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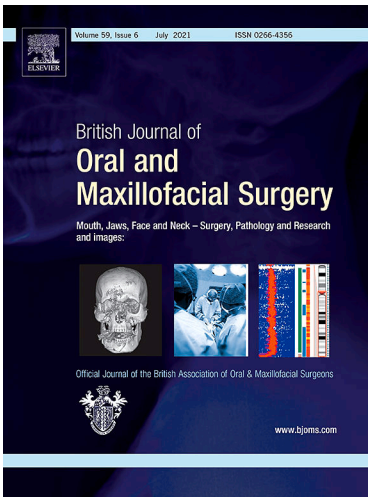

Improvement in Facial Aesthetics of Orthognathic Patients after Surgery-first Approach

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Improvement in Facial Aesthetics of Orthognathic Patients after Surgery-first Approach

Abstract

Background: Facial appearance significantly affects psychosocial well-being, and improvement in facial aesthetics is considered an essential outcome of orthognathic treatment. The surgery-first approach (SFA) has emerged as a promising alternative to the conventional orthodontics-first approach (OFA), due to its potential advantages in reducing treatment duration and cost, delivering early aesthetic improvement, and increasing patient satisfaction. However, the impact of the SFA on final facial aesthetics, and how it compares with the OFA, has not yet been investigated. **Method:** This retrospective study aimed to compare the improvement in facial aesthetics after orthognathic surgery, in an SFA and an OFA group. Pre- and postoperative three-dimensional stereophotogrammetry facial images for 40 patients were evaluated by five professional assessors using the Global Aesthetic Improvement Scale (GAIS). **Results:** Similar aesthetic improvement outcomes were found for both the SFA and OFA groups. The GAIS score was significantly correlated with the following facial variables: upper lip projection, chin prominence, facial proportions, para-nasal hollowing, lip competence, mandibular projection, and facial profile. No significant correlation was found between the change in aesthetic score and the surgical variables. There was a positive association between the overall GAIS score and the gender and experience level of the individual assessors. **Conclusion:** This study suggests that the facial aesthetic improvement achieved with the SFA is satisfactory and comparable to that of the OFA.

Keywords: Orthognathic; surgery first; aesthetic; orthodontics; 3D facial assessment.

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Introduction

Facial aesthetics is an object of desire in modern societies. The balance and harmony of the face play a important role in social behaviour and perception worldwide.[1] In recent years, attention has been

directed towards the aesthetic impact of orthognathic surgery on facial appearance.[2] The increased awareness of facial aesthetics has also led to an increase in the number of patients seeking orthognathic treatment.[3]

Since the 1970s, the orthodontics-first approach (OFA) has been utilised as a standard protocol for the management of orthognathic cases where the course of the treatment includes three stages; pre-surgical orthodontics, orthognathic surgery, and post-surgical orthodontics.[4,5] Lee et al. (1994), discussed the concept of the surgery-first approach (SFA), suggesting that the early correction of the skeletal deformity should facilitate easier and quicker orthodontic tooth movement, due to normalisation of the soft tissue envelope.[6] Since then, there has been increasing interest in the SFA, due to the progressive accumulation of clinical evidence for its efficiency.[7] Compared to the conventional approach, the SFA offers shorter overall treatment time, elimination of exaggerated facial disharmony and dental dysfunction caused by presurgical decompensation, and comparable postsurgical skeletal stability.[8,9,10] However, the SFA is not applicable to all cases,[11] and requires careful orthodontic planning.[12,15]

There is evidence that orthognathic surgery improves dentofacial function, facial aesthetics, and quality of life parameters[13,14] but, to the best of our knowledge, no studies to date have compared the improvement in facial aesthetics produced by the SFA and OFA. Most studies have been limited to assessment of facial aesthetics in patients treated using the OFA.[13,15]

The Global Aesthetic Improvement Scale (GAIS) is a validated universal scale that has been used in several studies to monitor the level of facial aesthetic improvement and treatment outcomes.[16–19] Using GAIS as an objective tool, this study aimed to compare the improvement in facial aesthetics of an SFA and an OFA group of patients.

