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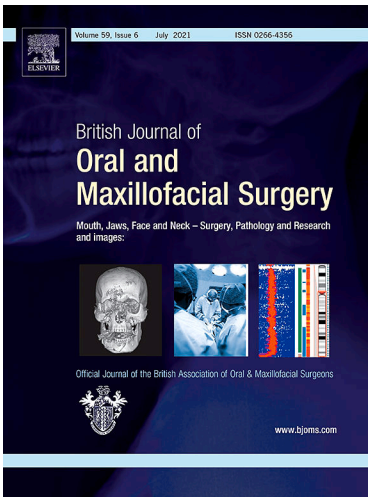

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Philip Benington, M. Anwar, A. Mohan, T. Gillgrass, A. Ayoub

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Outcome measures of the surgery first approach for orthognathic correction of dentofacial deformities.

Philip Benington[a]

M. Anwar[a]

A. Mohan[a]

T. Gillgrass[a]

A. Ayoub[b]

[a]*Dpartment of Orthodontics, Glasgow University Dental Hospital & School/ University of Glasgow, 378*

Sauchiehall Street, Glasgow, G23JZ, United Kingdom

b*Department Oral & Maxillofacial Surgery, Glasgow University Dental Hospital & School/ University of Glasgow, 378 Sauchiehall Street, Glasgow, G23JZ, United Kingdom*

Corresponding author:

Prof. Ashraf F Ayoub

Professor of Oral & Maxillofacial Surgery

Glasgow University Dental Hospital & School

378 Sauchiehall Street

Glasgow G2 3JZ

United Kingdom

Email: ashraf.ayoub@glasgow.ac.uk

Tel 0044 141 2119701

Mobile 07710413133

Abstract

Background: In the surgery-first approach (SFA) the orthognathic surgery is performed without the need for presurgical orthodontic treatment. **Aim:** This study was aimed at assessing the treatment durations and occlusal outcomes for a consecutive cohort of patients, with a range of dentofacial deformities, who have completed orthognathic treatment using the SFA. **Methodology:** The duration of orthognathic treatment was measured. The overall change in occlusion, and the quality of the final occlusion, were evaluated using the patients' study casts. A single independent, calibrated, operator carried out the occlusal scores, using the validated Peer Assessment Rating (PAR) index. This was repeated to test intra-operator reliability. **Results:** A total of 51 patients completed surgery-first treatment during the study period. The mean age at surgery was 23.3 years. The pre-treatment skeletal jaw relationship was Class III in 39 cases, and Class II in 12 cases. The mean overall treatment duration was 11.7 months (SD = 5.7). The intra-examiner reliability of assessing the occlusion was high. The PAR scores confirmed a significant improvement in the quality of occlusion at the completion of treatment, which compares favourably with previous studies on the conventional orthodontics-first approach. **Conclusion:** The SFA can be effective at correcting both Class 2 and Class 3 malocclusion types with reduced treatment times.

Keywords: Orthognathic; orthodontics; surgery first; osteotomy; deformities.

Introduction

In the surgery-first approach (SFA) to orthognathic treatment, the surgery is performed without the need for presurgical orthodontic treatment. Dental decompensation has traditionally been

considered an essential component of orthognathic surgery, and a move towards carrying out the necessary tooth movements entirely postoperatively represents a paradigm shift in the treatment pathway.

The objectives of pre-surgical orthodontics in the conventional orthodontics-first approach (OFA) are to align, level, and coordinate the dental arches to achieve maximum inter-digitation of the planned post-operative occlusion.[1-3] An accurately fitting occlusion helps to locate the jaws into the planned post-surgical relationship and the degree of incisor decompensation dictates the magnitude of the antero-posterior jaw movement, as well as potentially aiding post-operative stability. However, this approach has the undesirable effect of accentuating the patient's malocclusion and facial dysmorphology, which has been found to reduce quality of life measures in the pre-operative period.[4,5]

In addition, the OFA tends to involve extended treatment times, with orthodontic appliances in place for 18-28 months pre-surgically and 12-24 months post-surgically.[2,3,6] This has been found to result in patient dissatisfaction[7] and increases the risk of iatrogenic tooth damage.[8,9] By contrast, the SFA has been shown to greatly reduce the overall length of treatment.[10,11]

For the SFA to be acceptable, it is important that the quality of occlusions achieved are comparable with those reported for the conventional OFA. Several studies have assessed occlusal outcomes for OFA patients using the Peer Assessment Rating (PAR),[12-15] but there is a lack of studies assessing occlusal outcomes for SFA patients, with only Liao et al. (2010)[16] using PAR (with North American Weighting) on Taiwanese subjects and finding mean reductions of 88% and 92% for SFA and OFA groups respectively. Our own previous study, comparing PAR scores for Class III SFA and OFA patients, found median percentage PAR reductions of 90% and 88% respectively.[11] However, the sample was restricted to patients having Le Fort I maxillary advancement only and did not represent the full range of malocclusions and surgical procedures being treated through our clinic.

