the treatment, the values of the SNB and ANB angles were reached approximately close to the reference values in patients with bimaxillary surgery, while in patients with monomaxillary surgery, deviation from the reference values is still present.

The results of our study showed that after orthodontic-surgical treatment, a large number of linear and angular parameters typical of MPG changed. After the end of treatment, the total posterior and posterior upper facial height was increased, and the total anterior and anterior lower facial height was reduced. That improved the relationship between the total anterior and posterior facial height and led to the harmonization of the facial profile after the completion of treatment. As a consequence of orthodontic-surgical treatment, there were significant changes in the values of the angles SNA, SNB, and ANB. The angles of SNA and ANB were increased, while the angle of SNB was reduced after the end of treatment. Most of the vertical components of MPG have been reduced. Significant reduction of NS/MP, ArGoMe, and Bjork polygon angles improved the positions of the upper and lower jaws towards the anterior cranial base and the interrelationship of the jaws in the vertical direction. That resulted in a reduction in total anterior facial height, especially lower anterior facial height, and harmonization of occlusion. After the surgery, there were significant changes in the size of the SpP/MP angle, which represents the relationship between the upper and lower jaws in the vertical plane.

Orthodontic-surgical treatment has significantly improved dental and bone parameters, established proper occlusal relationships, and improved facial appearance in patients with MPG.

Conclusion

After the orthodontic-surgical treatment MPG, dental and skeletal changes occur on the craniofacial skeleton, which significantly affects the appearance of the patient's face.

The results of our study showed that after the end of the treatment, there were no statistically significant differences between patients who underwent surgery of the monomaxillary type and patients who underwent surgery of the bimaxillary type, although, before treatment, there were significant differences between these two groups of patients. Patients who underwent bimaxillary surgery had significant deviations in parameters in both the vertical and sagittal directions before the surgery.

After the end of the treatment, regardless of the initial differences, all the measured parameters were brought closer to the reference values, which speaks in favor of the adequately chosen treatment method and surgical technique.

This paper showed that the correct treatment method, the correct choice of surgical technique, and orthodontic therapy in patients with different forms of MPG achieve similar results close to the reference values.

R E F E R E N C E S

1. *Čutović T, Jović N, Stojanović Lj, Radojičić J, Mladenović I, Matijević S*, et al. A cephalometric analysis of the cranial base and frontal part of the face in patients with mandibular prognathism. Vojnosanit Pregl 2014; 71(6): 534–41.
2. *Li Q, Zhang F, Li X, Chen F.* Genome scan for locus involved in mandibular prognathism in pedigrees from China. Plos ONE 2010; 5(9): e12678.
3. *Radalj Miličić Z, Kranjčević Bubuica A, Nikolov Borić D, Špalj S, Meštrović S.* Linear predictors of facial rotation pattern in Croatian Subjects with skeletal Class III maloclusion. Acta Stomatol Croat 2018; 52(3): 227–37.
4. *Milačić M.* Orthodontics: the present for the future. Belgrade: Akademska misao; 2015. (Serbian)
5. *Stojanović Lj, Mileusnić I, Mileusnić B, Čutović T.* Orthodontic-surgical treatment of the skeletal class III malocclusion: a case report. Vojnosanit Pregl 2013; 70(2): 215–20.
6. *Downarowicz P, Matthews-Brzozowska T, Kawala B, Drohomyretska M.* Dynamic changes in morphometric analysis in patients fol-

