Original Article

Influence of single-jaw surgery vs bimaxillary surgery on the outcome and duration of combined orthodontic-surgical treatment

Ian Arad[a]; Jasveer Jandu[a]; Paul Bassett[b]; Padhraig S. Fleming[c]

ABSTRACT

Objective: To analyze the effects of single-jaw surgery (mandible or maxilla only) vs bimaxillary surgery on final peer assessment rating (PAR) score outcome and overall treatment duration.

Materials and Methods: Treatment records of 63 consecutively treated orthognathic patients were assessed; 41 underwent bimaxillary procedures, and the remainder single-jaw procedures. All treatment was undertaken at Kent and Canterbury Hospital in the United Kingdom. Demographic characteristics and clinical parameters, including treatment duration, number of visits required, initial and final PAR scores, and number of extractions undertaken, were recorded.

Results: The mean treatment time was 30.6 months; treatment time was shortest in the maxillary procedure only group. The mean reduction in percentage PAR score was 77%, with an average final score of 9. Linear regression analysis confirmed that procedure type had no influence on final PAR score ($P = .62$) or on overall treatment duration after adjustment for extractions and initial PAR score as confounders ($P = .47$).

Conclusions: No significant difference was noted in treatment duration or in occlusal outcome between single- and double-jaw surgeries. (*Angle Orthod.* 2011;81:983–987.)

KEY WORDS: Orthognathic; Outcome; Orthodontic; Duration; Osteotomy

INTRODUCTION

Orthognathic procedures are being prescribed with increasing frequency to address malocclusion with a significant skeletal component.[1] This trend reflects a growing emphasis on dental and facial esthetics, with greater uptake in females.[2] In addition, orthognathic outcomes are becoming more predictable, morbidity is less, and inpatient stays are shorter[1]; intermaxillary fixation has been largely superseded by rigid internal fixation, permitting an earlier return of masticatory function. Levels of satisfaction with orthognathic procedures are generally high, and significant improvement in oral health–related quality of life is typical.

[a] Senior House Officer, Department of Orthodontics and Maxillofacial Surgery, Kent and Canterbury Hospital, Kent, United Kingdom.

[b] Medical Statistician, Kent and Canterbury Hospital, Kent, United Kingdom.

[c] Locum Consultant, Royal London Dental Institute, London, United Kingdom; Kent and Canterbury Hospital, Kent, United Kingdom.

Corresponding author: Dr Padhraig S. Fleming, Royal London Dental Institute, Whitechapel, London E1 1BB, United Kingdom (e-mail: padhraig.fleming@gmail.com)

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The surgical cost alone of combined care is estimated to be in excess of 5000 British pounds.[3] Therefore, achievement of optimal results is important to provide a cost-effective service. Both patient-centered and objective assessment of combined care may be undertaken. The peer assessment rating (PAR) provides a valid and reproducible[4–6] objective assessment of the success of orthodontic treatment in isolation and has been applied to assess the quality of occlusal outcome following combined treatment.[7–10]

The duration of combined treatment has typically been estimated at 2 years or longer.[7–9] Indeed, O'Brien et al.[7] in a prospective investigation highlighted that mean treatment duration may approach 3 years, with a mean time of 33 months reported.[7] Extended treatment duration is known to reduce cooperation and satisfaction, and to amplify the potential for deleterious effects, including root resorption and decalcification.

The cost,[4] complexity, inaccuracy, and morbidity associated with bimaxillary procedures exceed those associated with single-jaw surgery. Nevertheless, the use of double-jaw procedures is often necessary to achieve ideal facial harmony and stability and to produce an ideal dental occlusion. Therefore, the aims of this retrospective study were to assess the impact of single- versus double-jaw surgery on occlusal outcomes and treatment duration.

