

Quality of Life Treatment Outcomes of Class III Skeletal Patients After Bimaxillary Osteotomies

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ABSTRACT

Introduction: Bimaxillary osteotomies are commonly done to correct dentofacial deformities. Osteotomy at the LeFort I level and bilateral sagittal split osteotomy (BSSO) are commonly used in combination to treat patients with Class III skeletal dentofacial deformities. However, few studies are available which assess the treatment outcome measured in terms of quality of life (QoL) of Class III skeletal patients after bimaxillary osteotomies. This study aims to evaluate the long-term benefits of bimaxillary osteotomies, measured in terms of QoL outcomes of Class III skeletal patients at two (2) years post-surgery.

Methods: This study was conducted at the National Dental Centre Singapore and selected patients were given 2 questionnaires each based on Oral Health Impact Profile (OHIP-14) and Orthognathic Quality of Life Questionnaire (OQLQ). The patients were told to report each question using a Likert-type scale and their perception for each question before and after surgery.

Results: A total of 41 patients were recruited in this study, of which 23 were males and 18 were females. Their age ranged from 17 to 32 years old at the time of surgery and the median age was 20 years 2 months. All the patients in this study were Chinese. All the patients underwent LeFort I maxillary procedure in addition to BSSO setback surgery. The Wilcoxon Signed Rank test was used for evaluation of the statistics. There were significant changes to both OHIP-14 and OQLQ scores ($p < 0.001$) two-years post-operatively. All the OHIP-14 domains, functional limitation ($p < 0.001$), physical pain ($p < 0.001$), psychological discomfort ($p < 0.001$), physical disability ($p = 0.001$), social disability ($p < 0.001$) and handicap ($p < 0.001$), were significantly decreased when compared to pre-surgical scores. The OQLQ domain scores, social aspects of deformity ($p < 0.001$), facial aesthetics ($p < 0.001$), oral function ($p < 0.001$), and awareness of facial deformity ($p = 0.013$), were also significantly lower two-years post-operatively.

Conclusion: Treatment outcomes measured in terms of QoL were significantly improved in Class III skeletal patients after bimaxillary osteotomies. The function, psychosocial and facial aesthetics improved significantly after surgery and these aspects continued well into two-years post-surgery. The inclusion of QoL as a routine treatment outcome measure in orthognathic surgery would be beneficial in clinical profiling of patients, decision making and evaluating the efficacy of the procedure. It could potentially be used to evaluate surgical complications, arising from orthognathic surgery, and its impact on QoL in patients. More studies would be required to establish its correlation in the future.

Keywords: Dental, Facial, Jaws, Prognathism

INTRODUCTION

Bimaxillary osteotomies are commonly done to correct dentofacial deformities. Osteotomy at the LeFort I level is a common surgical technique employed for the correction of maxillary deformities. Bilateral sagittal split osteotomy (BSSO) is a versatile surgical procedure commonly used in orthognathic surgery to treat patients with mandibular deformities. This procedure allows correction

of prognathism, retrognathism, asymmetry, limited superior and inferior repositioning of the mandible. It is clear that orthognathic surgery, in general, would benefit patients with severe malocclusion associated with skeletal discrepancies leading to the improvement in function and appearance. This surgical correction has a large impact on the physical and psychosocial aspects of the patient and consequently leads

to an improvement of their quality of life (QoL)¹⁻³. This is especially true in Class III skeletal patients who present with a hyperplastic maxilla and hyperplastic mandible. This gives rise to a concave facial profile and disproportionate facial appearance leading to functional, aesthetics and psychosocial problems.

However, the use of BSSO technique has been controversial for the correction of mandibular prognathism in Class III skeletal patients which affects about 22.4% of Singapore's population⁴. The controversy stems from the fact that some surgeons discourage the use of the BSSO due to the risk of damaging the inferior alveolar nerve, which runs within the body of the mandible, resulting in long-term neurosensory disturbances to the lip and chin, and may affect the QoL of the patient in the long-term⁵.

The use of quality of life as a measure of well-being in patients undergoing orthognathic surgeries has been gaining interest in recent years. Quality of life can be used as a discriminatory tool to identify patients with or without dentofacial deformities⁶. It can also be used as a tool to monitor the course of patient's recovery when QoL instruments are administered pre-operatively and post-operatively. Most QoL studies done with regards to orthognathic surgeries are not specific, the samples in these studies comprise of different variables such as different patient profiles, dentofacial deformities and surgical techniques, and few studies were done to monitor exclusively, the long-term benefits of mandibular setback surgery using the BSSO technique in these patients^{2,7,8}. This study aims to evaluate the long-term benefits of bimaxillary osteotomies, measured in terms of QoL outcomes of Class III skeletal patients at two years post-surgery. The null hypothesis in this study is that bimaxillary surgery does not improve Orthognathic Quality of Life Questionnaire (OQLQ) scores after two years post-surgery.

