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Surgery-first approach for correction of class III dentofacial deformity with Le Fort I osteotomy; is it advantageous?

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Abstract

The surgery-first approach (SFA) to orthognathic treatment aims to reduce its duration without compromising the outcome. However, the objective assessment of the achieved occlusion has been limited. This study was designed to assess the treatment duration, outpatient appointment number, and quality of occlusal outcomes for two groups of patients; one treated with the SFA and the other with an orthodontics-first approach (OFA). We carried our a retrospective cohort study of case records for twenty consecutive SFA, and 23 consecutive OFA, cases with class III malocclusions, treated with Le Fort I maxillary osteotomy only. Pre-and post-treatment study models were assessed using the Peer Assessment Rating (PAR). Significant differences ($p<0.001$) were found between the median active treatment durations (10.2 months for the SFA and 32.5 months for the OFA) and appointment numbers (14 for SFA and 24 for OFA). Median absolute PAR reductions were 40 for the SFA and 39 for the OFA. There was no significant difference between the groups regarding quality of occlusal correction. Treatment durations for the SFA group were significantly shorter than for the OFA group, with fewer outpatient appointments. The quality of occlusal outcome for both SFA and OFA groups were satisfactory and comparable.

Keywords: Surgery-first approach; Treatment duration; Occlusal outcome

Introduction

Correction of dentofacial deformities usually involves a combination of orthodontic treatment and orthognathic surgery. In the conventional, or orthodontics-first approach (OFA), the orthodontic treatment is typically aimed at achieving alignment, decompensation, and arch coordination, prior to surgery. Postsurgical orthodontics is then aimed at occlusal settling and finishing.[1] The fixed appliances also facilitate intermaxillary elastics to counteract relapse and maintain the planned occlusion. Advantages of this approach include predictable surgery, based on a well interdigitated occlusion, which may also contribute to surgical stability.[2–4] However, it is also associated with long treatment durations, ranging from 18–28 months presurgically and 12–24 months postsurgically.[2] Such protracted treatment times can increase the risk of iatrogenic damage, and presurgical decompensation accentuates the malocclusion and facial disharmony, which can negatively affect quality-of-life measures.[5,6]

The surgery-first approach (SFA) potentially addresses some of these disadvantages, through immediate correction of the skeletal discrepancy (Figs. 1 and 2), followed by a single postoperative orthodontic phase (Fig. 3). Treatment duration has been found to be reduced and the adverse effects of presurgical decompensation are avoided.[7,8] Possible reasons for the reduced treatment duration include more rapid tooth movement due to increased cellular activity, reduced muscle and bite forces, and occlusal interferences, in the immediate postoperative period.[9–11] In addition, pressure from the orofacial soft tissues, with a corrected jaw relationship, would be expected to aid decompensation, whereas presurgical orthodontics occurs against soft tissue resistance.[12]

Several studies have assessed occlusal outcomes for OFA patients using the Peer Assessment Rating (PAR). Out of 100

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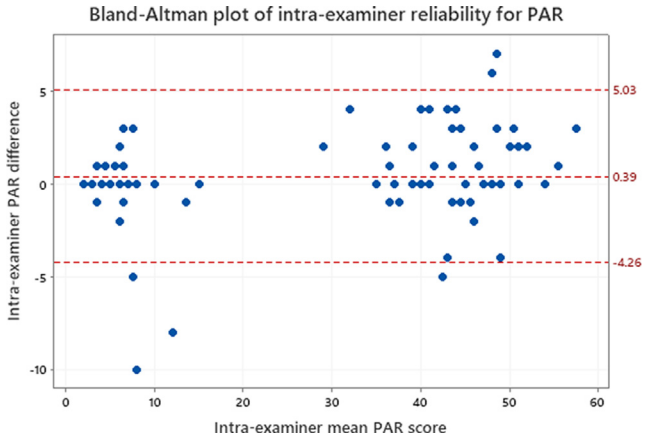