Table 1. Demographic and Clinical Characteristics of the Sample

Group	Maxilla Only	Mandible Only	Bimaxillary Surgery	Overall
Number (%)	5 (7.9)	17 (27)	41 (65.1)	63
Age, y	18.6 (4.98)	22.25 (6.69)	21.95 (7.71)	21.35 (7.46)
Gender	Male = Female =	Male = Female =	Male = Female =	Male = 19 Female = 44
Malocclusion type	Class II div 1: 3 Class II div 2: 0 Class III: 2	Class II div 1: 8 Class II div 2: 4 Class III: 5	Class II div 1: 9 Class II div 2: 1 Class III: 31	Class II div 1: 20 Class II div 2: 5 Class III: 38
Patients having extractions, n	0	2	2	4
Treatment time, y	2.12 (1.03)	2.7 (0.91)	2.53 (0.98)	2.55 (0.97)
Number of visits	21.6 (5.95)	27.82 (6.16)	25.93 (6.74)	26.11 (6.78)
Initial PAR score	32.6 (9.91)	38.24 (9.4)	44.07 (8.44)	41.58 (9.03)
Final PAR score	9.6 (5.77)	7.7 (4.21)	8.9 (5.06)	8.63 (4.91)
% PAR decrease	63.7 (36.56)	79.5 (10.29)	77.53 (15.04)	77.01 (16.81)

Numbers in brackets are Standard Deviations. The breakdown of males and females is as follows: Maxilla only- 4 Females and 1 male. Mandible only- 11 Females and 6 Males. Bimaxillary surgery- 29 Females and 12 Males.

MATERIALS AND METHODS

Based on a previous prospective study[7] demonstrating a mean treatment time of 32.8 months (standard deviation [SD], 11.3 months), a total of 54 patients were required to demonstrate a clinically meaningful difference of 3 months in treatment duration with a power of 80% and an α of .05. Sixty-three patients who had received combined orthodontic-surgical treatment were identified within the maxillofacial unit at East Kent University Hospitals Foundation Trust. Selection commenced in April 2010 and continued until December 2010. Inclusion criteria were as follows: (1) patients having a significant severe skeletal malocclusion requiring both orthodontic treatment and orthognathic surgery, (2) patients receiving all treatment at East Kent University Hospitals Foundation Trust, and (3) treatment not provided for correction of congenital birth defect or posttraumatic reconstruction. Subjects were excluded from the study if they had cleft lip and/or palate or other craniofacial anomaly; were taking medications; or had undergone previous orthognathic treatment.

Orthodontic treatment was carried out by seven clinicians (three consultant orthodontists and four specialist registrars) within the department, and the surgical procedures by one of four maxillofacial surgeons. All 63 pretreatment and posttreatment study models were PAR scored by one of two orthodontic technicians.

Absolute and percentage PAR score reductions and final PAR scores were calculated. Total treatment time was recorded from initial placement of the fixed orthodontic appliance until its removal. All data were entered into an Excel spreadsheet for analysis. The type of surgery performed on each patient was noted, together with the patient's age at the start of treatment and the requirement for extractions with the exception of third molars. Data for final PAR score and treatment duration were normally distributed. Therefore, the influence of surgical procedure (maxillary procedure only, mandibular procedure only, or bimaxillary surgery) on final PAR score and on treatment duration was assessed using linear regression analysis.

RESULTS

A total of 63 patients satisfied the inclusion criteria, including 19 males (30%) and 44 females (70%) with an average age of 21.35 years (range, 14–46 years). Of the 63 patients, 20 (31.7%) had Class II division 1 malocclusions, 5 (7.9%) had Class II division 2 malocclusions, and 38 (60.3%) had Class III malocclusions (Table 1).

Most patients underwent a bimaxillary procedure (65%). Five patients had a maxillary procedure in isolation, and 17 patients had a mandibular procedure only. Of those undergoing mandibular surgery in isolation, five had isolated mandibular setback and 12 underwent a mandibular advancement procedure. Extractions were undertaken as part of combined care in four cases. Mean treatment time was 2.55 years (30.6 months) overall, necessitating a mean of 26.11 patient visits. Treatment time was shortest in those undergoing a Le Fort I procedure in isolation, with bimaxillary surgery requiring 2.53 years of treatment on average.

