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Quality of Life (QoL) changes after orthognathic surgery: Do they correlate with the quantum of hard and soft tissue change?

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ABSTRACT

Aim: To investigate the relationship between post orthognathic surgery changes in soft and hard tissue cephalometric variables in Class II and Class III patients and quality of life (QoL) measured using a condition-specific QoL questionnaire and to determine cephalometric predictors of the overall OQLQ after surgery.

Methods: The sample included 50 orthodontic patients, 28 Class II and 22 Class III skeletal relationships whose treatment included orthognathic surgery. Correlations between cephalometric changes and Orthognathic Quality of Life Questionnaire (OQLQ) were tested by Pearson's correlation. Multiple linear regression was used to determine cephalometric predictors of the overall OQLQ after surgery.

Results: In Class II patients, OQLQ before surgery and changes in SNA were significant predictors for OQLQ after surgery. For Class III patients, OQLQ after surgery was significantly correlated with the change in mandibular plane angle and lower face height ($r = 0.6$ and $r = 0.5$ respectively). The decrease in facial angle was negatively correlated with OQLQ ($r = -0.4$). Mandibular plane angle, mandibular length, and OQLQ before surgery were significant predictors for OQLQ after surgery.

Conclusion: QoL improved for Class II and III after orthognathic surgery. Changes in certain cephalometric measurements seem to predict quality of life after orthognathic surgery.

Keywords: Cephalometric changes, Quality of life, Class II, Class III, Orthognathic surgery, Questionnaire, Health-Related Quality Of Life, Oral-health quality of life.

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INTRODUCTION

The World Health Organization defines "quality of life-QoL" as the way individuals perceive their place in life in relation to their cultures and values.[1] Dentofacial deformity has a negative impact on QoL by affecting social relationships and self-esteem.[2, 3] Patients requiring surgical correction have been found to have lower QoL.[4-6] This issue is of interest to both orthodontists and oral surgeons.[7-10]

QoL is measured through condition-specific or generic measures. Studies have shown that condition-specific instruments can detect small changes and are therefore more useful for assessing subjective outcomes.[11] QoL is commonly measured in orthognathic patients using three indices: The Short Form Health Survey (SF-36) [12], Oral Health Impact Profile (OHIP-14) [13] and the Orthognathic Quality of Life Questionnaire (OQLQ) which is condition-specific, and the most accurate and sensitive instrument. This has been validated by Cunningham et. specifically for orthognathic surgery. [11, 14] An Arabic version has been translated by native Arabic speakers and validated. [15-17]

Literature suggests that orthognathic surgery has a significant positive impact on QoL.[15,16,18-30] However, patients' perception of improvement in QoL may not align with the objective criteria used to plan the surgery.[31, 32] While cephalometric values can still be used to predict treatment outcomes, relying solely on this approach may result in inadequate corrections and subsequent dissatisfaction.[33, 34] Therefore, treatment planning should consider the impact of both soft and hard tissue changes on patients' QoL.

The relationship between QoL and cephalometric changes after surgery is scarcely reported. Few studies utilized a nonspecific tool (OHIP-14) in Class III patients [35-38], while only one included Class II patients.[37] Additionally, only two articles used the OQLQ to examine the impact of dentofacial deformities on QoL and cephalometric measurements before surgery. These studies were cross-sectional and they found that a higher overjet beyond normal values was associated with poorer QoL[39] and that greater deviation in the ANB angle increased patient awareness of their deformity.[40]

Uncertainty still exists about the relationship between objective measures (cephalometric changes) and subjective measures (QoL), and no longitudinal studies have evaluated cephalometric changes and their correlation with QoL after orthognathic surgery using the OQLQ. The present study aims to investigate the changes in patients’ QoL after surgery, and to correlate these changes with cephalometric variables in Class II and Class III patients. The null hypothesis is that there is no correlation between OQLQ and cephalometric changes after orthognathic surgery.

