

Analysis and comparison of quality of life and patients' satisfaction between dental-skeletal dysmorphisms and Obstructive Sleep Apnea (OSA) patients following orthognathic surgery

D.S. ROSSI¹, F. GOKER², F. CULLATI¹, A. BAJ^{1,2}, D. PIGNATELLI¹,
G. BELTRAMINI^{1,2}, A. RUSSILLO^{1,2}, A.B. GIANNI^{1,2}, A.G. LUCCHINA³,
C. MORTELLARO³, M. DEL FABBRO^{1,2}

¹Dental and Maxillo-Facial Surgery Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico di Milano, Milan, Italy

²Department of Biomedical, Surgical and Dental Sciences, University of Milan, Milan, Italy

³Research Laboratory in Regenerative Medicine and Tissue Engineering, Saint Camillus International University of Health Sciences, Rome, Italy

*D.S. Rossi and F. Goker share the first authorship
C. Mortellaro and M.D. Fabbro share the last authorship*

Abstract. – OBJECTIVE: The aim of this study was to evaluate the impact of orthognathic surgery on the patients' satisfaction and quality of life (QoL) in patients with dental skeletal dysmorphisms and Obstructive Sleep Apnea (OSA).

SUBJECTS AND METHODS: Patients were grouped into two cohorts, patients with OSA (G1) and patients with dento-skeletal dysmorphisms (G2). SF-36 questionnaire was obtained from all subjects before interventions. A standardized follow-up protocol, including a second SF-36 questionnaire was planned as at least 6 months after surgery. The impact of surgery on satisfaction was evaluated by post-operative patient satisfaction-based survey.

RESULTS: 61 patients were included as: 21 OSA (G1), 12 Class II (G2-a) and 28 Class III (G2-b) patients. The mean post-operative follow-up was 65.47±26.36 months. In the SF-36 results, when pre and post operative surveys were compared, the quality of life increased significantly for G1 in all items except for body pain. In G2, when pre and post operative surveys were compared, the quality of life increased significantly in items related to emotional well-being, health transition, role limitations due to emotional problems, while other parameters did not significantly change. When groups were compared, there was no difference among them except for physical functioning which was improved for OSA patients. According to the Rustemeyer results, overall post-operative satisfaction score was 84.92±14.72%. There was a significant difference for patient satisfaction considering facial aesthetics in both groups. For

chewing function there was no difference for patient satisfaction in G1, but there was a significant difference in G2 patients.

CONCLUSIONS: Orthognathic surgery seems to be beneficial in terms of patients' satisfaction and patients' satisfaction for both dental skeletal dysmorphism and OSA patients.

Key Words:

Dental skeletal dysmorphism, OSA, Orthognathic surgery, Maxillomandibular advancement surgery, Bi-maxillary surgery, Quality of life questionnaire.

Introduction

In recent decades there has been a radical change in medicine with a shift from a paternalistic model, also called a biomedical model, to a biopsychosocial model that no longer places disease at the center of medical attention, but the preferences, expectations, culture, and education of the patients. Furthermore, there is an increasing attention to the quality of life, as medical care must not only eradicate the disease, but must guarantee the best quality of life and the greatest possible satisfaction for the patient^{1,2}.

Currently, the aim of orthognathic surgery, together with management of dentofacial deformities, also should consider among its objectives, an improvement to the quality of life of these patients that are suffering from various

pathologies²⁻⁴. The main issues associated with dento-skeletal dysmorphisms include chewing function and the serious repercussions on the facial aesthetics of such patients⁵. The chewing function is essential for adequate systemic well-being. Recent studies⁵ have shown that chewing is of great importance, not only for food intake but also for the systemic, mental, and physical functions of the organism. Additionally, a good chewing function guarantees a better social life, since patients with such malformations of the maxillofacial mass have more qualms about eating meals in public^{6,7}. Although there are other factors, the main reason that motivates these patients to undergo surgery is improvement in facial aesthetics⁶⁻⁸. Considering the findings of various studies, it is easy to understand that improving the aesthetics of the face plays an important role in ensuring the mental well-being of patients and an improvement in their quality of life. It has been shown^{5,9} that people with dentofacial dysmorphism can experience psychosocial stress, both directly, through insults and derogatory comments, and indirectly, due to sociocultural precepts or stereotypes. Fear of stigmatization can push patients to implement avoidance behaviors, aimed at minimizing the stress generated by social exclusion. Therefore, patients with severe dysmorphism should be treated with both surgical treatment and good psychological support¹⁰.

The therapeutic options of choice to solve problems of patients suffering from dento-skeletal deformities is either the orthodontic therapy followed by bimaxillary osteotomy operation or by direct surgical treatment, called "surgery first"¹¹. This type of maxillomandibular advancement (MMA) surgery is considered as an invasive surgery that causes significant changes in the anatomy of the splanchnocranium. Additionally, the advancement of the maxilla and mandible causes the widening of the airways in both the anteroposterior and lateral-lateral dimensions, which result in an improvement in airflow and a decrease in airway resistance¹². In the 1990s, MMA surgery began to be tested also on a particular class of patients, those who suffered from OSA (Obstructive Sleep Apnea). OSA patients are characterized by obstructive apneas, hypopneas and/or arousals related to respiratory effort caused by repetitive collapse of the upper airways during sleep¹³. Patients with moderate or severe untreated OSA have increased cardiovascular and cerebrovascular morbidity, as they

have an increased risk of systemic hypertension, coronary artery disease, cardiac arrhythmias, heart failure and stroke¹⁴. OSA is also associated with group 3 pulmonary hypertension and right heart failure. The development of metabolic syndrome and type 2 diabetes are also serious complications in OSA patients; in fact, they have a higher prevalence of insulin resistance, type 2 diabetes and complications related to diabetes¹⁵. In patients with metabolic syndrome, OSA has been independently associated with an increase in glucose and triglyceride levels as well as with an increase in markers of inflammation, and atherosclerosis, suggesting that OSA may exacerbate the cardiometabolic risk attributed to obesity and metabolic syndrome¹⁶. Furthermore, it is known that sleep apnea can lead to neuropsychiatric dysfunction by worsening inattention, memory, and cognitive deficits which, together, can result in impaired executive function and increase the likelihood of errors and accidents¹⁷, while other neuropsychiatric manifestations include mood changes and irritability, as well as depression, psychosis, and sexual dysfunction¹⁸.

For OSA patients, there are other treatment options available to cope with the pathological condition, since, above all, there is a risk that surgery can be associated with critical complications. However, especially in cases of severe OSA, currently MMA (Maxillomandibular Advancement) surgery is considered as an effective treatment, in which an enlargement of the upper airway is achieved physically by expanding the facial skeletal framework^{12,19}. In order to decide the best treatment choice, the pros and cons of the various options should be discussed with the patients. The choice is a very complex procedure, which requires a great deal of communication between the doctor and the patient^{5,19}. In cases of severe OSA evaluation of the post-operative results show beneficial results in terms of patients' satisfaction and better quality of life¹⁹. The improvement in the quality of life of patients who choose surgical treatment can be undoubtedly advantageous¹⁹. However, MMA surgery is an invasive procedure and the peri- and post-operative possible complications in this type of surgery might include infection, inflammation, pain, malocclusion, and unsatisfactory cosmetic results¹⁹.

A patient's health-related quality of life (QoL) evaluation is an extremely complex concept. SF-36 is a 36-item Short Form Health Survey, that is widely used to evaluate health-related quality of

life in the clinics. SF-36 is a validated oral health quality of life assessment tool that is used to analyze specific domains²⁰ before the operation and at the follow-up visits.

