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Orthognathic surgery satisfaction following FAB treatment

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ABSTRACT

The aim of this retrospective study is to evaluate long-term patient satisfaction after bimaxillary orthognathic surgery planned according to the Face-Airway-Bite (FAB) philosophy.

A sample of 65 patients out of 80 consecutively treated between 2015 and 2017 met the inclusion criteria for the study. All patients suffered from different type of malocclusions and were treated with bimaxillary orthognathic surgery at the Unit of Maxillofacial Surgery, University of Verona. Each patient completed a 15-item ad hoc questionnaire investigating the reasons for undergoing treatment and evaluating presurgical and long-term postsurgical satisfaction with facial appearance, breathing, and chewing. Epworth sleepiness scale was administered before and after treatment.

In the study group, 48% of patients underwent surgery to correct malocclusion, 22% to enhance facial appearance, 18% to resolve temporomandibular joint pain, and 12% for other reasons. Patients presenting for solely OSAS were excluded from the study to prevent skewing of the data. The mean score for long-term satisfaction was 9.06 ± 1.03/10. The mean facial appearance score was 5.26/10 before and 8.85/10 after surgery, respectively. The mean chewing score was 5.30/10 before and 8.81/10 after surgery. Although none of patients reported breathing problems before surgery, 65% of them referred postoperative breathing improvement. The mean follow-up period for questionnaire administration was 32months.

Patients undergoing bimaxillary orthognathic surgery planned according to the FAB principles reported high satisfaction with treatment outcomes. Patients' outcome approval was primarily related to improvement in function and aesthetics; however, airway and pain complaints were additionally improved.

1. Introduction

Dentoskeletal malformations are anomalies in the proportion and anatomical position of facial bones that can alter chewing, temporomandibular joint (TMJ) function, facial esthetics, and breathing (Proffit et al., 2004). Altered facial esthetics secondary to malocclusions influences self-confidence, self-esteem, and overall quality of life (Proothi et al., 2010). Orthognathic surgery (bone movement, usually bimaxillary surgery) is indicated when orthodontic treatment (tooth movement) is incapable of successful correction of the face, airway, and bite.

1.1. Expectations vs. motivation

Patient satisfaction after orthognathic surgery depends on the facial, airway, and bite outcome but is influenced by unknown patient *expectations* and *motivations*. Moreover, preexisting psychological factors such as the patient's social context, self-esteem, and mental health (Phillips et al., 2004), may significantly impact the degree of satisfaction with treatment outcomes. Further, Rustemeyer et al. (Rustemeyer et al., 2010) stated that patient dissatisfaction not only depends on poor surgical outcomes, but frequently poor communication between surgeon

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PATIENT MOTIVATION QUESTIONNAIRE

Patients often request changes in their bites or faces, relief from pain or discomfort, and obstructive sleep apnea correction. Please help us understand your problem by checking the following information; please be specific **(circle the words *more, less, forward, backward, longer, shorter*, etc.)**:

Teeth: If your teeth could be changed, how would you like them to change?

[ ] straighten the front teeth ***upper / lower***
[ ] straighten the back teeth ***upper / lower***
[ ] make the upper front teeth ***longer / shorter***
[ ] move upper teeth ***forward / backward***
[ ] move lower teeth ***forward / backward***
[ ] make the line of the upper front teeth more level
[ ] move the midline of the ***upper / lower*** teeth to the ***left / right***
[ ] other _____

Face: If your facial appearance could be changed, what would you change?

[ ] get rid of sag under lower jaw
[ ] move chin ***forward / backward***
[ ] move chin ***left / right*** to center it
[ ] move lower lip ***forward / backward***
[ ] move upper lip ***forward / backward***
[ ] move the area around my nose ***forward / backward***
[ ] make the profile of my nose ***longer / shorter***
[ ] move the area under my eyes ***forward / backward***
[ ] make my cheekbones ***larger / smaller***
[ ] show ***more / less*** of my ***teeth / gums*** when I smile
[ ] make my lips ***closer together / farther apart*** when my teeth are touching
[ ] make my lips not touch and roll out when my teeth are touching
[ ] reduce the strain in my ***chin / lips*** when I close my lips
[ ] make my face more ***narrow / wide***
[ ] reduce the ***width / fullness*** of my lower jaw behind my mouth
[ ] How much of your time is spent thinking about your appearance and/or bite? ***never / rarely / often / all the time***
[ ] other _____

TMJ or Muscle Symptoms: If you want to reduce pain or discomfort where would it be located? Please be specific about the location; circle the right side, left side or both if they apply.

[ ] in front of my ears ***right / left***
[ ] above my ears ***right / left***
[ ] below my ears ***right / left***
[ ] in my ears ***right / left***
[ ] in my neck ***right / left*** [ ] other _____

Obstructive Sleep Apnea Symptoms: Which obstructive sleep apnea symptoms do you want corrected?

[ ] day time sleepiness or fatigue
[ ] night time snoring
[ ] increased blood pressure or irregular heartbeat
[ ] depression [ ] other _____

Name _____ Date _____

Fig. 1. Patient motivation questionnaire.

Table 1
Profile FAB treatment listed. Seven steps, when followed produce Face, Airway, and Bite correction. Note - steps 1, 2, and 5 largely determine the nasal base and chin projections.