METHODS

Study design and subjects

The current study is a prospective cohort study of a consecutive sample of 50 orthodontic patients with 28 Class II and 22 Class III dentofacial deformities whose treatment plan included orthognathic surgery. Patients were recruited from an orthodontic private practice in XX, XX after signing the consent form to participate in this study. All surgeries were performed by the same team. Skeletal jaw discrepancies were defined by the ANB angle. Angles greater than 4 were classified as Class II, and angles less than 0 were classified as Class III. Patients with any craniofacial anomalies, temporomandibular joint disorders and history of trauma were excluded. Two time points were recorded: T0; defined as the initial record. T1; defined as a minimum of 6 months after orthognathic surgery. Demographic data and pre-and post-surgical cephalograms and OQLQ scores were collected from all subjects at T0 and T1. The XX University Hospital ethical committee approved the study.

Lateral cephalometry

Natural head position on a Cephalostat was used for all radiographs taken with the same exposure parameters, with teeth in centric occlusion, and lips relaxed. [41] A total of 7 hard and 8 soft tissue cephalometric variables were measured. Dolphin Image Management Solutions 11.9 software was employed. Intra and inter-examiner reliability was performed on 10 cephalograms.

Questionnaire

The OQLQ Arabic translation was used to assess patient quality of life before surgery and at least six months following surgery. It contains 22 questions, rated from 1 “bothers you a little" up to 4 "bothers you a lot". The questionnaire covers four domains: social impediment, facial esthetics, oral function, and awareness of dentofacial deformities. An individual's total score ranges from 0 to 88. Lower scores represent better quality of life.

Statistical analysis:

Statistical analysis was carried out using IBM SPSS Statistics, version 21.0. Shapiro-Wilk test was used for testing normality of data. Test retest method using An intra-interclass correlation coefficient (ICC) was used to calculate intra and inter examiner reliability. Gender differences in OQLQ scores were evaluated using independent sample t-test. The change in cephalometric measurements were assessed using a paired t-test. The correlation between cephalometric changes and OQLQ score was tested by Pearson’s correlation analysis. Demographic and cephalometric predictors of overall OQLQ scores after surgery were determined using backward stepwise multiple linear regression analysis. Results were considered significant when $P < 0.05$.

RESULTS:

A total of 50 patients (28 Class II and 22 Class III dentofacial deformities) whose treatment plans included orthognathic surgery were included **(Table 1).** There were no statistically significant gender differences in OQLQ score after surgery among patients in both groups ($P > 0.05$) **(Table 2).** The results of test-retest reliability showed excellent reliability ($ICC > 0.9$).

TABLE 1: Demographic characteristics of patients.

Variables	Class II	Class III
N	28 patients	22 patients
Age	30.2 ± 3.4 years	28.9 ± 4.9 years
Gender n (%) Male Female	 2 (7.7%) 26 (92.3%)	 12 (57.9%) 10 (42.1%)

TABLE 2: Gender differences in OQLQ score after surgery among patients in both groups.

Group	Gender	N	Mean (SD)	P-Value
Class II	Male	2	26.5 (20.5)	0.2
	Female	26	12.8 (12.3)	
Class III	Male	12	15.3 (15.4)	0.4
	Female	10	9.6 (14.5)	

Changes in OQLQ score and cephalometric parameters from T0 to T1:

In both groups, there was a statistically significant decrease in overall OQLQ score after orthognathic surgery ($P < 0.001$).