In the case of orthognathic surgery, there are limited number of articles that have assessed the quality of life of dento-skeletal dysmorphism patients following the bimaxillary osteotomy. Furthermore, there are far fewer articles on the quality of life of OSA patients undergoing the orthognathic surgery. This represents a real obstacle for patients suffering from this disorder during the process of decision²¹⁻²⁵. Furthermore, there are no articles on the assessment of orthognathic surgery outcomes that compare OSA patients and other dysmorphic conditions, in terms of quality of life and patient satisfaction.

Rustemeyer questionnaire is a short form survey that can be used as a post-operative tool for evaluating patients' overall satisfaction, the relatives', and friends' opinions about the results of MMA surgery, and aesthetic and masticatory improvements compared to before surgery^{26,27}.

In this regard, the present study aimed to evaluate outcomes orthognathic surgery, in terms of patients' satisfaction and quality-of-life changes. For this reason, SF-36 and Rustemeyer questionnaires were obtained to assess the results.

The patients were divided into two groups as: OSA patients and dento-skeletal dysmorphism, to understand which are the health domains in which of the two cohorts perceived the greatest improvements. The main objective of this study was to analyze quality of life and the patients' satisfaction in both classes of patients and compare the data with each other, demonstrating that OSA patients can also benefit from surgery, as much as other dysmorphic conditions.

Subjects and Methods

Study Protocol

This retrospective clinical study included patients with dento-skeletal dysmorphism and patients with OSA who underwent orthognathic surgery.

The diagnosis of dento-skeletal malformations was based on the clinical and cephalometric examination, while the diagnosis of OSA was made by the use of questionnaires, preferably in the presence of a partner and on instrumental examinations, of which the gold standard is polysomnography.

This study was conducted between April 2011 and June 2022 at the Department of Oral Surgery and Maxillofacial Surgery, University of Milan.

Inclusion/Exclusion Criteria

The patients recruited in this study included those who underwent orthognathic surgery for the following reasons:

- Class II dento-skeletal malformation;
- Class III dento-skeletal malformation;
- OSA patients: severe OSA (AHI > 30);
- Patients who have been operated on for at least 6 months;
- Patients who completed the preoperative and post-operative SF-36 questionnaire;
- Patients who completed the post-operative Rustemeyer questionnaire.

The following were excluded from this study:

- Patients with psychological problems;
- Active infection in oral maxillofacial region;
- The patients suffering from any major illness like immunocompromised, organ failures, and HIV;
- Oncological patients in the maxillofacial area;
- Patients who have undergone radiotherapy in the head and neck area.

The protocol adapted (pre/post-surgical medications, surgical approach, and the follow-up) was previously described in more details in an article by the same team of authors¹⁹ (OSA article).

Preoperative Preparation

Presurgical protocol included taking detailed health anamnesis from each patient with clinical and radiological examinations. All study participants completed an SF-36 questionnaire before the intervention. OSA patients were examined with additional examinations such as polysomnography to confirm diagnosis.

The SF-36 questionnaire was obtained from all participants before surgery and was re-administered at least 6 months after surgery, so that the results were not compromised by biases related to the post-operative course.

Surgical Procedures

In brief, all patients underwent orthognathic surgery under general anaesthesia with nasotracheal intubation and local anesthesia with vasoconstrictor (4% articaine with 1:100,000 adrenalin).

Mandibular operation included bilateral sagittal-splint osteotomies of the mandibular bone which were performed with the aid of cutting guides using piezoelectric or conventional saw instrument. Pre-planned mandibular advancement was achieved and maintained with plates and osteosynthesis screws (either patient-specific CAD-CAM custom-made plates or plates). Maxillary Le Fort I osteotomy was performed, and the maxilla was moved to its new position using occlusal splints attached to the mandible. Finally, the maxilla was fixed on each side using two L-shaped miniplates and bicortical screws. The occlusion was stabilized by occlusal splint and elastic maxillomandibular fixation. Genioplasty was performed in case of retrognathia or receding chins.

Postoperative Protocol

After the operation, patients were recommended to follow a pureed diet in the first week after surgery, and then switch to a soft diet in the following two months, keep the rubber bands for a complete intermaxillary block in the first week after surgery and gradually reduce their use, use the bite in the appropriate way.

The antibiotic and medications regimen

All patients were prescribed postoperative analgesics and antibiotic administered a day before surgery.

Augmentin 1 gr (3×15 days), Ketoloprac (15 gtt 3×1 2 days) or Azithromycin 500 mg for 3 days in cases of allergy to penicillin.

Paracetamol (3×1 2 days and continue in case of pain and fever), Pantoprozol (20 mg 1×1 5 days), Rinostill plus (or any other Aerosol with acetylsystein 3×1 4 days), Clorhexidine rinses (after meals).

The follow-up regimen was as follows: routine weekly visits in the first month, then every 2 weeks in the second and third months, then monthly until the end of the first year.

Data Collection and Evaluation of Results

Data collection included demographics, medical history, and type of surgery undergone. The patients were divided into two groups [Group 1 (G1): OSA patients that received orthognathic surgery, Group 2 (G2): patients that received orthognathic surgery because of dento-skeletal dysmorphism]. The Group 2 patients were additionally divided into subgroups [Sub-group 2a

(G2a): class III dento-skeletal dysmorphisms and sub-group: Group 2b (G2b): class II dento-skeletal dysmorphisms].

The outcome variables of this study based on the survey and questionnaire forms obtained. The evaluation based on the comparison of the results of each group using SF-36 and Rustemeyer questionnaires.

SF-36 Questionnaire

The SF-36 was obtained from all patients pre- and post-operatively, while the Rustemeyer is a questionnaire designed to be administered only after surgery.

Rustemeyer Questionnaire

The Rustemeyer questionnaire consists of six questions, which purpose is to evaluate the general satisfaction of the participants, the opinions of relatives and friends regarding the results of the surgery and the opinions regarding the change in aesthetics and chewing function following the surgery^{19,26,27}. An Italian version of the Rustemeyer's questionnaire was not available, so it was translated into Italian.

Questions of Rustemeyer's questionnaire about patients' satisfaction after surgery can be find listed below:

Please mark one grade of the scale from 0 (poor) to 10 (excellent)

- R1.** How would you assess your facial aesthetics before surgery?
- R2.** How would you assess your facial aesthetics after surgery?
- R3.** How would you assess your chewing function before surgery?
- R4.** How would you assess your chewing function today?
- R5.** How do you feel exactly about the surgical outcome of your operation?
- R6.** How do your relatives and friends feel in total about the surgical outcome of your operation?

0-1-2-3-4-5-6-7-8-9-10 (results from 0 to 10).

Statistical Analysis

Statistical analysis was performed using GraphPad Prism 5.03 (GraphPad Software, Inc., La Jolla, CA, USA).

Descriptive statistics of this study was done using mean values and standard deviation (SD) for quantitative variables normally distributed.

Normality of distributions was assessed using the D'Agostino and Pearson omnibus test. *p*-value of less than 0.05 was considered significant.

The success rate of the surgery was assessed with the SF-36 questionnaire comparing the results before and after the surgical treatment. Statistical comparisons were performed between variables of two groups (OSA patients and patients that received orthognathic surgery for other reason) using different statistical tests. Each subscale of the preoperative and postoperative SF-36 questionnaires was compared by using the paired Student's *t*-test. For each subscale, all the items were averaged, to have a single value.