Aim of the study

This study was aimed at assessing the treatment durations and occlusal outcomes for a consecutive cohort of patients, with a range of dentofacial deformities, who have completed orthognathic treatment in our unit, using the SFA.

Materials & Methods

Approval for this retrospective service evaluation study was granted by the local Clinical Governance Committee. The subjects were consecutive orthognathic patients who were managed by a single multidisciplinary team in one teaching hospital between 2014 and 2021. Patients with craniofacial syndromes, and/or cleft deformities, were excluded, as well as patients having had previous surgery to the jaws or comprehensive orthodontic treatment. For all patients, the surgical movements were planned using 3D soft tissue prediction software (KLS Martin), and 3D printed occlusal wafers were used as surgical guides. The prediction planning of the postoperative occlusion was determined digitally in conjunction with the dental casts.

The duration of treatment was measured from the day of placement, to the day of removal, of the orthodontic appliances. In all cases, the upper and lower fixed orthodontic appliances were placed within a few days prior to surgery.

The overall change in occlusion, and the quality of the final occlusion, were evaluated using the patients' orthodontically trimmed pre- and post-treatment study casts. A single independent, calibrated, operator carried out the PAR scores, using UK weighting, and scoring was repeated on 30 sets of models a minimum of one week later, to test intra-operator reliability.

Results

A total of 51 patients completed surgery-first treatment during the study period. The mean age at surgery was 23.3 years (range 15 - 47 years), with 38 females and 13 males. The pre-treatment malocclusion was Class 3 in 39 cases and Class 2 in 12 cases. Surgery involved Le Fort 1 osteotomy only in 27 cases (Figure 1), bilateral sagittal split osteotomy only in 12 cases (Figure 2), bi-maxillary surgery in 11 cases, and segmental maxillary osteotomy only in 1 case. Three of the patients had significant facial asymmetries. Orthodontic treatment was carried out on a non-extraction basis in 43 cases and with extractions in 8 cases.

The mean overall treatment duration was 11.7 months (SD = 5.7), with a range of 4.5 - 32 months. The mean number of outpatient orthodontic appointments was 15 (SD = 4), with a range of 8 - 26.

The number of cases for which both pre- and post-treatment study models were available to carry out PAR scores was 43. Intra-examiner reliability between first and second scorings was assessed using Bland Altman plots, mean score differences, and 95% limits of agreement, for 24 cases. The mean difference between first and second scorings was 0.39 (SD = 2.37), which was within the acceptable mean difference of <2 points.[17]

The median preoperative PAR score was 43.5 which ranged from 15 to 57. The median post-treatment score was 5 and ranged from 2 to 15. The median of the absolute reduction was 38 which ranged from 15 to 47. The overall percentage of the improvement of the PAR score was 88% which ranged from 57 to 96.

The PAR data for the whole sample showed that 39 case were 'greatly improved', and 4 cases were 'improved', with no cases being 'worse/no better'. For the cases that were 'improved', one had a post-treatment PAR score of >10, along with three others in the sample. Three of these cases had an absolute PAR reduction of >22 points and therefore were still in the 'greatly improved' category.

Discussion

The findings of this study support the evidence in the literature for the shorter treatment duration of SFA cases in comparison with the OFA. Possible reasons for this are the single phase of postoperative orthodontic treatment, and the reduced resistance to tooth movement from the oro-facial tissues following correction of the skeletal jaw relationship.[18] Other contributing factors may be the reduced masticatory muscle activity and bite force, along with fewer occlusal contacts and interferences, in the immediate post-operative period.[19] Orthodontic tooth movement during the first few months may also be more rapid due to the so-called regional acceleratory phenomenon, owing to the increased cellular and metabolic activity resulting from surgical trauma.[20,21]The mean number of outpatient appointments recorded in our study is broadly in agreement with that found by Uribe et al. (2015)[22], and in close agreement with that of our previous study.[11] This suggests an additional benefit for both patients and clinicians of a reduced number of outpatient appointments, which is potentially accompanied by a cost saving.