Method

Study design

A retrospective cohort study was conducted on all patients who had undergone orthognathic surgery and 3D facial imaging at our unit between 2016 and 2022. Cases involving both single jaw and bimaxillary surgery were included and the patients were divided into SFA and OFA groups. The treatment plans were based on the magnitude of the deformity, as well as the patients' functional and aesthetic concerns. The quality of the predicted occlusion was of particular importance where the SFA was used. All patients were treated by the same surgeon and orthodontist following a standard protocol of data collection, analysis, and prediction planning. Patients with a complete set of both preoperative and postoperative 3D images were considered for inclusion in the study. Patients were excluded if they had poor quality 3D images, cleft lip and palate, craniofacial syndromes, and a history of facial trauma or maxillofacial pathology.

3D Imaging

The current study was based on the subjective analysis of a set of 3D images, which were captured before surgery, and at 9 to12 months postoperatively. The 3D facial scans were captured using the same stereophotogrammetric device: the Di3D capture system (Dimensional Imaging, Hillington Park, Glasgow, UK). All the 3D facial images were taken under standardized conditions by the same professional photographer. Patients were scanned at rest, in natural head position, with relaxed facial musculature.

Panel assessment

The panel consisted of five selected consultants (two of whom were male). The assessors had different levels of experience and were not involved in the treatment of the patients. A series of ten 3D facial images were shown to the panel members for training and calibration purposes. These ten cases were not included in the study sample. The assessors were instructed to ignore skin tone and texture, as well as hairstyle, and position of the ears. They were asked to focus only on improvement of facial aesthetics with respect to facial balance and harmony. The assessors were shown a PowerPoint presentation, which included a 360° video of each patient's preoperative and postoperative 3D facial capture, as well as a standardized set of still images, comprising the frontal, profile, and 45° images of right and left sides of the face (Fig. 1). These were then used to grade the perceived improvement in facial harmony using the GAIS.[16] The GAIS score consists of seven categories ranging from 3 for considerably improved, to -3 for considerably worsened, (Table 1). The grades were translated into numerical scores from 1 to 7, to allow statistical analysis of the results. To test intra-rater reliability, ten percent of the patient images were replicated and included randomly within the rest of the images. [20, 21]

Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics for Windows version 26. A Kolmogorov–Smirnov test was conducted to assess normal distribution, followed by parametric or non-parametric statistical testing as indicated. Descriptive statistics (mean, standard deviation (SD), and frequency) were computed for the data. The inter-rater reliability was evaluated using the interclass correlation coefficient (ICC).[22] The ICC values were measured with two-mixed model, consistency type at 95% confidence interval. The correlation of the overall GAIS score with facial aesthetic parameters, surgical variables and panel demographic variables was analyzed using Spearman's correlation test. Differences were considered significant at $p < 0.05$. A correlation coefficient (r) was defined as high ($r > 0.70$), moderate ($r = 0.30$ to 0.70), and low ($r < 0.30$).[20]

Results

A total of 40 orthognathic patients (30 females and 10 males) were included in this study: 20 in each group. Twenty-two had undergone Le Fort I osteotomy, 9 Bilateral Sagittal Split Osteotomy (BSSO), and 9 bimaxillary osteotomy (BIMAX). The age at the time of surgery ranged from 14 to 50 years with a median of 23 years. Of the panel members, three of the five had more than 10 years of clinical experience.

No statistically significant difference was found in the overall GAIS score between the two groups using independent t-test ($P = 0.417$). The mean GAIS score of the SFA group was 6.08 (SD = 0.92), which was comparable to the mean score of 5.98 (SD: 0.88) for the OFA group. Good inter-rater reliability was noted, with a correlation coefficient of 0.85. The scores for the replicated cases demonstrated good intra-rater reliability, with an agreement rate of 75-100%.