Score comparison of each Rustemeyer question was made using the non-parametric Mann-Whitney test for independent samples. The comparison between groups and between pre- and post-surgery was made with unpaired Student's *t*-test.

Results

A total of 61 (33 male, 29 female) patients were included in this study which consisted of 21 patients who had OSA, 12 patients who had class II dento-skeletal dysmorphism (sub-group: G2a) and 29 patients who had class III dento-skeletal dysmorphism (sub-group: Group 2b). The average age of the patients at the time of the surgery ranged between 24 and 65 years with a mean value of 34.75±11.33 (standard deviation, SD). All the patients underwent Le Fort I and bilateral sagittal mandibular osteotomy. In 4 patients Le Fort I was done in 3 fragments. Additional operations performed can be listed as follows: 9 Iliac Crest graft, 16 genioplasty, 11 lipofilling, 1 ex-

traction of wisdom teeth, 1 plastic nose surgery, and 1 remodelling of mandibular angles. The mean follow-up period after the operation was 65.47±26.36 months.

Rustemeyer Results

As can be seen from Rustemeyer list of questions in the Subject and Methods section of this work: questions R1-R2 are about the assessment of facial aesthetics before (R1) and after (R2) surgery, while questions R3-R4 are about assessment of chewing function before (R3) and after (R4) surgery. According to the results, there was a significant within-group difference for patient satisfaction considering facial aesthetics in both OSA and non-OSA groups. For chewing function there was no significant difference for patient satisfaction in OSA patients (Group 1), but there was a statistically significant difference in patients that were operated for dento-skeletal malformations (Group 2). When R1, R2, R3, R4 values were compared among groups, satisfaction was higher in Group 2 for facial esthetics and chewing function. The comparison results among groups for both groups and sub-groups for R6 showed no statistically significant results. In R5 evaluation the only significant difference was seen in Group 2. In brief, satisfaction for facial aesthetics and chewing function for OSA patients did not change much when pre- and post-operative values were compared. However, in dento-skeletal dysmorphism patients (also when considered as a whole group or as sub-groups), these patients had higher satisfaction after surgery (Table I).

In questions R5 (R5=How do you feel exactly about the surgical outcome of your operation?) and R6 (R6= How do your relatives and friends

Table I. Unpaired *t*-test – *p*-values.

	R1	R2	R3	R4	R5	R6
OSA vs. overall non-OSA patients	< 0.0001*	0.12	< 0.0001*	0.0013*	0.39	0.90
OSA vs. III class	0.0003*	0.1477	< 0.0001*	0.0008*	0.8169	0.6779
OSA vs. II class	0.0001*	0.2649	0.0001*	0.1125	0.0866	0.3825
	R1 vs. R2		R3 vs. R4			
Pre vs. post OSA	0.035262*		0.289262			
Pre vs. post DYS	< 0.0001*		< 0.0001*			
Pre vs. post CLIII	< 0.0001*		< 0.0001*			
Pre vs. post CLII	< 0.0001*		0.0085*			

*Statistically significant.

Table II. SF-36 results as percentages (correct and add Standard deviation).

	MH	PF	RP	RE	VT	SF	BP	GH	HT
OSA (pre)	71.04	85.95	61.9	68.25	51.42	73.21	88.33	56.42	54.76
OSA (post)	79.8	95.23	98.8	100	75.23	88.69	92.73	72.71	70.23
Dysmorphisms (pre)	72.3	92.62	83.75	78.33	67.75	80	90.87	73.87	58.75
Dysmorphisms (post)	78.9	98.62	95.62	92.5	72.12	82.81	91.62	77.25	72.5
CLASS III (pre)	72.4	91	83	75	69	78	87.8	73	59
CLASS III (post)	79.2	98	94	90	72	83	88.4	74	74
CLASS II (pre)	71.7	96	88	86	65	82	98.1	76	63
CLASS II (post)	73.7	98	92	92	69	77	92.7	79	63

MH (Emotional well-being); PF (Physical functioning); RP (Role limitations due to physical health); RE (Role limitations due to emotional problems); VT (Energy/fatigue); SF (Social functioning); BP (Bodily Pain); GH (General health); HT (Health transition).

feel in total about the surgical outcome of your operation?), the results were not different except for a significant value for R5 in Group 2, OSA patients were more positive for general outcomes of orthognathic surgery.

According to the Rustemeyer results, overall post-operative satisfaction score was $84.92 \pm 14.72\%$. For OSA and non-OSA patients it was 82.26 ± 11.23 and 86.28 ± 16.17 , respectively (not significantly different, $p=0.31$).

SF-36 Results

In SF-36, questions are scored on a scale from 0 to 100, with 100 representing the highest level of functioning possible. The scores from those questions that address each specific area of functional health status are then averaged together, for a final score within each of the 8 dimensions measured [HT (Health transition) (1 question) (Physical functioning) (10 questions) RP (Role limitations due to physical health) (4 questions) RE (Role limita-

tions due to emotional problems) (3 questions) VT (Energy/ fatigue) (4 questions) MH (Emotional well-being) (5 questions), SF (Social functioning) (2 questions), BP (Bodily Pain) (2 questions) GH (General health) (5 questions)]. According to the results of SF-36 that are listed in Table II, in OSA patients, there was a tendency for increase in quality-of-life evaluations for post-operative period (except for a slight decrease in dysmorphism patients' group for pain evaluation). The results of student *t*-test of SF-36 questionnaire can be seen listed in Table III. The results with statistically significant differences are highlighted in red.

As can be seen in Table III when pre and post operative surveys were compared, in Group 1 (OSA patients), the quality of life increased statistical significantly in all items for post-operative period except for body pain (BP).

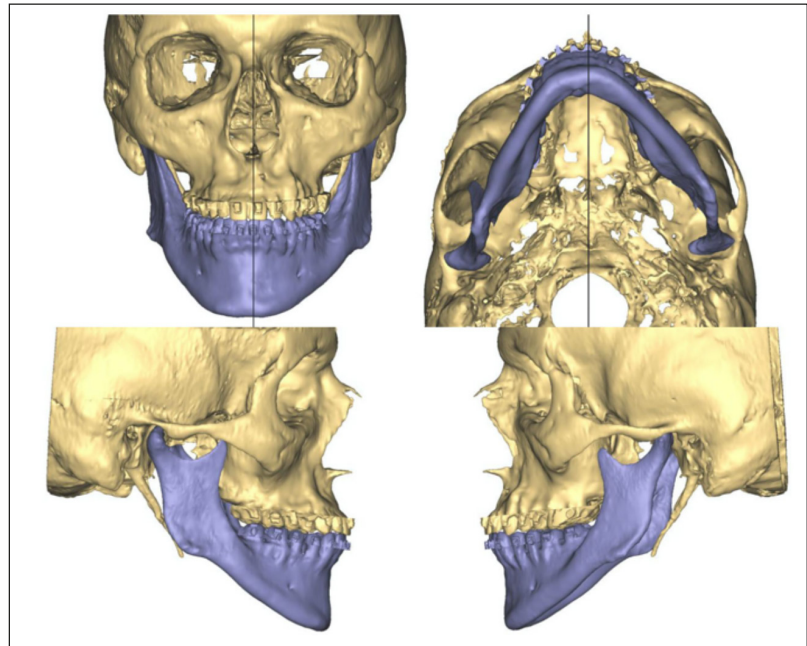
In Group 2 (dysmorphism patients), when pre and post operative surveys were compared, the quality of life increased statistical significantly in items related to emotional well-being, health

Table III. SF-36 student t-test results.