METHODS

This study was approved by the SingHealth Centralised Institutional Review Board (CIRB) and conducted in the National Dental Centre Singapore (NDCS).

The inclusion criteria for this study include:

1. Subjects between the age group of 17–55 years.
2. Pre- and post-surgical orthodontics done in National Dental Centre Singapore.
3. Subjects with Skeletal Class III relationship who underwent LeFort I osteotomy and mandibular setback procedure using BSSO.
4. Informed consent to participate in the study.

Exclusion criteria include:

1. Pre-existing genetic syndromes or congenital deformities.
2. History of previous orthognathic surgeries.
3. Concurrent segmental osteotomies or genioplasties.
4. Pre-existing or repaired cleft lip and/or palate.
5. Pre-existing neurosensory deficit of the mental and/or lingual nerves prior to orthognathic surgery.
6. History of maxillary and/or mandibular fracture or pathology.
7. Women planning to conceive or pregnant women.

A letter of participation to surgeons was given to all oral & maxillofacial surgeons in NDCS. All the surgeons agreed to participate in the study. The names of patients who had mandibular setback done between 18 to 30 months ago were identified. This was done by searching through operating theatre registers in Singapore General Hospital and Changi General Hospital. Shortlisted subjects' particulars were retrieved from the Medical Records Office in NDCS and checked against the inclusion and exclusion criteria.

Shortlisted patients were contacted via phone and verbal consents were taken. An appointment

letter was sent to each patient. Study details were explained and written consent taken on the appointment visit. Parental consent was obtained from patients under the age of 21.

Patients were recalled at two years post-surgery. Each patient was given a set of two questionnaires, Oral Health Impact Profile (OHIP-14) and Orthognathic Quality of Life Questionnaire (OQLQ) on the study appointment⁹⁻¹².

The OHIP-14 is a subset of the 49-question Oral Health Impact Profile (OHIP-49). The OHIP-14, like its predecessor, measures people's perception of the impact of oral health conditions on their well-being^{9,10}. It contains 14 items separated into seven domains, namely functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. Each item is qualified with a Likert-type scale which grades 0 = 'never', 1 = 'hardly ever', 2 = 'occasionally', 3 = 'fairly often' and 4 = 'very often'. The minimum score in OHIP-14 is 0, indicating no impact, and the maximum score being 56, indicating worst impact to QoL. Each domain is represented by two items. The minimum score for each domain is thus 0 and maximum is 8 (Appendix A).

The OQLQ was developed to measure the QoL in patients with severe dentofacial deformity seeking orthognathic surgery^{11,12}. The questionnaire contains 22 items, separated into four domains, namely facial aesthetics, oral function, awareness of dentofacial aesthetics and social aspects of dentofacial deformity. Each item is scored on a 4-point scale, where 1 indicates "bothers you a little", 4 = "bothers you a lot", 2 and 3 = "between these statements". A 0 score is given if the statement "does not apply or does not bother". The maximum score that can be obtained is 88, indicating a large impact to the patient's QoL. The minimum score is 0 and indicates no or minimal impact to the QoL. Unlike OHIP-14, the domains are

represented by different number of items. Facial aesthetics and oral function are represented by five items each, giving a score from 0 to 20. Awareness of dentofacial aesthetics is represented by four items with a score from 0 to 16 and social aspects of dentofacial deformity is represented by eight items, giving a score from 0 to 32 (Appendix B).

Patients were required to answer according to how they perceived themselves before and two years after orthognathic surgery.

Data Analysis

The collective and domain scores for OHIP-14 and OQLQ were obtained and analysed according to their respective scoring algorithm. The power of the study was calculated using OQLQ as reference. The scores before and after surgery were compared using the Wilcoxon Signed Rank Test.

RESULTS

A total of 277 patients underwent orthognathic surgery from January 2006 to December 2008. A hundred and fourteen patients met both the inclusion and exclusion criteria, and 41 patients consented to participate in the study. Out of the 41 subjects, 23 were males (56.1%) and 18 were females (43.9%). All forty-one of the subjects were of Chinese descent (100%). Their age ranged from 17 to 35 years old at the time of surgery, the median age was 20 years 2 months.

The follow-up visits were conducted between 21 months and 27 months post-surgery. All the subjects underwent both LeFort I maxillary osteotomy and mandibular BSSO setback surgery. Patient-characteristics are shown in Table 1.