Profile FAB Steps	
1. Correct Mx 11 inclinations - ortho	Range 54°–60°
2. Correct Md 11 inclinations - ortho	Range 60°–68°
3. Move Md to class I occlusion	Incisor overbite 2.3–3.7 mm Incisor overjet 2.4–3.6 mm Molar overbite 1–2 mm Alternative – import final occlusion
4. Move Mx11 to esthetic position	Upper lip to TVL 2° to 5° Upper lip angle 8.5°–18° Upper incisor to TVL -11 to -6mm Nasal base to TVL 9–13 mm *goal – esthetic upper lip and nasal base support
5. Correct occlusal planes	Upper occlusal plane to TVL 94°–97° Lower occlusal plane to TVL 92°–96° Nasal base projection to TVL -12 to -8mm Chin to TVL -5 to 0 mm
6. Reposture lips and chin	Upper lip thins slightly with LFI advancement Lower lip repostures up and in and does not thin
7. Chin osteotomy when necessary	Height 42–46 mm lower incisor tip to soft tissue Menton Projection −5 to 0 mm to the TVL

and patient.

Orthognathic surgery patients may have unrealistic facial *expectations*. To offset unrealistic facial *expectations*, the surgeon must educate the patient regarding what facial change is realistically feasible. Many studies fail to distinguish between patient *motivating factors* for orthognathic surgery and surgical result *expectations* (G. W. Arnett and Worley, 1999). *Motivation* for treatment derives from preexisting patient problems (e.g., malocclusion, facial asymmetry), whereas patient *expectations* arise largely from communication with the surgeon performing the operation. To enhance communications, Arnett has suggested using a patient motivation questionnaire (Fig. 1) to reveal the patients' *motivation* and *expectations* for the face, airway, and bite prior to surgery. The patient motivation questionnaire educates the patient to possible outcomes and educates the surgeon to what the patient expects all prior to treatment (G. W. Arnett and Worley, 1999).

With the present study, we examine patients' motivation for and satisfaction after combined orthodontic and surgical treatment planned according to Face-Airway-Bite principles (FAB) as described by Arnett (G. W. Arnett and Bergman, 1993a, 1993b; G. W. Arnett et al., 1999; G. William Arnett et al., 2022; G. William Arnett, D'Agostino et al., 2022; G. William Arnett and Gunson, 2004). We were interested to verify whether the FAB diagnosis and treatment planning approach results in high patient satisfaction with treatment outcomes.

2. Materials and methods

In this retrospective longitudinal study, 65 out of 80 consecutively treated patients met inclusion criteria. Inclusion criteria were malocclusion diagnosis, ortho-surgical treatment with execution of bimaxillary surgery, complete medical records. Exclusion criteria were history of maxillofacial trauma, previous diagnosis of obstructive sleep apnea syndrome (OSAS), previous orthognathic surgery, cleft lip and palate, and incomplete medical records. Patients with previous rhinoplasty were excluded to prevent possible outcome errors. The patients underwent orthognathic surgery at the Unit of Maxillofacial Surgery of Verona University Hospital between 2015 and 2017.

All patients underwent combined orthodontic and surgical treatment. Diagnosis, surgical planning, surgery, and follow-up assessment were all performed by the same expert ortho-surgical team (Dr. E. Grendene; Drs. A. D'Agostino and L. Trevisiol). Planning of surgical

Table 2
Frontal FAB steps listed. Accomplishing Mx11 on the facial midline, leveling of the Mx33 to the facial horizontal, and correction of posterior yaw produce frontal facial balance.

Frontal FAB Steps	
1. Align Mx11 and Md11 midlines	To facial midline
2. Level Mx33 and Md33	To facial horizontal
3. Correct bimaxillary yaw	To produce mandibular inferior border symmetry

movements was based on the Face-Airway-Bite (FAB) principles as described by Arnett (G. W. Arnett and Bergman, 1993a, 1993b; G. W. Arnett et al., 1999; G. William Arnett, D'Agostino et al., 2022; G. William Arnett et al., 2022; G. William Arnett and Gunson, 2004). Tables 1 and 2 describe the basic FAB protocol used for profile and frontal treatment.

The surgery consisted of mandibular bilateral sagittal split osteotomies and a one or three-piece Le Fort I osteotomy. The BSSO was operated first. An intermediate splint positioned the mandible in the FAB derived position. The Le Fort I was operated second and no final splint was utilized to maximize the intercuspation of the final occlusion. Postsurgical orthodontics was performed to optimize and refine the occlusion (G. William Arnett et al., 2022; G. William Arnett, D'Agostino et al., 2022). Additional procedures such as mentoplasty, malarplasty (D'Agostino et al., 2016; Mazzoni et al. 2017, 2020; Iaquinta et al., 2022), and lipofilling, were utilized as necessary. Esthetic rhinoplasty was not performed on any patients to remove that variable from the patient outcome perception.