	MH	GH	HT	PF	RP	RE	VT	SF	BP
Pre vs. post OSA	0.002*	0.003*	0.009*	0.03	< 0.001*	< 0.001*	< 0.001*	< 0.001*	0.331
Pre vs. post DYS	< 0.001*	0.11	< 0.001*	0.06	0.13	0.03*	0.02	0.36	0.81
Pre vs. post class III	0.001*	0.165	< 0.001*	0.083	0.141	0.045*	0.060	0.100	0.428
Pre vs. post class II	0.575	0.477	1.000	0.435	0.674	0.339	0.184	0.318	0.114
OSA vs. DYS pre/post	0.82	0.29	0.719	0.05*	0.21	0.09	0.44	0.213	0.767
OSA vs. class III	0.74	0.41	0.325	0.08	0.28	0.07	0.70	0.405	0.700
OSA vs. class II	0.21	0.35	0.360	0.24	0.12	0.19	0.18	0.083	0.995

*Statistically significant. MH (Emotional well-being); PF (Physical functioning); RP (Role limitations due to physical health); RE (Role limitations due to emotional problems); VT (Energy/fatigue); SF (Social functioning); BP (Bodily Pain); GH (General health); HT (Health transition).

Figure 1. Pre-Surgical Plan: preoperative situation.



transition, role limitations due to emotional problems, while other parameters did not significantly change.

In Class III patients, the quality of life increased statistical significantly in items related to emotional well-being, health transition, role limitations due to emotional problems, while other parameters did not significantly change.

In Class II patients, no parameters changed significantly in pre-operative versus post-operative evaluation for quality of life.

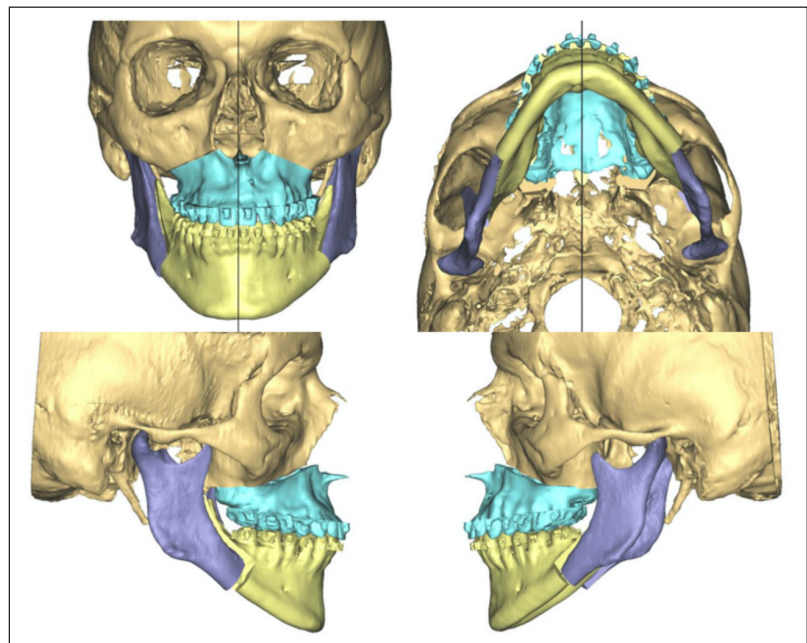
When groups were compared, there was no significant difference among them except for physical functioning which was improved in OSA patients.

A complete case documentation operated by computer guided surgery can be seen in Figures 1-11.

Discussion

Orthognathic surgery is one of the branches of medicine that has improved the quality of

Figure 2. Pre-surgical plan: maxillary movement first.



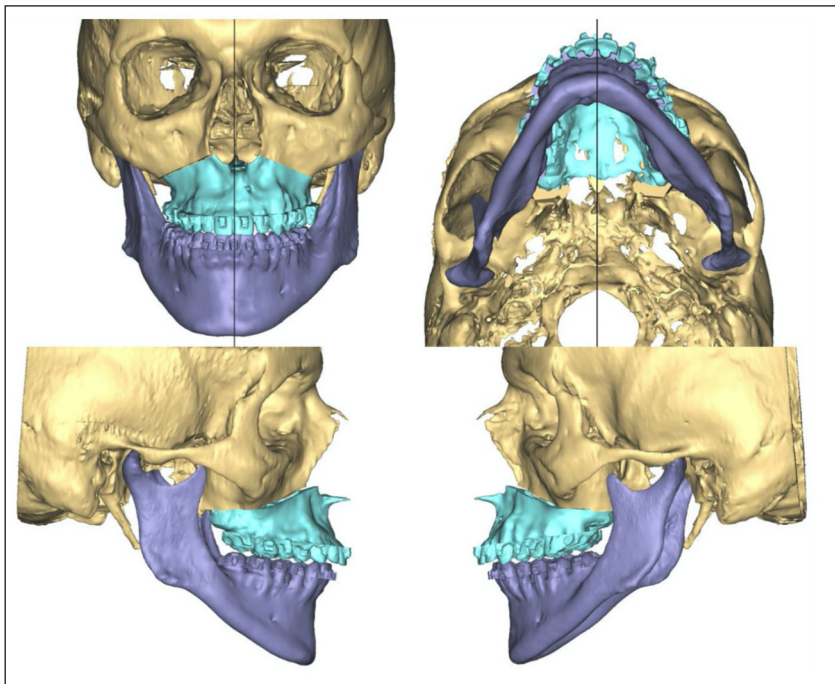


Figure 3. Pre-surgical plan: final position.

life of patients among its objectives, and it has been known since decades that these patients can benefit enormously from surgery^{3,28}. The quality of life and patient's satisfaction are becoming increasingly important in the field of clinical medicine²⁹⁻³¹, and the scientific community has recognized the importance of guaranteeing a good

quality of life to the patient when choosing the treatment option. Among various quality of life assessment tools, SF-36 is widely utilized tool for measuring QoL changes^{32,33}. On the other hand, currently there are limited number of reports^{25,26} using Rustemeyer for post-operative satisfaction assessment in orthognathic patients.

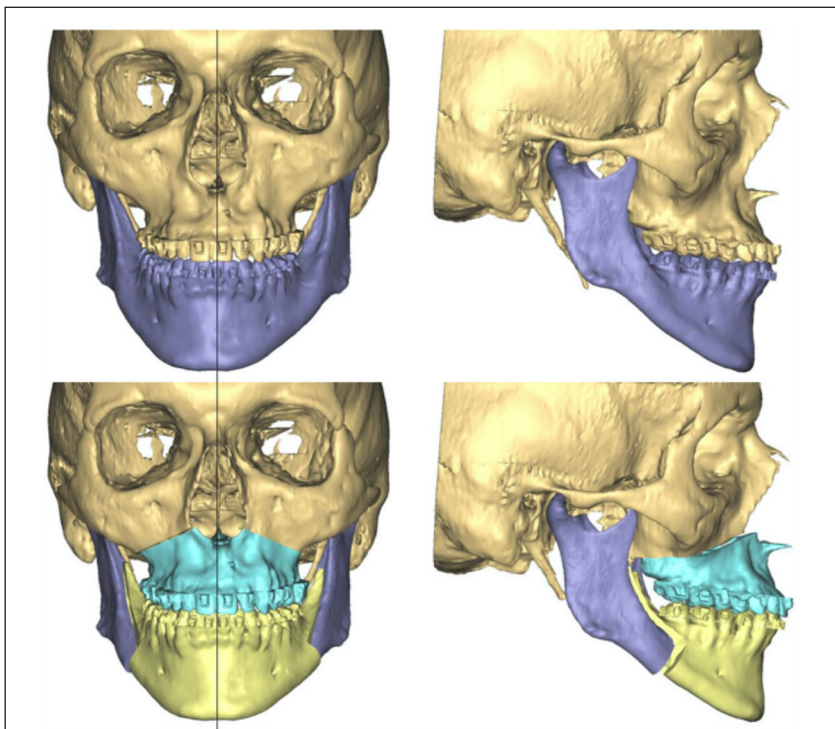


Figure 4. Surgical plan: before and after.