"Significant improvement" and "considerable improvement" scores were noted in 77.5% of the cases in both groups, and a "small improvement" score was noted in 16%. In two cases, "no change" was noted, and one case was judged to have a "small deterioration". No "significant deterioration" or "considerably worsened" scores were noted for any of the cases in the two groups (Fig. 2). The total improvement scores for the various facial parameters were 91.5 % (facial profile), 75.3% (mandibular projection), 68% (upper lip projection), 66% (chin prominence), 57% (para-nasal hollowing), 42% (lip competence), 39% (facial proportions), 33% (nasal prominence), and 27.5% (facial symmetry) (Fig. 3).

As part of the study, the effect of surgical variables on the overall GAIS score was evaluated, including the type of surgery (Le Fort I, BSSO, BIMAX), the involvement of a genioplasty, or malar augmentation. The Spearman correlation test was used to evaluate the correlations between the overall GAIS score and other variables, including facial aesthetic parameters, surgical variables and panel demographic variables. The results indicated that the relationships between the overall GAIS score and the surgical variables were not statistically significant ($p > 0.05$).

For the facial aesthetic parameters, significant high correlations were observed between the facial profile and GAIS scores (Table 2). Low correlation coefficients were observed with facial proportions ($p = 0.23$). A moderate correlation coefficient was found to be statistically significant between the overall GAIS and facial aesthetic variables, including upper lip projection, chin prominence, mandibular projection, para-nasal hollowing, and lip competence (Table 2). There was a statistically significant difference between the years of experience of panel and the overall GAIS score ($p = 0.017$).

Discussion

There is no doubt that the SFA avoids the deterioration in facial aesthetics produced by the pre-surgical dental decompensation phase of the OFA.[8-10] However, there is no clear evidence that the final aesthetic outcomes of SFA are better or worse than those for patients managed with the OFA. This study aimed to evaluate the improvement in facial appearance as one of the outcome measures for the SFA. Three-dimensional facial images of SFA and OFA patients were graded by trained professional assessors, using the validated GAIS. The null hypothesis for the study was accepted, with no differences in the achieved GAIS scores for the two groups being detected.

Healthcare authorities have looked at mechanisms to deal with the delays in delivering orthognathic services caused by the COVID-19 pandemic. The SFA could be a valid option as it significantly reduces the number of treatment visits and duration of the treatment, in addition to achieving comparable occlusal outcomes to the conventional OFA.[23,24]

Previous research, investigating the aesthetic outcome of orthognathic surgery in patients with dentofacial deformities, has focused primarily on facial attractiveness[3,2,25,26]. Although much has been learned from these studies, limited information is available about the aesthetic improvement achieved through surgery. The present study reports the global aesthetic

improvement of each case by comparing the initial facial soft tissue characteristics with the outcome. Previous studies have utilized a variety of 2-dimnesional (2D) imaging techniques.[27-28] With the advent of 3D imaging, a full representation of the morphology of the oro-facial region is readily available, allowing a more realistic assessment of the aesthetic improvement.

Our previous studies have shown that the SFA significantly reduces treatment duration, with fewer clinical appointments, whilst also achieving comparable occlusal outcomes[23]. In addition, SFA patients have reported better quality of life measures in comparison with OFA patients, due to the elimination of the pre-surgical decompensation phase.[29] The current study has shown that there is no significant difference between the facial aesthetic outcomes for our SFA and OFA patients. Okamoto et al. (2021), reported that soft tissue changes for SFA patients differed significantly from OFA patients, particularly in the amount of mandibular soft tissue projection.[30] However, their study was limited to cephalometric analysis and measurement of the soft tissue volume from CBCT scans, which may not have fully reflected the overall aesthetic improvement.

We acknowledge that the two study groups were not perfectly matched, with respect to the magnitude of dentofacial deformities. It could be argued that the preoperative 3D facial images of the SFA patients showed less deformity, because the pre-surgical dental decompensation, which usually worsens facial aesthetics, was not present. However, the fact that the two groups showed comparable levels of improvement counteracts this argument, and the significant improvement in facial aesthetics achieved in the SFA group supports the wider application of this approach.