One year ±15 days after surgery and only after removal of orthodontic appliances, the patients completed an ad hoc pre-/post-treatment questionnaire containing questions that had been used in previously published (Rustemeyer et al., 2010; Magro-Filho, 2015) studies. By using previous study questions, a comparison with the current study was possible. It is noted, previously published studies did not assess pre- and post-surgical patients' airway function. The English version of the questionnaire is presented below in Fig. 3. It was administered by staff not involved in the treatment and its validity was assessed and approved by the review board of the School of Dentistry of the University of Verona. According to the local law formal Ethics Approval was not required for retrospective studies, however, Institutional approval was granted and all patients' data were completely anonymized, as well as the study was conducted according to the Declaration of Helsinki. Additionally, the patients completed the Epworth Sleepiness scale as shown in Fig. 2 at the pre-surgical planning appointment and at the long-term post-surgery follow-up consultation.

2.1. Statistical analysis

The data was entered into a database using Excel software (Microsoft, Richmond, WA, USA). Statistical analysis was performed using MedCalc® (MedCalc Software bvba, Ostend, Belgium) and Excel software (Microsoft). The Wilcoxon test for paired data was used to test for correlations. Statistical significance was set at $p < 0.05$.

3. Results

The study consisted of 65 patients with the following characteristics: 41 women (63%); 24 men (37%); mean age 25 ± 4 (range 18.16–47.66); Class II malocclusion – 29 patients (29%); class III malocclusion – 46 (71%); anterior open bite – 10 (15.38%); and facial asymmetry – 19 (29.23%). The mean duration of follow-up was 32 months (range 12–48 months). Statistical analysis of questionnaire responses is presented below.

Patient Satisfaction Questionnaire. Please mark only one answer.

1.	What was your main reason for undergoing orthognathic surgery?		
	○ Facial appearance	○ TMJ pain	
	○ Difficulty chewing	○ Other reasons	
2.	What were your expectations before surgery?		
	○ Improved facial appearance	○ Improved facial appearance and chewing ability	
	○ Improved chewing	○ None/not sure	
3a.	How would you rate your chewing ability before surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
3b.	How would you rate your chewing ability after surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
4a.	How would you rate difficulty chewing, biting, eating food before surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
4b.	How would you rate difficulty chewing, biting, eating food after surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
5a.	How would you rate TMJ pain or restricted mouth opening before surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
5b.	How would you rate TMJ pain or restricted mouth opening after surgery?		
	0 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
6.	Has your breathing improved after surgery?		
	○ Yes	○ No	
7.	How satisfied are you with the surgical outcome of treatment?		
	1 (not at all) to 10 (very) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
8	How did family members or friends rate the surgical outcome of treatment?		
	1 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
9a.	How would you rate your facial appearance before surgery?		
	1 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
9b.	How would you rate your facial appearance after surgery?		
	1 (poor) to 10 (excellent) 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10		
10.	How do you feel about your facial appearance?		
	Unhappy	> 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 >	Happy
	Unbalanced	> 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 >	Balanced
	Asymmetrical	> 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 >	Symmetrical
	Unnatural	> 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 >	Natural
	Unsatisfied	> 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10 >	Satisfied
11.	How would you rate the surgical outcome of treatment?		
	○ Facial appearance improved	○ Facial appearance and chewing ability improved	
	○ Chewing ability improved	○ Not sure	
12.	Do you feel more extroverted and self-confident after surgery?		
	○ Yes	○ No	
13.	Assuming that orthognathic surgery is indicated, would you recommend it to someone you love?		
	○ Yes	○ No	
14.	If you had the option, would you undergo orthognathic surgery again?		
	○ Yes	○ No	
15.	Please explain why you are not completely satisfied with the outcome of treatment as regards facial appearance, TMJ pain, difficulty chewing, other reasons.		

Fig. 2. Patient Satisfaction Questionnaire shown. This pre and post questionnaire was used for the current study and was easily compared to previous publications which used the same questionnaire. Among answers of question nr 1 there is the option "joint pain": this option must be considered within the context it is posed, in fact all patients underwent bimaxillary surgery for malocclusion correction, this question exclusively aims at evaluating the presence of TMJ indirect pain that is cervical-facial pain somehow related to malocclusion side effects.

3.1. Reasons for surgery

Question 1. The main reasons were facial appearance (22%), difficulty in chewing (48%), temporomandibular joint (TMJ) pain or temporomandibular disorder (TMD) (18%), other reasons (12%). The "Other Reasons for Treatment" category included: to prevent future problems, desire to enhance self-esteem, and increased confidence in social settings (Fig. 4).

3.2. Patients expectations

Question 2. Most patients responded that they expected improvement both in facial appearance and chewing function (77%). Fewer (18%) expected improvement in chewing function only, very few (3%) expected improvement in facial appearance only and 2% had no expectations or were unsure (Fig. 5).

EPWORTH SLEEPINESS SCALE

How likely are you to dose off or fall asleep during the following situations?

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

		SCORE
1.	Sitting and reading	0 1 2 3
2.	Watching TV	0 1 2 3
3.	Sitting, inactive in a public place	0 1 2 3
4.	As a passenger in a car for an hour without a break	0 1 2 3
5.	Lying down to rest in the afternoon	0 1 2 3
6.	Sitting and talking to someone	0 1 2 3
7.	Sitting quietly after a lunch without alcohol	0 1 2 3
8.	In a car, while stopped for a few minutes in the traffic	0 1 2 3

Fig. 3. Epworth Sleepiness Scale (ESS) shown. The ESS is a clinical indicator of OSA. A ESS total score exceeding 9 is an indication of OSA.