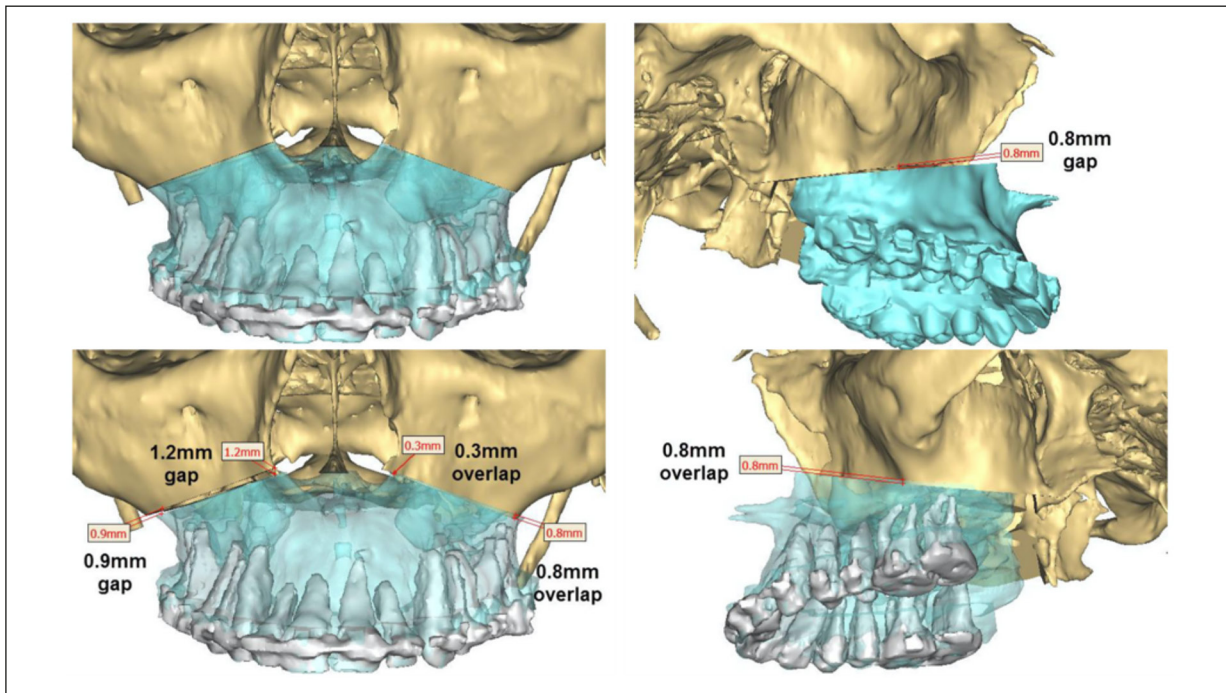


Figure 5. Surgical plan: maxilla movement overview.

Lee et al³⁴ conducted a study on the QoL of orthognathic patients using SF-36, OHIP-14 (14-item Short Form for generic oral health-related QoL) and by the 22-item condition-specific

Orthognathic Quality of Life Questionnaire (OQLQ). 36 patients were evaluated at baseline presurgical, at 6 weeks postoperatively, and 6 months postoperatively. As a result, they report-

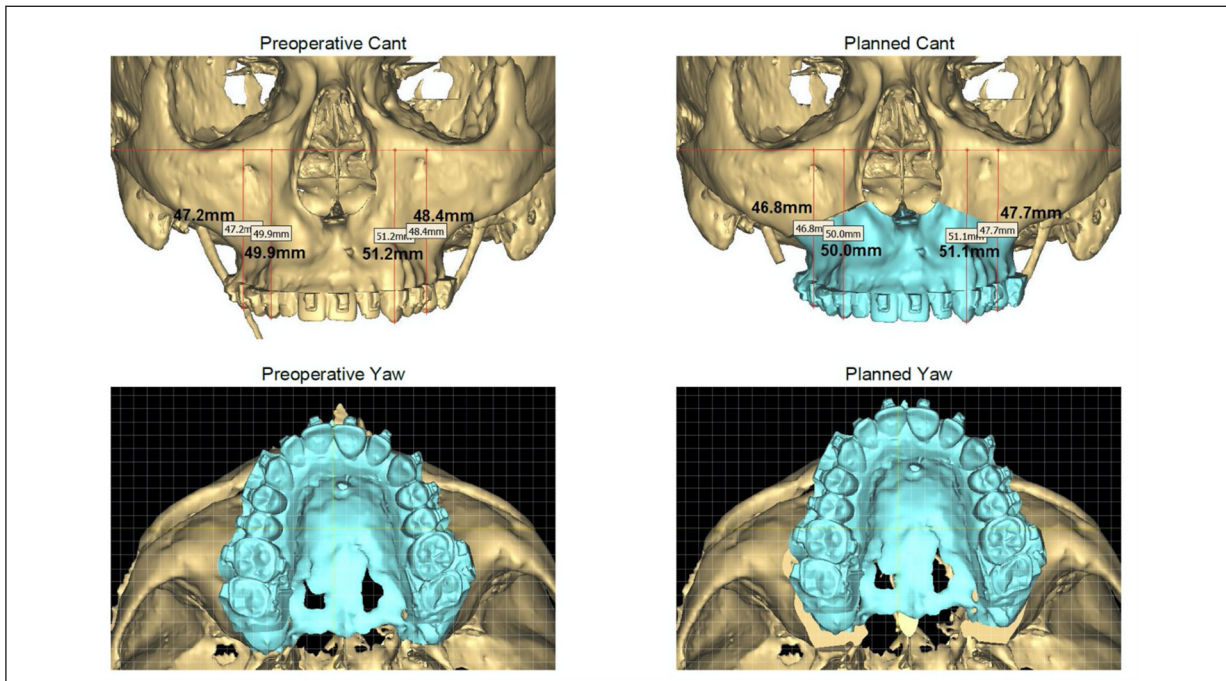


Figure 6. Surgical plan: maxilla movement overview (preoperative Cant and Yaw, and Planned Cant and Yaw).