The analysis revealed that the statistical power of this study exceeded 0.99 thus we reject the null hypothesis that bimaxillary surgery does not improve OQLQ scores after two years post-surgery. Mean score for OHIP-14 before surgery was 15.83

Table 1. Patient characteristics.

No. of subjects	41			
Gender	Males: 23 (56.1%)		Females: 18 (43.9%)	
Ethnicity	Chinese: 41 (100.0%)	Malay: 0 (0.0%)	Indian: 0 (0%)	Others: 0 (0.0%)
Age at surgery	Minimum: 17 yrs 3 mths		Maximum: 32 yrs 7 mths	
Bimaxillary procedures	41 (100.0%)			
No. of months post-surgery at time of review	Minimum: 21		Maximum: 27	

Table 2. Domain scores for OHIP-14.

OHIP-14	Functional Limitation		Physical Pain		Psychological Discomfort		Physical Disability		Psychological Disability		Social Disability		Handicap	
	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery
N	41	41	41	41	41	41	41	41	41	41	41	41	41	41
Median	2.00	1.00	2.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	2.00	0.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	5.00	4.00	7.00	4.00	8.00	5.00	8.00	3.00	8.00	3.00	7.00	3.00	6.00	3.00
P value	P < 0.001		P < 0.001		P < 0.001		P = 0.001		P < 0.001		P < 0.001		P < 0.001	

The median OHIP-14 functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap scores after surgery were significantly lower than their respective median OHIP-14 domain scores ($p < 0.001$, $p = 0.001$, Wilcoxon Signed Rank test).

from a possible maximum of 56. The minimum score obtained in the survey was 0 and the maximum was 44. The median OHIP-14 score was 14.00. In contrast, the mean OHIP-14 score two years after surgery was 4.68. The minimum score obtained was 0 and the maximum was 19. The median score after surgery was 3.00. The median OHIP-14 total score after treatment was significantly lower than the median OHIP-14 total score before treatment ($p < 0.001$, Wilcoxon Signed Rank test).

The mean score for OQLQ before surgery was 31.85 from a possible maximum of 88. The minimum score obtained was 1, and the maximum score was 82. The median score before surgery was 28.00. Two years after surgery, the mean score for OQLQ was 13.51. The minimum score obtained from the subjects was 0, and the maximum was 42. The median score was 11.00. The median OQLQ total score after treatment was significantly lower than the median OQLQ total score before treatment ($p < 0.001$, Wilcoxon Signed Rank test).

The median domain scores of both OHIP-14 and OQLQ were compared using Wilcoxon Signed Rank Test. The results are tabulated in Tables 2 and 3 respectively.

DISCUSSION

Various studies have described the benefits of orthognathic surgery especially in patients with Class III skeletal deformity. Pahkala and Kellokoski found that patients that underwent BSSO setback surgery were pleased with the outcome¹³. Another study found that Class III skeletal patients perceived that orthognathic surgery greatly improved their dental appearance, facial appearance and chewing ability. The majority of these patients were graded to be more satisfied with orthognathic surgery

compared to both Class I and Class II skeletal patients. Almost all the Class III patients indicated that they would be willing to make the same decision to undergo the surgery again based on their experiences¹⁴.

Nicodemo *et al.* conducted a study on the effects of orthognathic surgery of class III correction on quality of life measured by the 36-item Short Form Health Survey (SF-36)¹⁵. The study comprised 29 subjects presenting with Angle's Class III malocclusion, and the patients underwent maxillary advancement, mandibular setback or bimaxillary procedures. They found that only physical, and social aspects of their subjects' lives were significantly improved six months post-surgery. This is in contrast to a study conducted by Choi *et al.*⁸.

Choi *et al.* found that the Physical Health Component score of the SF-36 decreased immediately after surgery and started improving six months post orthognathic surgery. In the same study, the OHIP-14 score worsened at six weeks post-surgery although the Mental Health Component score and OQLQ scores improved. The discrepancy may be due to SF-36 being a generic QoL questionnaire which is not condition specific and therefore lacks sensitivity to detect minute changes in QoL⁵. After approximately one year post orthognathic surgery, all the QoL scores of the subjects improved. It was mentioned that dentofacial deformities such as Class II, Class III, asymmetry and other unspecified deformities were all evaluated in the study. However, there was no mention as to which surgical technique was used in the setback of the mandible in Class III skeletal patients which made up almost half the sample size in that study. If the vertical ramus osteotomy (VRO)

Table 3. Domain scores for OQLQ.