It would be difficult to conduct a prospective randomized trial to compare the aesthetic improvements between the SFA and OFA. Patients that are suitable for the SFA should be offered this management protocol, and we would consider it unethical to direct them to another treatment modality. In addition, a prospective RCT of this kind would be of questionable value, given the existing evidence that supports the advantages of the SFA.

Conclusions

The professional assessors perceived a similar level of improvement in overall facial aesthetics after orthognathic surgery in both SFA and OFA patients. The findings of the current study suggest that comparable facial aesthetic outcomes are achieved for orthognathic patients treated by either approach. This information is important to the multidisciplinary dentofacial deformities team when treatment planning orthognathic patients.

Conflict of Interest

The authors declare that they have no known financial conflict of interest.

Ethics statement/confirmation of patients' permission

This study was approved by the local Clinical Governance Committee. The patients signed release forms that permitted the use of their data and photographs for scientific research.

Table 1. *Global Aesthetic Improvement Scale (GAIS).*

Score	Evaluation	Description
3	Considerable improvement	Excellent aesthetic result
2	Significant improvement	Significant aesthetic improvement compared to the initial condition but not the best one for the patient
1	Small improvement	Clear aesthetic improvement compared to the initial condition
0	No change	The condition unchanged compared to the initial one
-1	Small deterioration	The condition has slightly worsened compared to the initial one
-2	Significant deterioration	Significant aesthetic deterioration compared to the initial condition
-3	Considerably worsened	Considerable deterioration compared to the initial condition

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Table 2. *Correlation Between facial parameters and overall GAIS score. *: a statistical significant difference. *: Correlation is significant at the 0.05 level (2-tailed), **: Correlation is significant at the 0.01 level (2-tailed).*

Variables		Correlation Coefficient, r	P value
Facial parameters	Facial profile	0.76**	<0.001
	Nasal prominence	0.11	0.109
	Upper lip projection	0.46**	<0.001
	Chin prominence	0.37**	<0.001
	Mandibular projection	0.49**	<0.001
	Facial proportions	0.16*	0.023
	Para-nasal hollowing	0.40**	0.000
	Lip competence	0.31**	0.000
	Facial symmetry	0.12	0.091

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Legends of the figures

Figure 1: Example of three-dimensional imaging set (preoperative and postoperative) presented to

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the panel assessors.

Figure 2: Overall Global Aesthetic Improvement Scale (GAIS). Data are expressed as a percentage.

Figure 3: Overall Global Aesthetic Improvement Scale (GAIS) for facial parameters. Data are expressed as a percentage.

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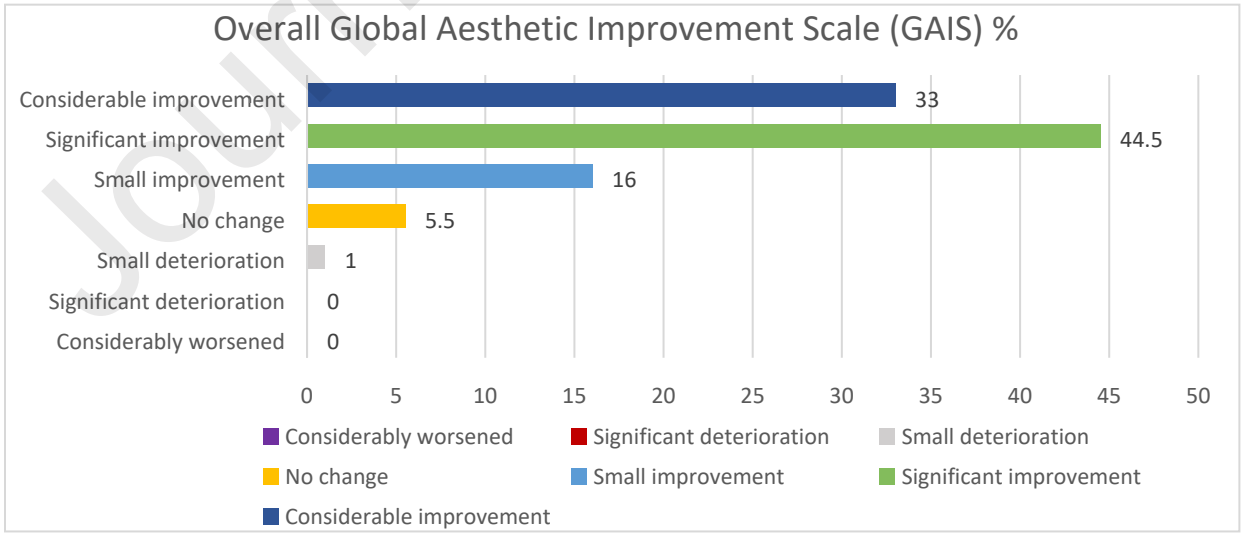