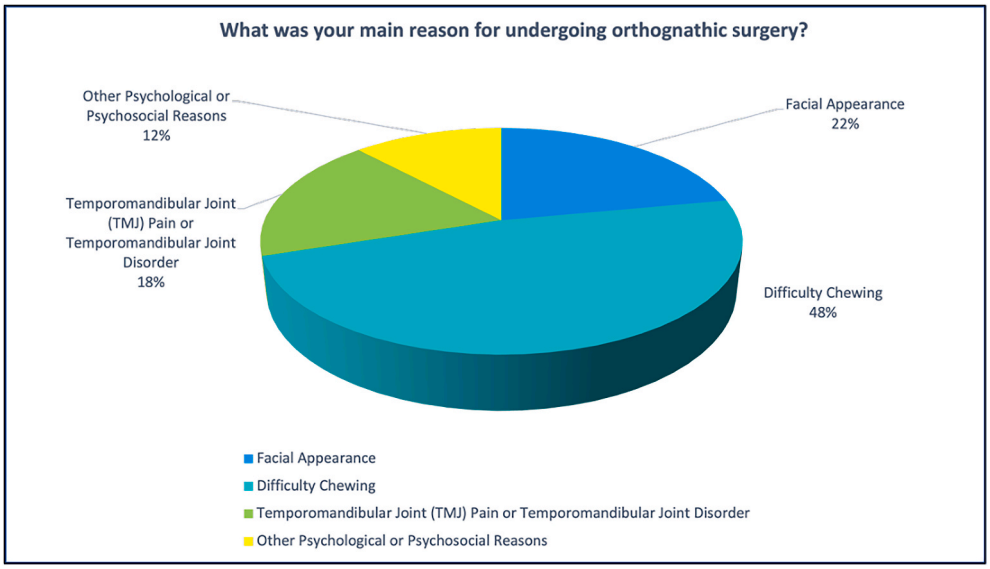

Fig. 4. Reasons for undergoing orthognathic surgery.

3.3. Function

(score range 1–10; a higher score denotes improved function.

Question 3a and 3b. The mean score for chewing ability was 5.30 ± 2.13 before and 8.71 ± 1.77 after surgery. This result was statistically significant ($p < 0.0001$) improvement.

Question 4a and 4b. The mean score for difficulty in chewing, biting, eating food was 4.95 ± 3.3 before and 2.17 ± 2.83 after surgery. This result was statistically significant ($p < 0.0001$).

Question 5a and 5b. The mean score for TMJ pain or restricted mouth opening was 4.65 ± 3.69 before surgery and 1.68 ± 2.08 after surgery. This result was statistically significant ($p < 0.0001$) improvement.

3.4. Breathing

Question 6. Postsurgical improvement in breathing was reported by 65% of patients in relation to physical exercise and overall breathing quality. The Epworth Sleepiness scale was also utilized to reveal airway function. The mean Epworth Sleepiness scale (ESS, range 0–24) score was 7.15 ± 4.78 before and 4.35 ± 4.02 after surgery. This result indicated statistically significant ($p < 0.05$) improvement in airway function (Fig. 6).

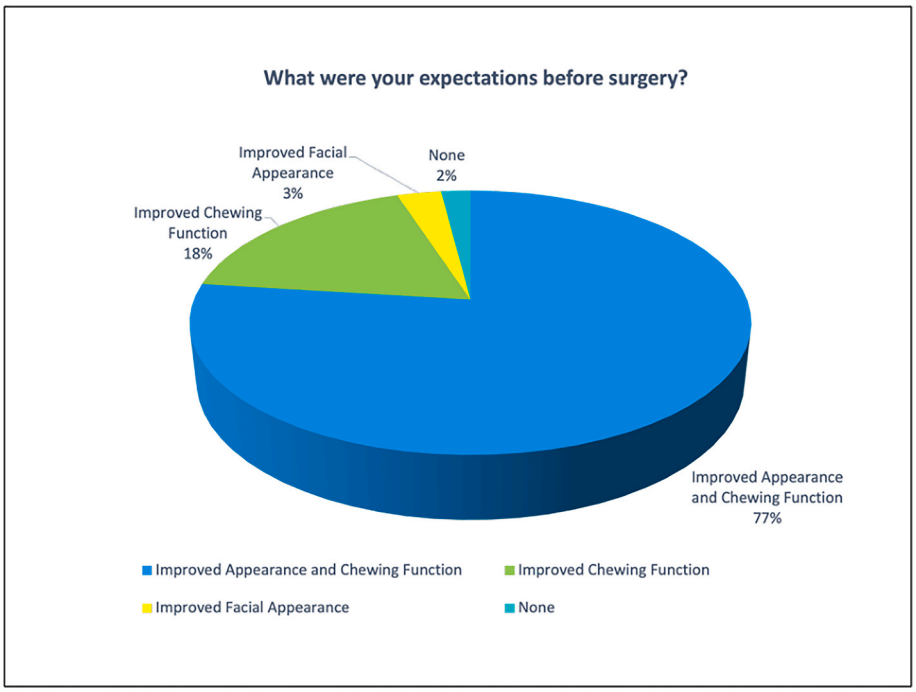

Fig. 5. Expectations before surgery.