Fig. 1. Bland-Altman plot of intra-examiner reliability for peer-assessment rating (PAR) scores. Mean differences and the 95% limits of agreement are shown with dashed lines.

consecutive patients, Almutairi et al[13] found 99% to be 'improved', and 82% to be 'greatly improved', while O'Brien et al[1] reported a mean reduction of 72%, in a prospective study of 71 cases. Jeremiah et al[14] found a 90.6% reduction, in a retrospective study of 108 patients, and similar results were reported from a retrospective study of 73 patients, by Cartwright et al.[15]

The few studies that have compared occlusal outcomes for OFA and SFA cases, have focused on basic features, such as overjet, overbite, and incisor inclination. The results of pooled data, reported by Yang et al[9] from two studies,[16] showed post-treatment overbite to be significantly smaller in OFA patients, while others have found no significant differences.[16,17] Kwon et al found the overjet and overbite to be normal, in a sample consisting solely of SFA cases.[18]

There is a lack of studies comprehensively assessing occlusal correction for SFA patients, with only Liao et al using PAR (with North American Weighting) on Taiwanese subjects and finding mean reductions of 88% and 92% for SFA and OFA groups, respectively.[19] No published study, to our knowledge, has yet compared occlusal outcomes for SFA and OFA patients, using UK weighted PAR. The aims of this retrospective cohort study, therefore, were to compare the treatment durations, number of outpatient appointments required, and pre- and post-treatment PAR scores, for an SFA and OFA group of class III patients.

Subjects and methods

This retrospective study compared two groups of orthognathic patients; one treated using the SFA, and the other using the OFA. Clinical records were assessed, including pre-and post-treatment dental models. All patients were managed by a single multi-disciplinary team in a UK university hospital. Approval was obtained from the local clinical governance committee. The study was limited to patients with maxillary deficiency, corrected using Le Fort I osteotomy. Craniofacial syndromes, cleft deformities, and segmental

Fig. 2. Surgery-first approach: preoperative facial and occlusal views.