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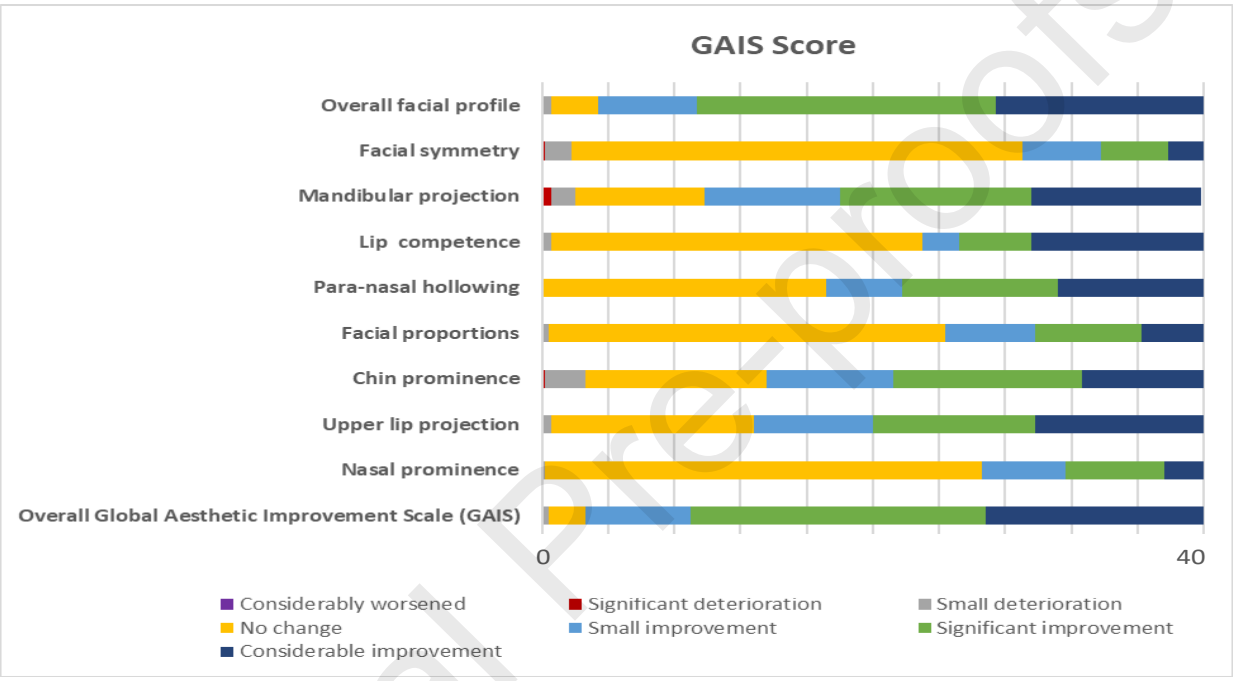

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