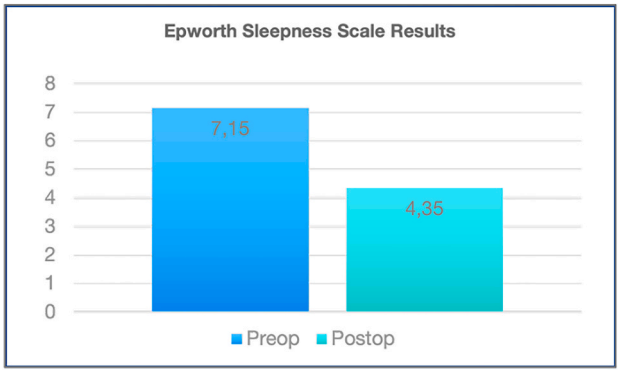

Fig. 6. Epworth Sleepness scale results before and after surgery.

3.5. Facial appearance

Question 7. The mean score was 9.06 ± 1.03 indicating high satisfaction with the FAB planned facial outcomes (Fig. 4).

Question 8. The mean score was 9.63 ± 0.60. This result was statistically significant ($p < 0.0001$) indicating high satisfaction with the FAB planned outcomes (Fig. 7).

Question 9a and 9b. The mean score was 5.26 ± 2.14 before surgery and 8.85 ± 0.97 after surgery. The increase of 3.5 points was statistically significant ($p < 0.0001$) indicating high facial satisfaction with the FAB planned outcome (Fig. 8).

Question 10. Postsurgical facial appearance was evaluated using five parameters, each rated on a visual analogic scale (VAS) score from 1 to 10. The mean score was 8.97 for satisfaction with facial appearance, 9.12 for naturalness, which is the parameter that received the highest rate, 8.55 for symmetry, 8.77 for facial harmony, and 9.09 for happiness with appearance (Fig. 9).

3.6. Psychological aspects

Question 11. Improvement in both chewing ability and facial appearance was reported by 92% of patients. This response can be compared to the responses to item 2 on patient expectations before surgery: 77% expected an improvement in both chewing ability and facial appearance (Fig. 10).

Question 12. The majority of patients (82%) responded that they felt more extroverted and self-confident after surgery (Fig. 11).

Question 13. Nearly all (97%) patients responded that they would recommend orthognathic surgery, if indicated, to someone they love.

Question 14.92% of patients responded that they would undergo orthognathic surgery again, whereas 8% stated they wouldn't.

Question 15. The reasons patients were unsatisfied with treatment were nerve damage, tingling sensation or numbness, facial edema, and difficult postoperative course. Perhaps these patients may not have been adequately informed about treatment and its potential complications.

4. Discussion

4.1. General surgical outcome

In literature review, Soh et al. (Soh and Narayanan, 2013) (21 papers) and Hunt et al., (2001) (29 studies) reported that orthognathic surgery patients experienced general improvement in quality of life and psychological well-being after surgery. Other studies have reported surgical outcome satisfaction ranging from 70% to 87% (Rustemeyer et al., 2010). Türker et al., (2008) reported that 76% of patients were highly satisfied with the general surgical outcome, 90% experienced enhanced facial appearance, 63% realized an increase in self-esteem, and 40% reported improvement in social relationships (Türker et al., 2008).

4.2. FAB based patient outcome impression

Global indication of *surgical satisfaction* is revealed by three questions; patient satisfaction with outcome, recommend surgery to another person, and would repeat surgery. The *FAB planned* orthognathic surgery (Tables 1 and 2) utilized in this study produced high levels of satisfaction revealed by 94% satisfaction with treatment outcomes, 97% would recommend surgery, and 92% would undergo surgery again if

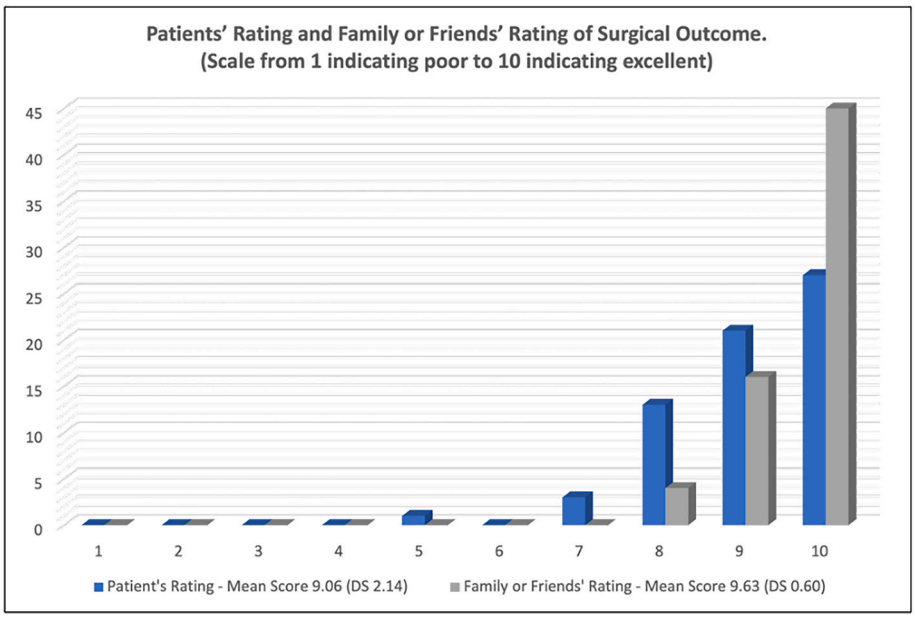

Fig. 7. Comparison between patients' rating and Family or Friends' rating of surgical outcome.