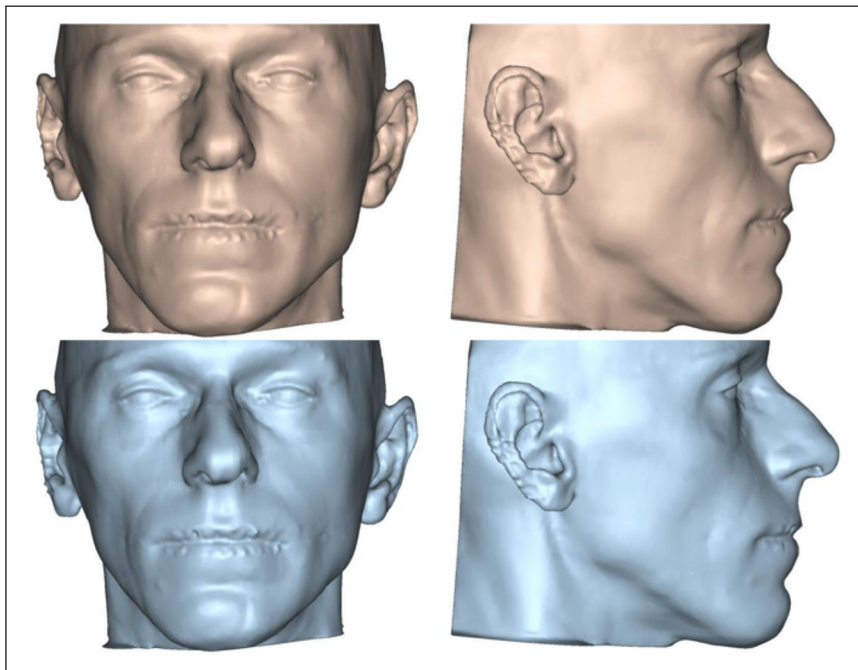


Figure 7. Surgical plan: soft tissue overview. Top: pre-operative soft tissue; bottom: simulated planned soft tissue.

ed, a significant change in QoL following orthognathic surgery. A marked but transient deterioration in many aspects related to general well-being was noted in the early postoperative period and significant improvement was documented by 6 months³⁴.

A similar study conducted by Kilinc and Ertas³⁵ aimed to evaluate 30 patients undergoing orthognathic surgery to correct Class III malformations (patients were divided according to the surgery they underwent: mono-maxillary or bi-maxillary) compared with 30 healthy participants (control

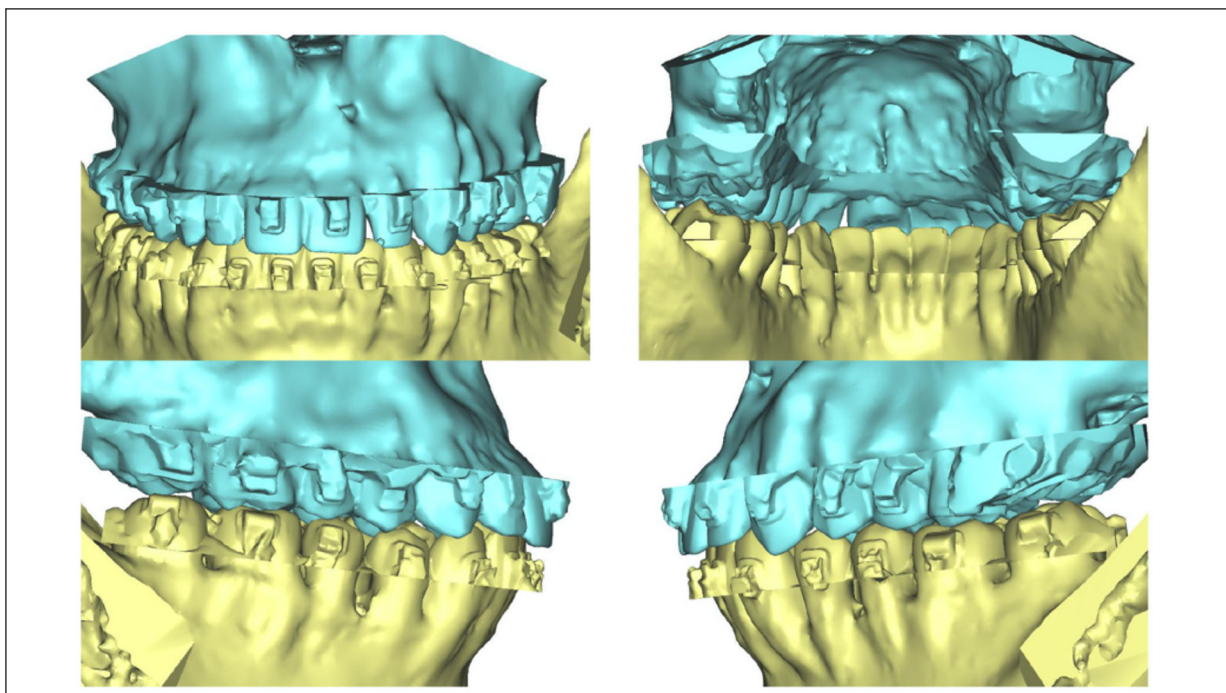


Figure 8. Surgical plan: final occlusion.

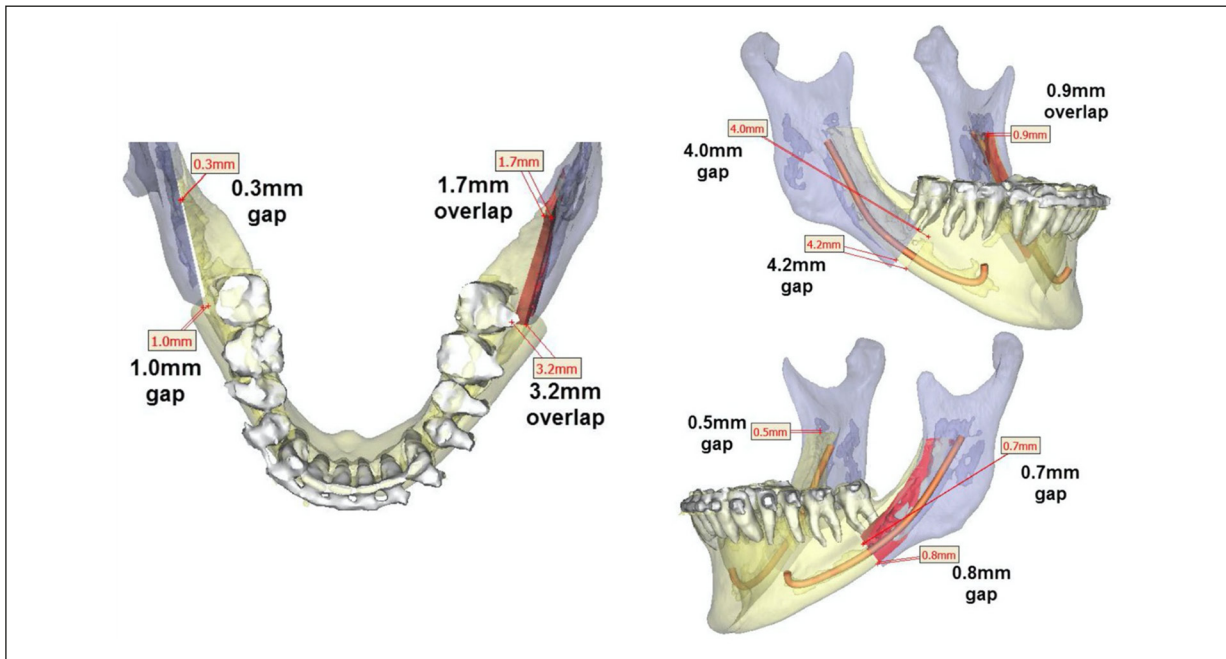


Figure 9. Surgical plan: mandible movement overview.

group with Class I skeletal structure) with SF-36, OQLQ and OHIP-14. According to the evaluation among groups, OQLQ scores showed a significant difference in the oral function domain only in the bimaxillary, and OHIP-14 scores showed

significant differences in half the OHIP-14 subscale scores in the monomaxillary and bimaxillary operated groups. The SF-36 scores showed significant differences only for the vitality domain in the monomaxillary group and the vitality and mental