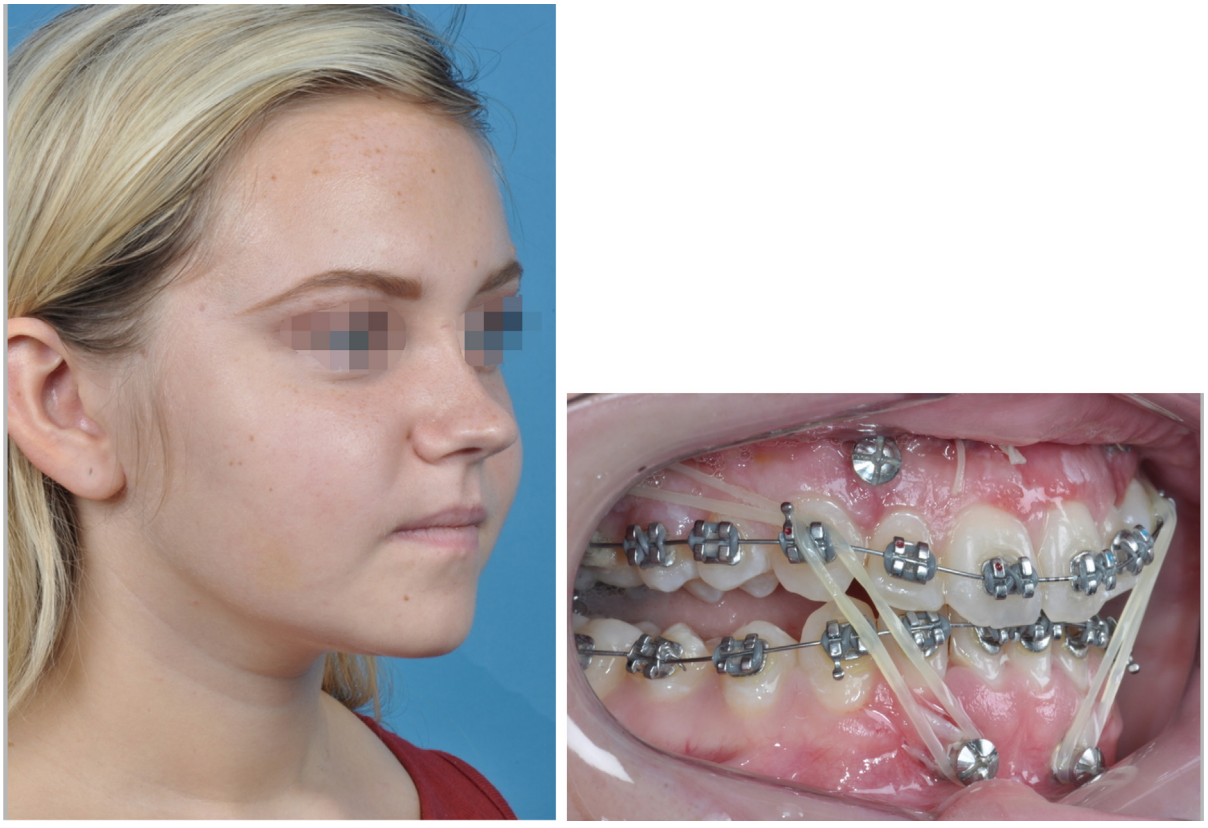

Fig. 3. Surgery-first approach: immediate postoperative facial and occlusal views.

osteotomies were excluded. Occlusal wafers were used as surgical guides for the antero-posterior and medio-lateral surgical movements. Vertical movements were measured during surgery using internal bony reference markers and an external (nasal) K-wire.

The SFA and OFA groups consisted of 20 and 23 patients, respectively. In all cases, the maxilla was advanced by at least 4mm. For the OFA patients, presurgical orthodontic treatment was carried out to align, level, decompensate, and coordinate the dental arches, with appointment intervals of 6-8 weeks. For the SFA patients, orthodontic appliances were placed immediately before surgery. Postoperatively, for both groups, weekly or bi-weekly outpatient appointments were required during the immediate healing phase (6-8 weeks), reducing to approximately 4-weekly thereafter. Treatment duration was defined as the period, in days, between the placement and removal of orthodontic appliances. The number of orthodontic outpatient appointments was counted over the duration of active treatment.

Occlusal quality was assessed, using the PAR index (UK weighting), by one independent, calibrated, blinded examiner on pre- and post-treatment study models. All scorings were repeated after an interval of at least one week to assess intra-examiner reliability. Data distribution was assessed using Shapiro-Wilk and Kolmogorov-Smirnov tests, with intra-examiner reliability being assessed using Bland Altman plots, mean score differences, and 95% limits of agreement. The Mann Whitney U test was applied for all comparisons, due to the non-normal distribution of the data. Data analysis was performed using IBM SPSS Statistics version 26.0 and Minitab version 19 statistical software.

Results

The mean ages were 27.7 years (range 17-47 years) for the SFA group, and 22.4 years (range 17-50 years) for the OFA group. The mean (SD) anteroposterior surgical movements were 7.4mm (2.0) for the SFA group and 6.3mm (1.6) for the OFA group.

The mean (range) overall treatment durations were 11.6 (4.5–32) months for the SFA group, and 35.1 (16.5–77.4) months for the OFA group, which was statistically significant ($p < 0.001$). Four subjects in the OFA group, and five in the SFA group, had extractions as part of treatment. Within the SFA group only, the median treatment duration for the extraction sub-group (13.6 months), was found to be significantly longer ($p = 0.044$) than for the non-extraction sub-group (9.8 months). The mean number of outpatient appointments for the completion of treatment was 14 for the SFA group and 24 for the OFA group, which was significantly different ($p < 0.001$).