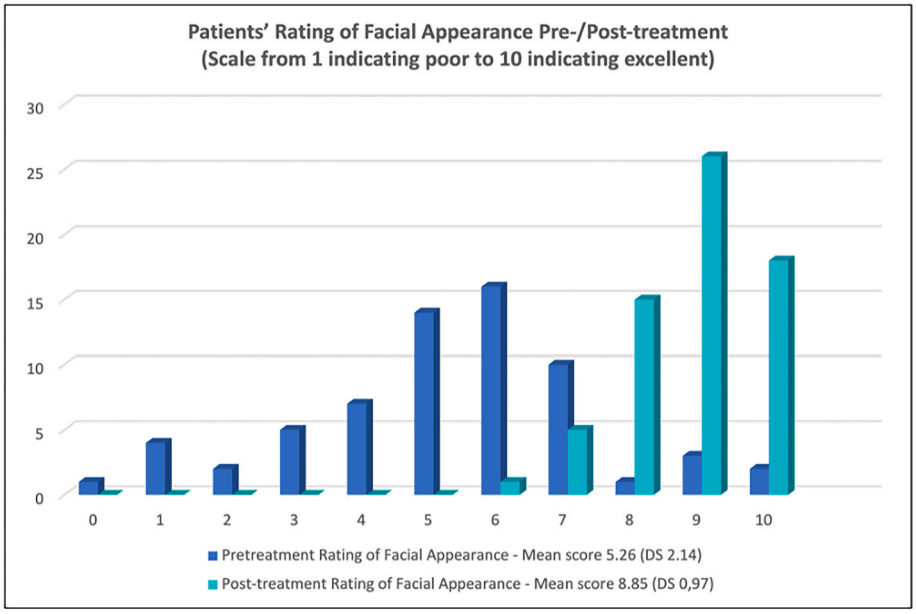

Fig. 8. Patients' rating of facial appearance pre-/post-treatment.

indicated. The current FAB study had generally higher levels of satisfaction than previous studies (Table 3). Rustemeyer et al. (Rustemeyer et al., 2010) and Türker et al., (2008) reported that 73% and 70% of patients, respectively, would recommend orthognathic surgery to others, while Sar et al. (Sar and Cagla, 2015) reported that 89% of patients would recommend surgery to others and that 69% would undergo surgery again if indicated. Similarly, Alkharafi et al. (AlKharafi et al., 2014) reported that 89.2% would recommend surgery to others and 83.8% would undergo surgery again if indicated. Posnik and Wallace (Posnick and Wallace, 2008) reported that 88% of patients were satisfied with surgical results, 93% would recommend it to others, and 83% would undergo surgery again. Finally, Oland et al., (2011) reported that 87% of patients were satisfied with surgical results, 71% would recommend surgery to others, and 65% would undergo surgery again.

4.3. Face, airway, and bite treatment plan outcomes

In the current study, patient satisfaction was achieved based on factors which specifically included the FAB treatment plan and generally patient involvement in the treatment planning, time spent educating patients, and addressing patient concerns prior to surgery. The FAB treatment planning, particularly the bimaxillary occlusal plane correction, is very important regarding the face and airways correction as reported by Trevisiol and D'Agostino (Trevisiol et al., 2022). Analysis of the pretreatment questionnaire disclosed that 3% expected an improvement only in facial appearance, 18% only in chewing ability, and 77% in both. The post-treatment questionnaire responses were different than pretreatment responses; 2% experienced only improved facial appearance, 3% only chewing ability, while 92% perceived an improvement in both facial appearance and chewing ability. The mean

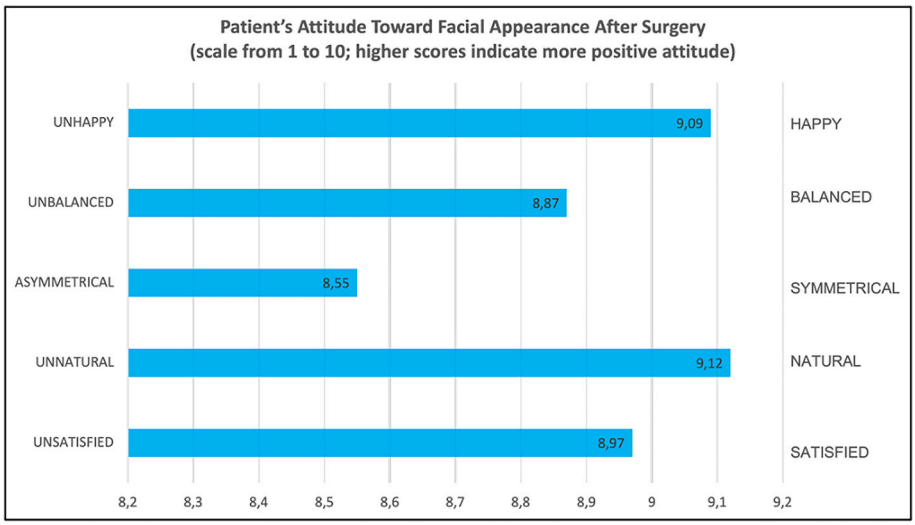

Fig. 9. Patients' attitude toward facial appearance after surgery.