lowing Class III bimaxillary surgery. Adv Clin Exp Med 2012; 21(1): 93–7.
7. *Johnston CH, Burden D, Kennedy D, Harradine N, Stevenson M.* Class III surgical-orthodontic treatment: A cephalometric study. Am J Orthod Dentofac Orthop 2006; 130(3): 300–9.
8. *Sinobad V, Strajnić Lj, Sinobad T.* Skeletal changes in patients with mandibular prognathism after mandibular set back and bimaxillary surgery – A comparative cephalometric study. Vojnosanit Pregl 2020; 77(4): 395–404.
9. *Aydil B, Őzer N, Marşan G.* Bimaxillary surgery in Class III malocclusion: Soft and hard tissue changes. J Craniomaxillofac Surg 2013; 41(3): 254–7.
10. *Marsan G, Cura N, Emekli U.* Soft and hard tissue changes after bimaxillary surgery in Turkish female Class III patients. J Craniomaxillofac Surg 2009; 37(1): 8–17.
11. *Kaklamanos EG, Kolokitha OE.* Relation between soft tissue and skeletal changes after mandibular setback surgery: A systematic review and meta-analysis. J Craniomaxillofac Surg 2016; 44(4): 427–35.
12. *Khadka A, Liu Y, Li J, Zhu S, Luo E, Feng G*, et al. Changes in quality of life after orthognathic surgery: a comparison based on the involvement of the occlusion. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011; 112(6): 719–25.
13. *Rezaei F, Masalehi H, Golshah A, Imani MM.* Oral health related quality of life of patients with class III skeletal malocclusion before and after orthognathic surgery. BMC Oral Health 2019; 19(1): 289.
14. *Zamboni R, de Moura FRR, Brew MC, Rivaldo EG, Braz MA, Grossmann E,* et al. Impacts of orthognathic surgery on patient satisfaction, overall quality of life, and oral health-related quality of life: a systematic literature review. Int J Dent 2019; 2019: 2864216.
15. *Belusic-Gobic M, Kralj M, Harmicar D, Cerovic R, Mady Maricic B, Spalj S.* Dentofacial deformity and orthognathic surgery: Influence on self-esteem and aspects of quality of life. J Craniomaxillofac Surg 2021; 49(4): 277–81.
16. *Trovik TA, Wisth PJ, Tornes K, Boe OE, Moen K.* Patients' perceptions of improvements after bilateral sagittal split osteotomy advancement surgery: 10 to 14 years of follow-up. Am J Orthod Dentofacial Orthop 2012; 141(2): 204–12.
17. *Martino F, Pena M, Joubert R.* Surgical-orthodontic retreatment of a severe skeletal Class III malocclusion following an orthodontic camouflage. Dental Press J Orthod 2021; 26(4): e2119247.
18. *Duarte V, Zaror C, Villanueva J, Werlinger F, Vidal C, Solé P,* et al. Changes in health-related quality of life after orthognathic surgery: a multicenter study. Clin Oral Investig 2022; 26(4): 3467–76.
19. *Martinez P, Bellot-Arcis C, Llamas JM, Cibrian R, Gandia JL, Paredes-Gallardo V.* Orthodontic camouflage versus orthognathic surgery for Class III deformity: a comparative cephalometric analysis. Int J Oral Maxillofac Surg 2017; 46(4): 490–5.
20. *Silva M, Francisco I, Sanz D, Palmeira L, Vale F.* Negative social comparisons and social discomfort in dentofacial deformity: a cross-sectional study. Minerva Dent Oral Sci 2021; 70(2): 88–94.
21. *Meger MN, Fatturi AL, Gerber JT, Weiss SG, Rocha JS, Scariot R,* et al. Impact of orthognathic surgery on quality of life of patients with dentofacial deformity: a systematic review and meta-analysis. Br J Oral Maxillofac Surg 2021; 59(3): 265–71.
22. *Zere E, Chaudhari PK, Sharan J, Dhingra K, Tiwari N.* Developing Class III malocclusions: challenges and solutions. Clin Cosmet Investig Dent 2018; 10: 99–116.
23. *Lee JY, Lee SM, Kim SH, Kim Y Il.* Long-term follow-up of intersegmental displacement after orthognathic surgery using cone-beam computed tomographic superimposition. Angle Orthod 2020; 90(4): 548–55.
24. *Čutović T.* Mandibular prognathism. Belgrade: Zadužbina Andrejević; 2014. (Serbian)
25. *Rustemeyer J, Martin A.* Soft tissue response in orthognathic surgery patients treated by bimaxillary osteotomy: cephalometry compared with 2-D photogrammetry. Oral Maxillofac Surg 2013; 17(1): 33–41.
26. *Rustemeyer J, Martin A.* Assessment of soft tissue changes by cephalometry and two-dimensional photogrammetry in bilateral sagittal split ramus osteotomy cases. J Oral Maxillofac Res 2011; 2(3): e2.
27. *Jacobsone G, Stenvik A, Espeland L.* Soft tissue response after Class III bimaxillary surgery. Impact of surgical change in face height and long-term skeletal relapse. Angle Orthod 2013; 83(3): 533–9.
28. *Becker OE, Avelar RL, Dolzan Ado N, Haas OL Jr, Scolari N, Oliveira RB.* Soft and hard tissue changes in skeletal Class III patients treated with double-jaw orthognathic surgery-maxillary advancement and mandibular setback. Int J Oral Maxillofac Surg 2014; 43(2): 204–12.
29. *Raschke GR, Rieger UM, Peisker A, Djedovic G, Gomez-Dammeier M, Guentsch A*, et al. Morphologic outcome of bimaxillary surgery- An anthropometric appraisal. Med Oral Patol Oral Cir Bucal 2015; 20 (1): e103–10.
30. *Baherimoghaddam T, Oshagh M, Naseri N, Nasrbadi I, Torkan S.* Changes in cephalometric variables after orthognathic surgery and their relationship to patients' Quality of life and satisfaction. J Oral Maxillofac Res 2014; 5(4): e6.
31. *Chew MT.* Soft and hard tissue changes after bimaxillary surgery in Chinese Class III patients. Angle Orthod 2005; 75(6): 959–63.

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