Table 3 shows the changes in cephalometric variables in both groups before and after surgery. In Class II patients, a statistically significant increase was detected at T1 in SNB, facial angle, mandibular length, soft tissue convexity angle, chin projection and nasolabial angle ($P < 0.05$). Furthermore, a significant decrease was found in SNA, ANB, overjet, mandibular plane angle, labiomental angle, upper and lower lip projections, and nasal projection ($P < 0.05$) **(Figure 1).**

	Parameters	Class II			Class III		
		Score, mean (SD)		T1-T0	Score, mean (SD)		T1-T0
		Presurgical (T0)	Postsurgical (T1)		Presurgical (T0)	Postsurgical (T1)	
OQLQ	Overall OQLQ	39.2(23.7)	13.8(13.0)	-25.5(22.1)**	33.2(18.9)	12.7(14.9)	-20.5(16.8)**
Skeletal\ Dental	SNA angle	84.6(3.7)	82.4(3.8)	2.2(2.6)**	79.7(5.2)	85.8(5.2)	6.0(2.7)**
	SNB angle	75.2(3.9)	79.6(3.8)	4.4(3.0)**	83.5(5.9)	82.5(4.0)	-0.9(3.5)
	ANB angle	7.2(2.2)	5.0(1.6)	-2.2(1.9)**	-3.8(3.4)	3.3(2.7)	7.0(3.4)**
	Facial angle (SN-NPog)	74.9(4.5)	81.4(3.6)	6.4(3.2)**	84.0(5.9)	83.9(3.4)	-0.1(3.8)
	Overjet (mm)	5.3(2.8)	2.6(1.2)	-2.7(2.8)**	-2.9(5.3)	3.0(1.3)	5.9(5.6)**
	Mandibular plane angle (SN-MP)	43.0(7.9)	38.7(5.5)	-4.3(4.4)**	37.3(8.4)	35.8(5.9)	-1.5(3.6)*
	Mandibular length (Co-Gn) (mm)	109.9(6.3)	121.4(19.5)	11.4(18.9)*	126.8(8.9)	124.2(7.3)	-2.6(4.2)*
Soft tissue	Soft tissue convexity (G'-Sn-Pog')	157.5(7.9)	162.9(5.5)	5.4(5.0)**	169.4 (5.8)	165.5(5.4)	-3.9(7.7)*
	Chin projection (G'-pg') (mm)	-7.4(7.4)	6.4(9.6)	13.7(7.3)**	4.1(10.3)	5.7(7.3)	1.6(8.5)
	Lower face height (Sn-Me') (mm)	75.4(5.9)	74.0(10.9)	-1.3(12.0)	76.2(5.8)	74.3(6.8)	-1.9(5.7)*
	Nasolabial angle	106.5(10.4)	109.4(9.3)	2.8(6.6)*	101.9(15.9)	103.5(12.3)	1.5(15.5)
	Labiomental angle	138.8(13.7)	131.6(13.9)	-7.2(18.1)*	151.8(13.5)	125.9(16.7)	-25.8(16.9)**
	Upper Lip Projection (mm)	5.4(2.0)	4.7(2.0)	-0.7(1.5)*	2.6(2.2)	5.4(1.9)	2.8(2.8)**
	Lower Lip Projection (mm)	6.5(2.5)	3.2(2.0)	-3.3(1.9)**	5.9(2.5)	4.0(1.9)	-1.9(2.6)*
	Nasal projection (Sn-P) (mm)	13.9(1.7)	12.6(2.5)	-1.4(2.0)**	14.9(2.3)	12.7(2.5)	-2.1(1.4)**

TABLE 3: Changes in cephalometric indices and OQLQ score for Class II and Class III in T0 and T1

*Statistically significant (Paired t-test, P < 0.05).