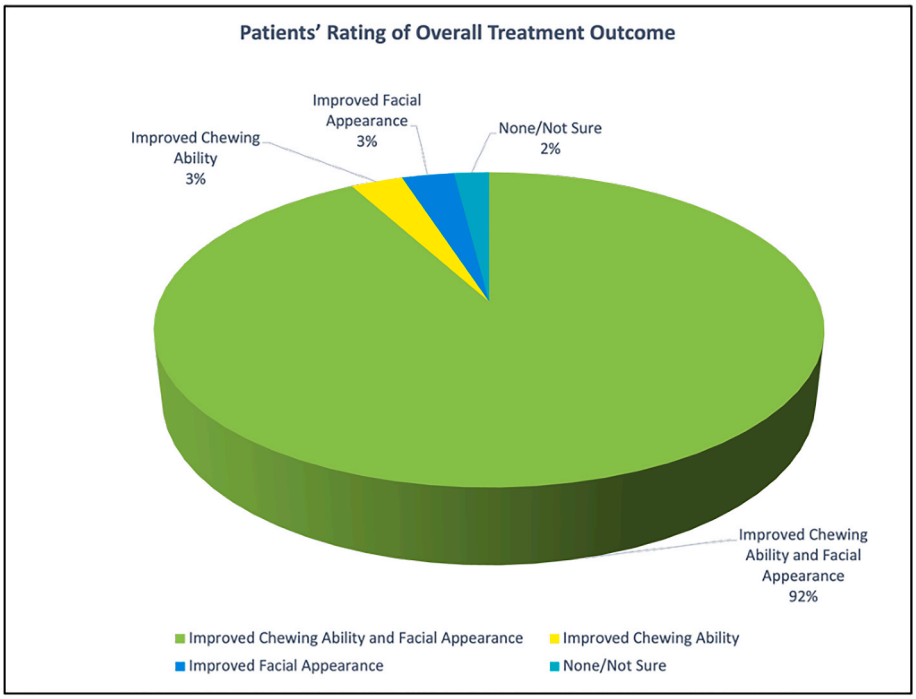

Fig. 10. Patients' rating of overall treatment outcome.

facial appearance score (range 1–10) was 5.26 before and 8.85 after surgery (+32%); the mean chewing ability score was 5.30 before and 8.71 after surgery (+34,1%). These observations are similar with Rustemeyer et al. (Rustemeyer et al., 2010) and Magro-Filho et al. (Magro-Filho, 2015) who reported similar increases in scores for facial appearance and chewing ability after orthognathic surgery.

Although the patients in the present study did not present with obstructive sleep apnea syndrome (OSAS) and treatment planning for dentoskeletal deformity did not foresee increasing airway volume, an improvement in breathing was observed. 65% of patients reported postsurgical improvement in breathing in relation to sports activity. Patients with OSAS were not included, because the authors wanted to evaluate whether there was an improvement in respiratory function despite the surgery was not planned with the intent to increase airways volume. Additionally, the Epworth Sleepiness scale (ESS) improved by -2.8 points after surgery. The improved breathing and Epworth score, again agree with the study published by Trevisiol and D'Agostino et al., which demonstrated a correlation between FAB planned bimaxillary counterclockwise surgery and large airways volume increases (Trevisiol et al., 2022). These observation also agree with findings of Magro-Filho et al. (Magro-Filho, 2015) who reported improved breathing (7.68/10) after orthognathic surgery. Similarly, Posnik and Wallace (Posnick and Wallace, 2008) reported that 90% of patients stated satisfaction with improved breathing after surgery.

4.4. *Patient motivation for surgery*

In the present study, the *primary motivations* for surgery were 48% to improve chewing, 22% for facial improvement, and 18% for TMJ symptoms improvement. These findings are similar with Proothi et al.

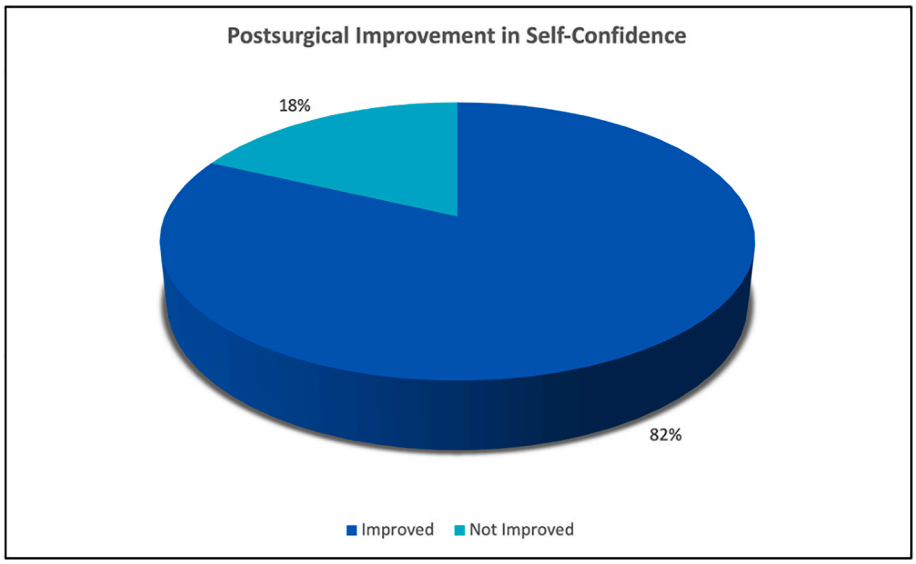

Fig. 11. Postsurgical improvement in self-confidence.