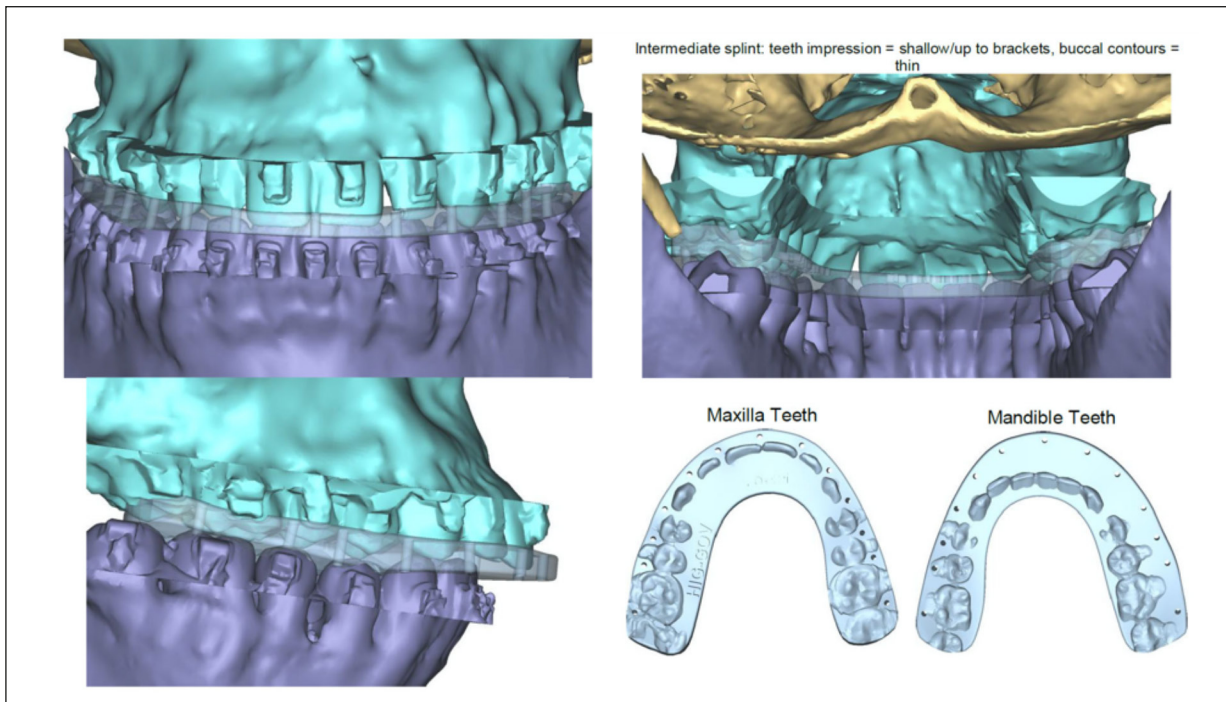


Figure 10. Guide design: intermediate splint.

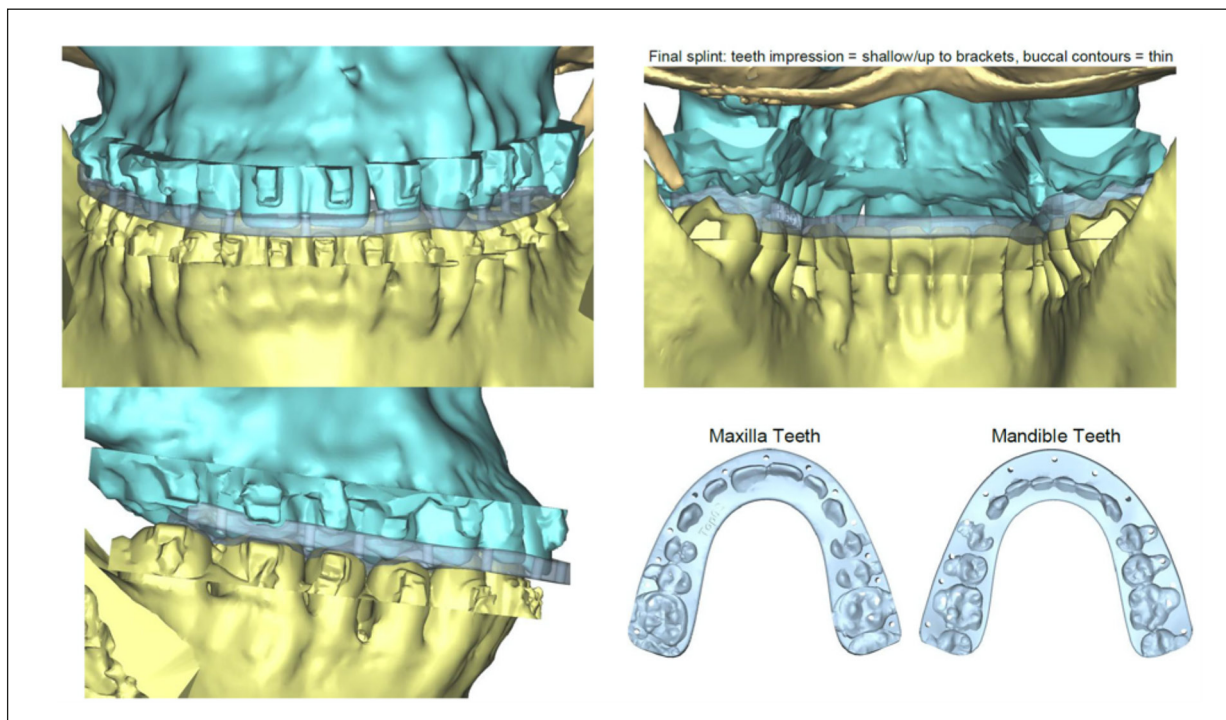


Figure 11. Guide design: final splint.

health domains in the bimaxillary group. As a conclusion, they reported that condition-specific and health-related QoL questionnaire results of orthognathic surgical patients seemed similar to that of participants without dentofacial deformities³⁵.

Another study that involved the use of the SF-36 was conducted by Nicodemo et al³⁶ on Class III patients. In this study it emerged that out of the eight domains evaluated by the SF-36, four improved in a statistically significant way (for vitality, emotionality, physical and social aspects). Regarding the physical and social aspects, a highly significant difference in outcomes was observed between the pre- and postoperative period, with higher mean scores after surgery regardless of gender and type of surgery. Regarding emotional aspects, an interaction effect was observed for timing and gender, with higher mean scores only being obtained for females after surgery³⁶.

Roman et al³⁷ examined the quality of life of patients using various questionnaires, including the following standardized questionnaires: the "how do you cope?" questionnaire, the emotional intelligence questionnaire (INTE), the list of personal values (LOPV), the SF-36, the satisfaction with life scale (SWLS). According to their results, young adults after bimaxillary orthognathic procedures show a high level of QoL. The level

of QoL also was dependent among others, on the level of emotional intelligence. Better ability to recognize emotions was associated with higher QoL in the domain of general health³⁷.

A more recent study by Vongkamolchoon et al³⁸ in 2021 evaluated the patients' QoL after orthognathic surgery utilizing SF-36 questionnaire. The results showed that one month after surgery, the limitations due to physical health and body pain had improved significantly, while the domain of limitations due to physical health, the domain of energy/fatigue and mental health domain were significantly improved 12 months after surgery. The postoperative 36-Item Short-Form Health Survey was significantly related to short-term and long-term satisfaction³⁸.