Forty-eight patients (76.2%) experienced PAR score reduction in excess of 70%, placing them in the greatly improved category of the PAR nomogram. Overall mean beginning and ending treatment PAR scores were 38 and 9, respectively, with a mean percentage PAR score reduction of 77%. PAR score reduction as a function of the surgical procedure is given in Table 2.

Regression analysis suggested that procedure type had no influence on final PAR score in the unadjusted

Table 2. PAR Score Changes With Specific Procedures[a]

Procedure	Mean Start PAR	Mean End PAR	Mean PAR Improvement, %	% of Subjects With Improvement >70%
BSSO only	39.4	9.4	76	100
FSSO only	37.75	7	80.9	75
LeFort I only	32.6	9.6	63.7	60
Bimaxillary surgery	44.08	8.9	77.5	71

[a] BSSO indicates Backward-sliding Sagittal Osteotomy; FSSO, Forward-sliding Sagittal Osteotomy; PAR, Peer Assessment Rating.

model ($P = .62$) and following adjustment for extractions and initial PAR score (Figure 1 and Table 3; $P = .65$). Likewise, treatment duration was found to be independent of the type of surgical procedure undertaken in an unadjusted linear regression model ($P = .49$) and after extractions were treated as a confounding variable (Table 4; $P = .47$).

DISCUSSION

The mean duration of 2.55 years (30.6 months) for combined orthodontic-surgical treatment overall highlighted in this research is compatible with previous retrospective investigations. In particular, Ponduri et al.[8] reported a mean duration of 32.8 months. However, in a Norwegian investigation, the mean treatment duration was considerably shorter at 21.9 months overall.[10] The mean postsurgical duration was 5.9 months in the latter study. Conversely, a randomized controlled trial demonstrated more prolonged treatment of almost 33 months.[7] This finding was attributed to selection bias related to retrospective research and the possibility for geographic variation in treatment duration. Selection bias in this study was avoided by including consecutive cases from an orthognathic database of completed cases. Nevertheless, cases failing to complete treatment may inadvertently have been omitted, artificially improving the results of this study. Therefore, with the exception of subjects undergoing a maxillary procedure in isolation, the progress of treatment was slower than that traditionally quoted. Our results, therefore, support the contention that clinicians may be overly optimistic in relation to their estimation of treatment length in combined cases.[7]

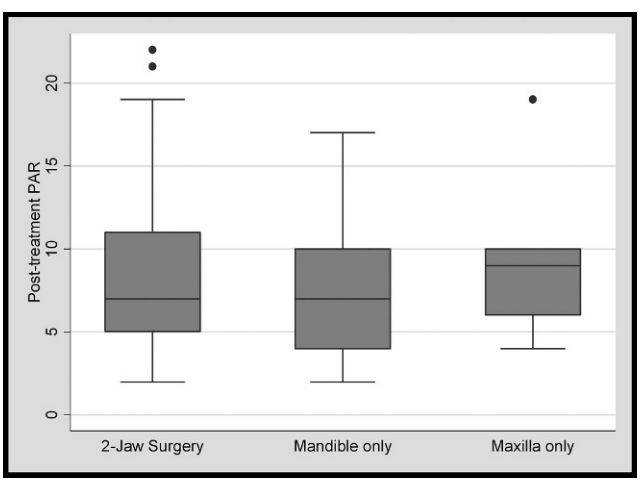

Figure 1. Box and whisker plot of final peer assessment rating (PAR) score with bimaxillary surgery and maxillary and mandibular surgery in isolation.

No statistical difference was demonstrated with respect to treatment duration and surgical procedure. Although treatment involving isolated maxillary surgery lasted just in excess of 2 years, treatment involving both mandibular surgery in isolation and bimaxillary surgery required up to 3 years. This finding reveals no difference with respect to surgical procedures; however, differences may have been obscured by an inadequate sample size (only five isolated maxillary procedures were performed). Hence, the study may have been inadequately powered to demonstrate a statistically significant difference. Further research into this question may be enhanced by a greater sample size.