Table 3
Results compared among studies: all percentages indicate positive patient answers for each question posed. Note – FAB treatment planning had a generally higher positive rating. *This data refers to the positive variation of post-surgical assessment of the considered item.

Author			PATIENT OUTCOME IMPRESSION			FACE, AIRWAY, and BITE				
	Year	Sample (patients)	Satisfaction with outcomes	Recommend surgery	Repeat surgery	↑ Facial appearance	Breathing Improvement	↑ Chewing ability	↑ Self esteem	Enhanced Social relations
FAB Planned	2017	65	94%	97%	92%	+32%*	65%	+34,1%*	82%	82%
Rustemeyer et al.	2012	77	77.9%	73%	–	+24,8%*	–	+26,6%*	67.5%	67,5%
Türker et al.	2008	30	76%	70%	63%	90%	–	–	63%	40%
Sar et al.	2015	82	97,6	89%	69%	90%	–	85%	98%	99%
Alkharafi et al.	2014	74	96,4%	89.2%	83.8%	73%	–	79,7%	86.5%	68%
Posnik et al.	2008	42	88%	93%	83%	–	90%	86%	–	–
Oland et al.	2011	118	87%	71%	65%	83.1%	21,2%	65%	59%	56%

(Proothi et al., 2010) who reported treatment motivation of 36% to improve chewing and 15% to improve facial appearance. Bock et al. (Bock et al., 2009) and Modig et al. (Modig et al., 2006) reported higher motivation based on functional improvement and less on esthetic expectations. Still other studies have reported facial enhancement was more often the reason for surgery than malocclusion or difficulty in chewing. For example, Rustemeyer et al. (Rustemeyer and Gregersen, 2012) compared responses to the Oral Health Impact Profile questionnaire (OHIP) pre- and post-treatment and found that discontent with facial appearance was more often cited than chewing or biting ability. A plausible explanation might be that among younger patients involved in the Rustemeyer[23] study, facial improvement was more important than functional considerations. The 'Arnett patient motivation for surgery questionnaire' (Table 1) is a reliable tool to reveal the patient with unrealistic motivations for surgery and to reeducate the patient to the surgeon's realistic outcome predictions.

4.5. Outcome expectations

Patient *motivation* for surgery may be confused with outcome *expectations*. The patient's motivation for surgery relates to the patient's pretreatment perceived problems such as malocclusion, facial appearance, and/or joint and muscle discomfort. Outcome expectations arise largely from the surgeons' predictions for the outcome of treatment. Therefore, surgeons must clearly inform patients about what surgery can and can't realistically achieve to avert flawed expectations. We agree with Türker et al., (2008) who reported that patients insufficiently informed about surgery are prone to be emotionally unprepared and anxious. In contrast, when patients and their families are adequately informed, they are better able to cope with postsurgical recovery and their expectations are better aligned with surgical results (Motegi et al., 2003). 8% of patients in our study would not undergo surgery again if they were given the choice – this group possibly had unrealistic outcome expectations as presented by the surgeon.

4.6. Study follow-up duration reliability

In regards to reliability of satisfaction questionnaire results, the Soh et al. (Soh and Narayanan, 2013) literature review revealed that most published satisfaction studies had a short 6 month follow-up duration. Motegi et al., (2003) conducted the longest follow-up of 5 years. Motegi found that the psychological benefits of orthognathic treatment increased until 2 years post-surgery at which time the perception of benefits plateaued. Motegi therefore suggested results should be evaluated at 2 years to be reliable. It is likely short follow-up studies associated with low levels of satisfaction may be related to incomplete postsurgical healing. Additionally, Türker et al., (2008) found that postsurgical adaptation may take longer than expected (Türker et al.,

2008). Kiyak et al. (H. Asuman Kiyak, 1984) administered a patient satisfaction questionnaire at five time points after orthognathic surgery and found that satisfaction increased up to 24 months after surgery. Our study had a mean follow-up of 30 months, which would be adequate and accurate according to the studies of Motegi and Türker.

5. Conclusions

In this study, patients undergoing orthognathic surgery planned according to the FAB principles were highly satisfied with treatment outcomes based on the patient satisfaction questionnaire given pre- and post-surgery. This was likely due to the simultaneous improvement of both function and esthetics. In our study, pre-treatment discussions with patients seemed to be effective in meeting patients' personal and psychological needs. An understanding of patient expectations is the key to patient satisfaction. With that in mind the published Patient Motivation Treatment Questionnaire by Arnett et al. (G. W. Arnett and Worley, 1999) is an adequate tool to reveal the patients' motivations prior to surgery.

Patient satisfaction is an essential goal in a modern combined orthodontic surgical treatment for dentofacial deformities. Further studies involving larger samples and with longer follow-up periods are recommended to support the evidence from this study.

Declaration of competing interest

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