Intra-examiner reliability between first and second PAR scorings was assessed from the mean difference and 95% limit of agreement. The mean (SD) difference was 0.39 (2.37), which was within the acceptable range of <2 PAR points, and the 95% limit of agreement was +/− 4.64 PAR

points, which was within the clinically acceptable level of agreement of +/− 12 PAR points, as described by Brown and Richmond,[20] with 9% of pairs falling outside +/− 2 of the mean difference (Fig. 1). However, as PAR scores were performed by only one examiner, they could be subject to bias and open to a type 1 error.

The median pre-treatment PAR scores were 45.0 for the OFA group, and 44.0 for the SFA group, while the median post-treatment PAR scores were 5.0 for the OFA group, and 4.0 for the SFA group (Table 1). The median absolute PAR reductions were 40 for the SFA group and 39 for the OFA group, while the median percentage PAR reductions were 90% for the SFA group and 88% for the OFA group. None of these showed a statistically significant difference between the groups and all cases were 'greatly improved' using the PAR nomogram.

Figures 2–4 show the facial appearance and the occlusion of one of the SFA cases before surgery, immediately following surgery, and at the completion of treatment.

Discussion

The reduction in treatment duration for the SFA group in our study was 22.5 months. Others have reported a range of 4.4 to 8.7 months.[12,16,21,22] The systematic review by Yang et al[9] reported a mean reduction of 5.25 months, which was statistically significant. However, they included the study by Ko et al, in which the 'surgery-first' group was treated using a modified OFA approach, and therefore not necessarily comparable.[23]

The OFA can be subject to delays between presurgical orthodontics and the surgery itself. Final planning is required, followed by allocation of a surgery date which sometimes needs to be cancelled and re-scheduled. Importantly, any such delays tend to occur when the patients are at the stage of maximum dental decompensation, which has been shown to cause dissatisfaction.[5,6,24] The seamless nature of the SFA pathway has the advantage that patients waiting for surgery are not yet in treatment. The systematic review by Barone et al confirms the shorter duration of SFA treatment and supports the improvement in quality of life due to the immediate facial correction.[25] This agrees with the findings of our previous study.[6]

For OFA patients, O'Brien et al,[1] and Jeremiah et al,[14] reported mean appointment numbers of 21.3 and 23.0, respectively, which are similar to the 24 found in our study. Alfaro et al[21] reported a mean number of 22 appointments, at 1.8-week intervals, while Uribe et al[26] reported 13.8, at 3-week intervals. It has been suggested that more frequent appointments are necessary to cope with the more rapid tooth movement that occurs in SFA patients.[21,26,27] However, it is difficult to estimate how much the shorter duration of SFA treatment is attributable to biological effects, as opposed to more frequent appointments.

The shorter treatment durations achieved with the SFA are only of value if they result in clinical outcomes that are at least equivalent to those achieved with the OFA. In our study, all cases were 'greatly improved', using the PAR nomogram, which compares favourably with the results for OFA patients reported in other studies.[1,13,14] For both the SFA and OFA groups in this study, the proportion of cases finishing with unacceptably high post-treatment scores compared favourably with other UK studies. One case in our OFA group had a post-treatment PAR score of 13, but no cases in the SFA group had a score of >10. These data were not reported by Almutairi et al, except for their maximum post-treatment PAR score of 30.[13] Jeremiah et al reported 13% of cases with post-treatment PAR scores of >10, with a maximum score of 30.[14] Our findings agreed with those of Hoang et al, whose retrospective study found similar clinical outcomes for both SFA and OFA patients.[28]

The composition of our patient groups differed from those in other studies, which included Class I, II, and III malocclusions, as well as single jaw and bi-maxillary surgery.[1,13–15] However, they can serve as a benchmark for comparison and in this respect both our OFA and SFA groups demonstrated a high standard of occlusal improvement and outcome. The results of our study suggest that there is no occlusal detriment in using the SFA to treat suitable Class III patients, with Le Fort I maxillary advancement only.