In the present study both questionnaires (SF-36 and Rustemeyer) were used. Since SF-36 is a widely used questionnaire, it validates QoL, while Rustemeyer is another, short questionnaire that allows clinicians to obtain very important information about patient's satisfaction. Moreover, Rustemeyer form can be easily administered to patients, who are often not cooperative in completing health questionnaires.

According to the results of the SF-36 questionnaire of this study, orthognathic patients have achieved improvements in all health domains.

However, there was a statistically significant improvement (p -value <0.05) in only 4 domains: mental health, vitality/energy, limitations due to physical health, limitations due to emotional problems, and change in health compared to the previous year (which is not a real domain of health but serves to evaluate changes in health over time). In the domains relating to physical functioning, general health, social activities and pain, there was no statistically significant improvement ($p>0.05$). These results collected with the SF-36 questionnaire seem to be similar to those found in the literature, as they show improvements in QoL after MMA surgery³⁴⁻³⁸.

In this work, in regard to the analysis carried out with the Rustemeyer questionnaire, it was found that orthognathic patients perceived an extremely significant improvement in both aesthetic and chewing function ($p<0.001$); in addition, patients reported that they were quite satisfied with the intervention (on a scale ranging from 0 to 10, patients reported an average degree of satisfaction of 7.83) and that friends and relatives were also satisfied with the result surgical (they reported a mean judgment equal to 8.33), with a significant difference ($p=0.037$), probably due to the fact that the aesthetic results are clearly visible, while the subjective perceptions of the patients could be influenced by the post-operative path and possible post-operative complications, such as lower lip dysesthesia. Unfortunately, in the scientific literature there are only very limited number of articles that use the Rustemeyer to analyze patient's satisfaction^{19,26,27}.

Rustemeyer et al²⁵ conducted the first study to underline the important variables affecting patient satisfaction after orthognathic surgery. This study used a specific post-operative questionnaire, which was therefore suitable to assess patient satisfaction after routine orthognathic surgery. This questionnaire designed by Rustemeyer can show results which are comparable with studies using fewer or more questions. Additionally, it includes questions for the evaluation of the opinions of friends and relatives, that can affect the satisfaction of the patient.

Another study²⁷ that utilized Rustemeyer questionnaire aimed to determine the improvements in the quality of life and patient's satisfaction based on the change in the position of some cephalometric points after surgery. This study found that following some changes (such as protrusion of the lower lip and chang-

es in the chin-labial angle) are associated with greater patient satisfaction, measured with the Rustemeyer questionnaire²⁷. However, although some variations correlated with good patient satisfaction and an improvement in their quality of life, the associations appeared to be moderate. The improvement in aesthetic and chewing was highly significant, while the changes in the perception of patients and relatives/friends regarding the outcome of the surgery were not significant²⁶.

Although the assessment of facial beauty is subjective, according to the results of this study, most patients who underwent orthognathic surgery readily accepted the change in their appearance and were highly satisfied with the outcome. The high satisfaction rate was in accordance with that reported in previous studies, and with the results of the present work. Positive changes occurred in the personality profiles of patients and there was an obvious improvement in self-confidence as a result of an improved appearance and an improved chewing function.

In OSA patients, the decision for orthognathic surgery is a critical question. OSA is a disease that has critical negative impacts on people's lives³⁹. Currently, the frequency of OSA has increased worldwide and there are a variety of treatment options mentioned in the literature, which can be recommended to the patient depending on the severity of the disease. In cases of severe OSA and for patients who are not suitable for conservative OSA therapies such as C-PAP, surgical treatment is considered a viable option⁴⁰⁻⁴¹. The presence of untreated OSA is associated with a poorer quality of life and is a critical risk factor for the development of various clinical diseases and mental disorders³⁹. The risks and benefits of orthognathic surgery should be weighed with caution before making a decision about adult patients, especially those with compromised health conditions. QoL questionnaires are increasingly recognized as an important outcome measure for clinical medicine health even for patients with OSA⁴².

In recent decades, numerous QoL questionnaires have been proposed and used for orthognathic patients that underwent surgery for different types of reasons, including OSA. For OSA patients, MMA is a very valid therapeutic option, as it improves the QoL of patients who are affected by it and overcomes the problem related to poor compliance for medical treatment with C-PAP. However, there are no articles which

aimed to compare the outcomes between OSA patients and the patients that were operated for other skeletal problems.

In this work, the inter-class comparison was performed with the ambitious goal of demonstrating that this type of surgery, performed with extremely different purposes can give additional benefits in both classes of patients, and can improve QoL. Despite the technological and instrumental advances that have taken place in orthognathic surgery, which has become much faster and simpler than before, the dissatisfaction of OSA patients with the surgical outcome may still be not high enough⁴³. The risks and benefits of MMA surgery should be weighed with caution before making a decision about adult patients, especially those with compromised health conditions.

According to the results of the Rustemeyer questionnaire of this study, the general satisfaction of the patient after surgery can be considered high, as 82.26% of the participants declared positive results in terms of post-operative satisfaction. In addition, OSA patients reported that they perceived a significant improvement in the aesthetic appearance following the surgery ($p=0.03$), however, they also reported a worsening of masticatory function (the mean of the preoperative scores was 7.71, while that of the post-operative scores was 7.19) which, however, was not statistically significant ($p=0.28$). Finally, both patients and their friends and relatives were satisfied with the outcome of the intervention in a comparable way ($p=0.77$).

Today, orthognathic surgery for dysmorphic patients and for OSA patients is a widespread therapeutic option. However, despite technical and instrumental improvements, some studies show that the degree of patient dissatisfaction with surgical outcomes can be still quite high^{43,44}. This data is probably due to the difficult operative course, or to the post-operative complications that patients may encounter or to the fact that the patient's expectations regarding the outcome of the surgery were too high.

The limitations of this study can be listed as: a limited number of the sample group, no cephalometric evaluation of the soft and hard tissue changes, no evaluation of the changes in the apnea/hypopnea index (AHI). However, even if the study has these limitations, it could be useful for doctors, as it highlights the improvement in the quality of life of patients who had undergone surgical treatment and could help them to recommend surgical treatment to patients.

Conclusions

The results obtained from this study, consistent with those of others found in the scientific literature, are extremely promising, as it was shown that orthognathic surgery significantly improved the quality of life in both classes of patients analyzed.

According to the results of this study, maxilomandibular advancement surgery seems to be a safe and effective treatment option with beneficial results in terms of patients' satisfaction and better quality of life in both patient groups, in cases of severe OSA and dysmorphism.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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Authors' Contribution

F.G., D.S.R., F.C. M.D.F., G.B, A.R., A.B., A.B.G. and D.P. conceived and designed the analysis. Databases were searched and data were collected by F.G., D.S.R., A.G.L., C.M., G.B, A.R., F.C. and D.P. All the authors contributed on analysis and interpretation of data for the work. F.G. drafted the work and wrote the manuscript with input from all authors. F.G., D.S.R., F.C., A.G.L., C.M., G.B, A.R., A.B., M.D.F. and A.B.G. revised the work critically for intellectual content. Integrity of the work was appropriately investigated and resolved by all authors. All authors contributed and approved equally to the final version of the manuscript.

Ethics Approval

The study protocol was approved by the Ethics Committee of Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Regione Lombardia with date 09/03/2016 Ethics Committee of Milano Area B Act 1300/2015, Determinazione No.: 421. The study was compliant with the principles set out in the Declaration of Helsinki on medical protocol and ethics.

Informed Consent

Informed consent was obtained from all subjects involved in the study.

Availability of Data and Materials

Data of this work are available upon request.

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