OQLQ	Social Aspects of Deformity		Facial Aesthetics		Function		Awareness of Facial Deformity	
	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery	Before Surgery	After Surgery
N	41	41	41	41	41	41	41	41
Median	9.00	3.00	10.00	4.00	6.00	1.00	4.00	3.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	29.00	18.00	20.00	13.00	20.00	8.00	15.00	13.00
p value	<0.001		<0.001		<0.001		0.013	

The median OQLQ social aspects of deformity, facial aesthetics, function and awareness of facial deformity score after surgery were significantly lower than their respective median OQLQ domain scores ($p < 0.001$, $p = 0.013$, Wilcoxon Signed Rank test).

was used in the setback of mandible, the release of intermaxillary fixation (IMF) would coincide with six weeks review interval. With the release of IMF, the patient would probably experience some form of immediate functional and physical limitation and thus leading to a mild increase in OHIP-14 scores. All the QoL scores improved after an optimal period of recovery. In our study, both OHIP-14 and OQLQ were significantly improved at two years post-surgery which is comparable to the results obtained in Choi *et al.*'s study where SF-36, OHIP-14 and OQLQ all improved after one year post-surgery.

In our study, we chose the OHIP-14 and OQLQ because the OHIP-14 is a generic oral health specific questionnaire which has proven sensitive for orthognathic surgery. OQLQ on the other hand is a condition specific QoL questionnaire which was designed and validated for this purpose^{11,12}.

We also chose to evaluate patients at the two-year post-surgery period because the long-term complications associated with the BSSO such as skeletal relapse and neurosensory disturbances would have stabilised. We wanted to observe their impact of long-term complications on QoL. Therefore, the scores for OHIP-14, OQLQ and the various domains were only recorded two years post-surgery and not before. Nonetheless, the results were all significantly improved at two years post-surgery. This is in congruence with studies performed which reported lasting improvement of the patients' QoL¹⁶⁻¹⁸.

The Wilcoxon Signed Ranked test was used for our statistical analysis. This was because our results obtained from both OHIP-14 and OQLQ did not follow a normal distribution. In this study, the normality or homogeneity of variance assumption was violated, thus a non-parametric test was used. The median would be a more appropriate

parameter instead of the mean score as was done in other QoL studies. The subjects in our study experienced a statistically significant improvement in treatment outcome in terms of QoL and their respective domain scores after BSSO setback surgery.

All the cases in our study underwent combined maxillary advancement and BSSO mandibular setback surgery with rigid fixation. Bilateral sagittal split osteotomy and VRO are common surgical procedures done for the correction of prognathism. The major difference between the two techniques is that the BSSO allows titanium plates and screws to be placed intra-operatively and negates the need for post-operative intermaxillary fixation. However, like all surgical techniques, complications might arise with the employment of the BSSO technique. These complications can be divided into three broad categories, namely immediate, short-term and long-term complications. Immediate surgical complications occur intra-operatively, whereas short-term complications arise shortly after completion of the surgery and during the recovery of the patient. Long-term complications are apparent only after optimal time has been given for the recovery of the patient. The complications under each category are summarised in Table 4.

In BSSO, injury to the inferior alveolar nerve leading to neurosensory disturbances, that causes numbness of the lower lip and chin, is of great concern to many surgeons. One study quoted the percentage of nerve injury to be as high as 27.8%¹⁹. This is the main reason why some surgeons use the alternative VRO when managing patients with Class III skeletal deformities. Not surprisingly, Finlay *et al.* reported that long-term neurosensory disturbance is an important factor in patient's overall satisfaction²⁰. Interestingly, in another study, it was noted that patients did not seem bothered

Table 4. Complications of osteotomies.

Immediate	Bleeding
	Damage to teeth
	Damage to nerves
	Unfavourable fractures
	Avascularity of osteotomised segments
Short-term	Infection
	Post-operative bleeding
	Poor stability
	Necrosis of avascular osteotomised segments
	Gingival recession
	Devitalisation of teeth
Long-term	Malunion or non-union of bony segments
	Condylar resorption
	Neurosensory disturbances
	Facial paralysis
	Skeletal relapse
	Dental relapse

by partial neurosensory deficit after orthognathic surgery²¹. It can be suggested that in our study, neurosensory disturbances that might be related to BSSO technique did not affect the QoL of Class III skeletal patients significantly as all the QOL scores improved two years after surgery. It can also suggest that any long-term neurosensory deficit might not be severe to have caused a decrease in the QOL of these patients. More studies would need to be done to establish conclusive correlations between quantifiable measures of neurosensory disturbance and its impact on QoL scores.