Other factors with the potential to influence the duration of orthodontic and orthognathic treatment include age, gender, extractions, and treating clinician. A retrospective study by Luther et al.[9] highlighted that the duration of the preoperative phase of orthodontics may be influenced by the orthodontist; in the present study, all patients were treated or supervised by qualified specialists who had attained equivalent levels of training. Previous research demonstrated that age and gender have little impact on treatment duration.[9] Therefore, these items were omitted from the statistical analysis. Because extraction-based treatment is known to extend the treatment duration,[11] it was included as a potential confounding variable. However, extractions were found to have little influence on treatment duration; this may reflect the low extraction rate in our sample.

The overall results of this study reflect a high standard of care with a mean PAR percentage improvement of 77%. Just one patient fell within the ''worse, or no improvement'' category. However, because only outcomes of completed cases were assessed in this study, subjects abandoning treatment before the time of surgery may have been omitted from the retrospective data.

Table 3. Influence of Surgery Type on Final Occlusal Outcome

Extraction Adjustment	Group	Mean (SD)	Adjusted Mean	Difference Mean (95% CI)	*P* Value
Unadjusted	Two-jaw surgery	8.9 (5.1)	9.0	0	
	Mandible only	7.1 (4.4)	7.6	−1.4 (−4.4, 1.7)	
	Maxilla only	9.6 (5.8)	9.4	0.4 (−4.7, 5.4)	.62
Adjusted	Two-jaw surgery	8.9 (5.1)	8.9	0	
	Mandible only	7.1 (4.4)	7.6	−1.3 (−4.4, 1.8)	
	Maxilla only	9.6 (5.8)	9.3	0.4 (−4.7, 5.5)	.65

All patients undergoing mandibular surgery in isolation had percentage PAR score improvements in excess of 70%. Conversely, two of the five patients who underwent a Le Fort I procedure in isolation failed to attain this degree of improvement. This outcome highlights the limitations of the PAR index in assessment of orthognathic outcomes. In particular, one of the subjects demonstrating no occlusal improvement underwent therapy to address gross vertical maxillary excess. Although a successful surgical result occurred, this was not reflected in the occlusion. Consequently, a more reliable and universal assessment of orthognathic outcomes would be worthwhile. Such an index could account for both occlusal and facial parameters. Furthermore, the PAR index is heavily weighted in favor of addressing sagittal problems; consequently, occlusal changes arising as the result of vertical maxillary repositioning may be obscured.

A well-intercuspated final occlusion may promote prolonged stability of orthodontic treatment[12]; excellent occlusal results are reflected in PAR scores lower than 10. In the present study, the mean final PAR score following maxillary surgery in isolation was 9.6, which was marginally higher than that reported with bimaxillary procedures and mandibular surgery in isolation. This difference may reflect the difficulty involved in achieving a well-interdigitated occlusion following single-jaw procedures, and the inaccuracy inherent in predicting mandibular autorotation. Nevertheless, with minor differences between the final results, this finding supports the use of single-jaw surgery in isolation in cases where either single- or double-jaw surgery was considered appropriate.

The present study shows that little difference in treatment outcome or duration is likely with single- or double-jaw surgery; however, further prospective research with greater sample sizes would be required to confirm this impression. Nevertheless, on the basis of this research, it appears that prescription of single-jaw surgery is unlikely to result in occlusal compromise or an increase in treatment duration. However, this approach will reduce surgical costs and morbidity.

CONCLUSIONS

- No significant difference in treatment duration or occlusal outcome was noted between single- and double-jaw surgeries.

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Table 4. Adjusted and Unadjusted Linear Regression Models and the Influence of Surgery Type on Treatment Duration

		Unadjusted		Adjusted for Extractions	
Group	Mean (SD)	Difference (95% CI)	*P* Value	Difference (95% CI)	*P* Value
Two-jaw Surgery	2.5 (1.0)	0		0	
Mandible only	2.7 (0.9)	0.2 (−0.4, 0.7)		0.2 (−0.4, 0.8)	
Maxilla only	2.1 (1.0)	−0.4 (−1.3, 0.5)	.49	−0.4 (−1.4, 0.5)	.47

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