There is no consensus in the literature regarding the suitability of patients for the SFA, with some authors suggesting that only non-extraction cases, without severe incisor proclination or retroclination, and no more than mild to moderate curves of Spee, or transverse discrepancies, are manageable.[29,30] In our study, patients were accepted for the SFA if their dental casts demonstrated reasonable arch coordination, with no more than mild transverse discrepancies or curves of Spee on the upper arch. Extractions were carried out in four cases in the OFA group, and in five cases in the SFA group. Extraction-based treatment would be expected to take longer and could have been a confounding factor in the duration of treatment, particularly if it was more common in the OFA group. However, that was not the case in our

Table 1
Pre-treatment and post-treatment peer-assessment rating scores for the surgery-first and orthodontic-first groups, as well as the absolute and percentage peer-assessment rating score reductions. Data are number unless otherwise indicated.

Variable	Median	SD	Range	p value
Pre-treatment PAR:				0.718
OFA	45	7.2	30-59	
SFA	44	7.7	15-54	
Post-treatment PAR:				0.156
OFA	5	2.5	2–13	
SFA	4	2.0	2–8	
Absolute PAR reduction:				0.942
OFA	39	7.0	27–52	
SFA	40	3.8	32–47	
Percentage PAR reduction:				0.156
OFA	88	6.0	68–96	
SFA	90	3.6	84–95	

OFA = orthodontics-first approach; SFA = surgery-first approach; PAR = peer-assessment rating score.

Fig. 4. Surgery-first approach: end-of-treatment facial and occlusal views.

study. Jeong et al. studied extraction (13%) and non-extraction (87%) SFA cases, and found mean treatment times of 13.6 and 24.8 months, respectively.[13] Our results showed that extraction cases only took significantly longer in the SFA group (3.8 months), possibly because this increase accounted for a greater proportion of the relatively short overall SFA treatment time.

When planning the SFA cases, the magnitude of maxillary surgical correction required was determined by the morphology of the nasolabial soft tissues, as well as the position of the upper incisors. The patients' understanding of the need for postsurgical orthodontics to improve occlusal contacts was confirmed through the consent process. In our multidisciplinary team, the clinical psychologist takes part in the decision-making process regarding the suitability of patients to proceed with surgery as the first part of their treatment. In units where psychological support is not available, it is essential that the team ensures that the patients fully understand the sequence in which treatment will be carried out, along with an understanding of the aims of each procedure. Although the use of a surgical occlusal wafer is common practice in OFA cases, it is not always essential since the planned postsurgical occlusion is often well enough interdigitated to act as a surgical guide. However, in SFA cases, where no presurgical tooth movements have been carried out, the planned occlusion is typically not so accurately fitting, with fewer occlusal contacts, so a carefully manufactured wafer is more critical.

A strong feature of our study is the homogeneity of the sample, which was limited to Class III malocclusions, treated with Le Fort I osteotomy alone. Other studies assessed consecutive cases, regardless of malocclusion type or surgical procedure.[1,14,16] The retrospective nature of this study is an inherent limitation, but no prospective, randomised, controlled trials (RCT) have yet been carried out to compare OFA and SFA patient groups. An RCT, in which all cases were suitable for either approach, would reduce selection bias and the effects of confounding factors. However, to conduct such a trial might be of questionable value and ethics, given the existing evidence for the benefits of the SFA in suitable patients. This study was limited to Class III malocclusions, but other categories of malocclusion can also be treated using the SFA and these would warrant further investigation. This should become more feasible as case numbers increase. This study did not explore the differences in the long-term stability of Le Fort I osteotomy between the two groups, but it could be argued that they should be similar, as the surgical movements of the maxilla were closely matched between the groups, with no statistically significant differences in the quality of the occlusion at the end treatment.

Conclusion

The duration of orthognathic treatment, carried out using the SFA, was significantly shorter compared with the OFA, and

required fewer outpatient appointments. The quality of the occlusal correction was similar for the SFA and OFA, in a cohort of Class III patients treated with Le Fort I osteotomy only.

Ethics statement/confirmation of patients' permission

Approval was obtained from the local clinical governance committee. Patients' permission was obtained.

Conflict of interest

We have no conflicts of interest.

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