The other complication that is commonly associated with orthognathic surgery is skeletal and dental relapse. The amount of relapse can be affected by the choice of surgical technique and the type of fixation employed. Profitt *et al.* found that isolated mandibular setback had a higher degree of relapse when compared to the combination of maxillary advancement and mandibular setback. It was also noted that the combination of maxillary advancement and mandibular setback was only stable with the use of rigid fixation²². Abeltins *et al.* stated that the average relapse for maxillary advancement and mandibular setback procedures was about 26% of the surgical movement at one year review²³. Further studies may be required to evaluate the correlation of skeletal relapse and long-term QoL outcome in Class III skeletal patients.

This study was limited by a small sample size. It was conducted over a period of three years and only yielded a small sample size of 41 subjects. This was in part due to the stringent inclusive and exclusive criteria in the recruitment protocol. Moreover, social issues such as being unable to contact subjects due to their studying or working overseas, change in contact numbers and addresses. The recruitment of subjects was also on a voluntary basis and this contributed to the small sample size. This study may be biased towards a positive outcome as it can be postulated that only patients that are both compliant and had positive outcomes would participate in the study. However, it is also possible that patients who are satisfied with the outcome may not be interested to return for reviews as they perceive them as unnecessary, especially if they do not have any significant problems from the surgery.

Future directions

If QoL surveys can be routinely conducted for patients planning for orthognathic surgery and followed up with similar questionnaires during the recovery phase and subsequent reviews, we will be able to create a database and correlate baseline scores to post surgical scores. Patients can then be profiled according to the baseline pre-surgical QoL survey results and individualised predictions can be made as to whether orthognathic surgery would be beneficial. This would lead to better patient selection and treatment planning with regards to orthognathic surgery, particularly in patients exhibiting "borderline" dentofacial deformities in which orthodontic camouflage may be a viable alternative to orthognathic surgery.

It could also permit the correlation of the amount of skeletal change, subsequent relapse and neurosensory disturbance with the patient's perception of the efficacy of orthognathic surgery measured in terms of QoL.

CONCLUSION

Treatment outcomes measured in terms of quality of life were significantly improved in Class III skeletal patients after bimaxillary osteotomies. The function, psychosocial and facial aesthetics improved significantly after surgery and these aspects continued well into two years post-surgery. The inclusion of QoL as a routine treatment outcome measure in orthognathic surgery would be beneficial in clinical profiling of patients,

decision-making, evaluating the and efficacy of the procedure. It could potentially be used to evaluate surgical complications, arising from orthognathic surgery, and its impact on QoL in patients. More studies would be required to establish its correlation in the future.

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APPENDIX A. OHIP-14

Item No.	Statement	Domain
1.	Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	Functional Limitation
2.	Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?	
3.	Have you had painful aching in your mouth?	Physical Pain
4.	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	
5.	Have you been self conscious because of your teeth, mouth or dentures?	Psychological Discomfort
6.	Have you felt tense because of problems with your teeth, mouth or dentures?	
7.	Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	Physical Disability
8.	Have you had to interrupt meals because of problems with your teeth, mouth or dentures?	
9.	Have you found it difficult to relax because of problems with your teeth, mouth or dentures?	Psychological Disability
10.	Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?	
11.	Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	Social Disability
12.	Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?	
13.	Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?	Handicap
14.	Have you been totally unable to function because of problems with your teeth, mouth or dentures?	

APPENDIX B. OQLQ

Item No.	Statement	Domain
1.	I am self-conscious about the appearance of my teeth	Facial aesthetics
7.	I don't like seeing a side view of my face (profile)	
10.	I dislike having my photograph taken	
11.	I dislike being seen on video	
14.	I am self-conscious about my facial appearance	
2.	I have problems biting	Oral Function
3.	I have problems chewing	
4.	There are some foods I avoid eating because the way my teeth meet makes it difficult	
5.	I don't like eating in public places	
6.	I get pain in my face or jaw	
8.	I spend a lot of time studying my face in the mirror	Awareness of dentofacial aesthetics
9.	I spend a lot of time studying my teeth in the mirror	
12.	I often stare at other people's teeth	
13.	I often stare at other people's faces	
15.	I try to cover my mouth when I meet people for the first time	Social aspects of dentofacial deformities
16.	I worry about meeting people for the first time	
17.	I worry that people will make hurtful comments about my appearance	
18.	I lack confidence when I am out socially	
19.	I do not like smiling when I meet people	
20.	I sometimes get depressed about my appearance	
21.	I sometimes think that people are staring at me	
22.	Comments about my appearance really upset me, even when I know people are only joking	