Whilst the immediate correction of the jaw discrepancy is a key benefit of the SFA, it has the potential disadvantage of producing a post-surgical "secondary malocclusion", which then requires orthodontic correction.[21-24]The suitability of patients for the SFA in this study depended, to a large extent, on how easily the orthodontist judged the correction of the secondary malocclusion to be, and careful planning between the surgeon and orthodontist was required to agree the soft tissue, skeletal, and occlusal goals. Where the post-operative arch coordination was judged to be inadequate, and the orthodontics too unpredictable, the SFA was rejected in favour of the conventional OFA. Accentuated or asymmetric curves of Spee, particularly on the upper dental arch, transverse discrepancies, excessive occlusal interferences, or the need to separate roots to allow segmental surgical cuts, tended to contra-indicate the SFA. The lack of a well-defined post-surgical occlusion, the perceived unpredictability of the post-surgical orthodontic treatment and the possibility that it might lead to an unsatisfactory orthodontic result, may be a deterrent to the wider adoption of the SFA.

Over the last ten years our multi-disciplinary team has broadened the scope of the inclusion criteria for the SFA. Our current philosophy is that the SFA should be considered for all patients initially, with the exception of those where a limited phase of orthodontic treatment may adequately address their concern. We have found this to be case in some Class II, division 2 patients, where proclination and alignment of their upper incisors has eliminated the need for surgery.

The PAR scores for the cohort of SFA patients in this study compare favourably with those of several other studies of conventional OFA patients. Out of 100 consecutive patients Almutairi et al. (2017)[12] found 99% to be "improved", and 82% to be 'greatly improved', while a mean reduction of 72% has been reported, in a multi-centre prospective study of 71 cases.[13] Jeremiah et al. (2012)[14] found a 90.6% reduction, in a retrospective multi-centre study of 108 patients. Similar results were reported from a retrospective study at Kings College, London, involving 73 patients.[15]In our study, over 90% of the patients were in the "greatly improved" category, with a median post-treatment PAR score of 5.

In the SFA, the post-surgical occlusion tends to be less well interdigitated, with fewer occlusal contacts, than would be expected in OFA patients. This might be expected to adversely affect surgical stability in the early postoperative healing phase, but this is not generally supported by the findings of previous studies,[25.26] as well as a systematic review,[27] although it is acknowledged that further high-quality studies are required for more conclusive evidence. A disadvantage of the SFA is that the light aligning orthodontic arch wires that are in place when the patient undergoes surgery prevent the application of the surgical hooks that are commonly used in OFA cases to facilitate inter-maxillary elastics. Inter-maxillary traction is often important in counteracting surgical relapse, and bone anchorage was used in most cases in this study as a substitute for surgical hooks. Bone screws, or temporary anchorage devices (TADs), have the advantage that they allow traction to be applied directly to the skeletal bases, rather than the teeth. To monitor surgical and occlusal stability in the early postoperative period, the patients in this study were followed up weekly for the first month or so, adjusting the tension and direction of inter-maxillary elastics as required. Orthodontic adjustments were started as soon as comfortable intra-oral access was possible. The patients were seen bi-weekly for a further two months, and then every three to four weeks, until the end of treatment. The TADs were typically removed after around eight weeks once full healing had occurred. Intermaxillary elastic wear was continued between the fixed appliances to assist orthodontic tooth movement, where necessary, once rectangular arch wires were in place.

This study provides the largest assessment of patients treated with the surgery-first approach, using the PAR index, with UK weighting, and including all malocclusion groups. The retrospective nature of the study was a limitation, in that some patients' study casts were missing and so could not be scored. Also, the suitability of the patients for the SFA was judged subjectively, based on the clinical experience of the orthodontist, and no matched group of OFA patients was available for comparison.

Whilst the orthodontics-first approach to orthognathic treatment is widely practised, the SFA increasingly shows the potential to benefit suitable patients. The sharing of experiences between clinical teams with an interest in the approach would help to refine the technique and could lead to larger multi-centre studies. The establishment of national guidelines would be beneficial to more clearly define the suitability criteria, and limitations, of the approach. It is debatable if a prospective randomised study should be considered to compare SFA with the conventional OFA for patients who are suitable for both approaches, since it could be considered unethical to offer the OFA in cases which would clearly benefit from the shortened treatment duration, and reduced anxiety, that the SFA offers.

Conclusions

The duration of treatment found for this cohort of surgery-first orthognathic patients was considerably shorter in comparison to those published for conventional orthodontics-first patients. The standard of occlusal outcomes was satisfactory and compared favourably with that of previous studies. The SFA was found to be effective in the correction of both Class II and Class III malocclusions in suitable patients.

Conflict of Interest

No conflict of interest

Ethics statement/confirmation of patient permission

Local approval for this study was obtained. Patient permission obtained

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Legends of the figures

Figure 1. Pretreatment intraoral photograph of one of the class III cases which had mandibular set back surgery

Figure 2 shows the immediate postsurgical occlusion of the same case

Figure **3** shows the post-treatment results.

Figure 4. Pretreatment intraoral photograph of one the class II cases which had bilateral sagittal split mandibular advancement

Figure 5 shows the immediate postsurgical occlusion of the same case

Figure 6 shows the post-treatment results.