**Statistically highly significant (Paired t-test, P < 0.001).

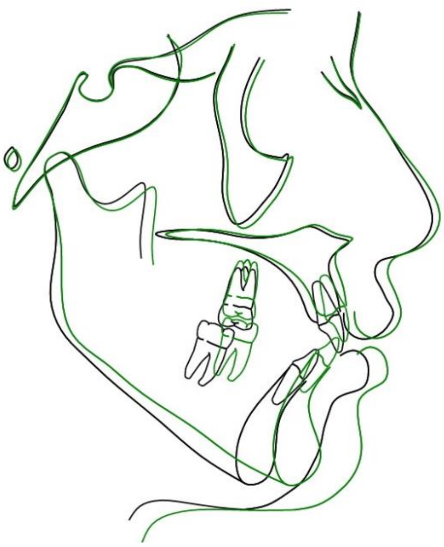

Figure 1: Superimposition of initial and final average tracing of Class II cases

Amongst Class III patients, a significant increase was detected at T1 in SNA, ANB, overjet and upper lip projection ($P < 0.05$). The soft tissue convexity, labiomental angle, mandibular plane angle, mandibular length, lower face height, lower lip projection, and nasal projection showed a significant reduction after surgery ($P < 0.05$) **(Figure 2).**

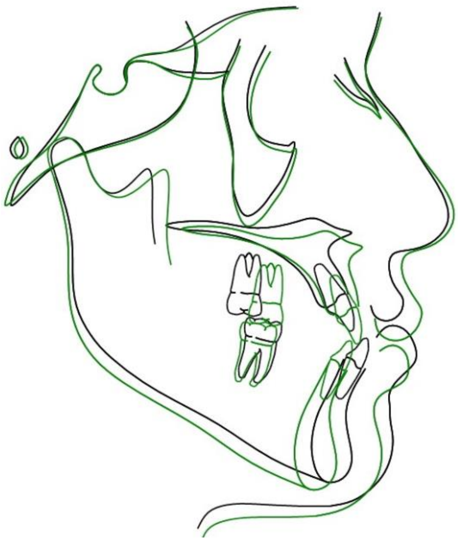

Figure 2: Superimposition of initial and final average tracing of Class III cases

The correlation between changes in cephalometric parameters and OQLQ after surgery:

Among Class II patients, a weak positive correlation that was not significant ($P > 0.05$) was found between OQLQ after surgery and the difference in SNA and in nasal projection. The changes in other cephalometric parameters were not correlated to OQLQ after surgery. Among Class III patients, the OQLQ score after surgery was moderately correlated with the difference in mandibular plane angle and the difference in lower face height ($r = 0.6$; $P < 0.05$ and $r = 0.5$; $P < 0.05$ respectively). A weak negative correlation was found between the facial angle change and OQLQ score ($r = -0.4$; $P < 0.05$).

The changes in SNB, and ANB had weak, nonsignificant correlation with the OQLQ score **(Table 4).**

TABLE 4: Correlations between cephalometric changes and OQLQ after treatment for Class II and Class III.

	Parameters	Class II		Class III	
		Total QOLQ r	**P value**	**Total QOLQ r**	**P value**
Skeletal\Dental	Difference in SNA angle	0.3	0.1	-0.1	0.5
	Difference in SNB angle	-0.2	0.3	-0.3	0.07
	Difference in ANB angle	0.09	0.6	0.3	0.1
	Difference in Facial angle (SN-Npog)	0.2	0.2	-0.4	0.02*
	Difference in Overjet (mm)	0.08	0.9	0.2	0.2
	Difference in Mandibular length (Co-Gn) (mm)	0.1	0.3	0.1	0.5
	Difference in Mandibular plane angle (SN-MP)	-0.07	0.7	0.6	0.001*
Soft tissue	Difference in Soft Tissue Convexity (G'-Sn-Pog')	0.07	0.7	-0.1	0.4
	Difference in Chin projection (G'-pg') (mm)	-0.1	0.5	-0.1	0.3
	Difference in Nasolabial angle	-0.07	0.7	0.2	0.2
	Difference in Labiomental angle	0.03	0.8	0.2	0.2
	Difference in Upper Lip Projection (mm)	-0.1	0.3	-0.03	0.8
	Difference in Lower Lip Projection (mm)	-0.1	0.4	0.08	0.9
	Difference in Lower face height (Sn-Me')(mm)	0.05	0.7	0.5	0.007*
	Difference in Nasal projection (mm)	0.3	0.08	-0.4	0.05

*Statistically significant (Pearson correlations, $P < 0.05$).

Predictors of overall (OQLQ) score for Class II and Class III patients:

To evaluate demographic and cephalometric predictors of overall OQLQ after surgery while controlling for confounding, all variables were entered into backward stepwise multiple linear regression models. SNA difference and OQLQ before surgery remained in the adjusted model for Class II patients (Table 4). The model was statistically significant for class II patients ($P < 0.05$). A 1 degree increase in SNA difference was associated with 1.9 increase in OQLQ score after surgery (**ß** = 1.9, $P < 0.05$). Moreover, a 1 unit increase in OQLQ score before surgery was associated with increased OQLQ score after surgery by 0.2 (**ß** = 0.2, $P < 0.05$) **(Table 5).**

TABLE 5: Cephalometric Predictors of Overall (OQLQ) Score for Class II

Independent variables	ß	SE-b	t	P value
Difference in SNA angle	1.9	0.852	2.248	0.03
OQOL before surgery	0.2	0.094	2.681	0.01

Note: OQLQ after the surgery was the dependent variable; ß is the unstandardized coefficients; SE-b is the Standard error; R^2 =0.29; Adjusted R^2 =0.24; F = 5.2

For class III patients, the difference in mandibular plane angle, difference in mandibular length and OQLQ before surgery remained in the adjusted model (Table 5). The model was statistically significant (P <0.001). A degree increase in the difference in mandibular plane angle was associated with 2.9 increase in OQLQ score after surgery (**ß** = 2.9, P < 0.001). In addition, each 1 mm increase in the difference in mandibular length was associated with a 1.1 increase in OQLQ score after surgery (**ß** = 1.1, P < 0.05). Moreover, a 1 unit increase in the OQLQ score before surgery was associated with 0.4 units increase in the OQLQ score after surgery (**ß** = 0.4, P < 0.001) **(Table 6).**

TABLE 6: Cephalometric Predictors of Overall (OQLQ) Score for Class III

Note: OQLQ after the surgery was the dependent variable; ß is the unstandardized coefficients; SE-b is the Standard error; R^2 =0.82; Adjusted R^2 =0.79; F = 27.9.

Independent variables	ß	SE-b	t	P value
Difference in mandibular plane angle (SN-MP)	2.9	0.411	7.142	<0.001
Difference in mandibular length (Co-Gn) (mm)	1.1	0.357	3.334	0.004
OQOL before	0.4	0.079	5.992	<0.001

DISCUSSION

A significant decrease in the overall OQLQ score after orthognathic surgery, indicating an improvement in QoL was noticed across the cohort. These findings agree with previous studies that used OQLQ to report significant improvement in patients' QoL after orthognathic surgery. [15-18, 20-24, 26, 27, 30, 36]

The surgical correction amongst Class II subjects in the study was achieved by a combination of maxillary impaction and mandibular advancement. Significant improvements were seen in the soft tissue profile as indicated by an increase in the convexity angle and improved position of lips and chin. These findings agree with the results of previous studies.[37, 42] No cephalometric variables significantly correlated with the OQLQ after surgery amongst Class II patients, which contradict Baherimoghaddam T et al. [37] These differences could be attributed to a different instrument used in the present study.[10] Regression analysis showed that a decrease in SNA was associated with a better OH-QoL. This is probably due to patients' perception of a significant midface protrusion [43, 44] though the correction was primarily due to mandibular advancement.[42]

Surgical correction among Class III patients in the sample was by maxillary advancement as evident by an average increase of SNA angle by 6 degrees. A significant improvement was noted in the soft tissue convexity, position of lips, overjet, lower face height, and mandibular plane angle which is in accordance with earlier studies.[35-38, 45] There was a significant correlation between cephalometric changes and OQLQ after orthognathic surgery. A reduction in lower face height appears to be correlated with a better OQLQ. This was also reported by Chadda et al [36] An interesting finding was that the decrease in mandibular plane angle was correlated with a better OQLQ among Class III patients. This has not been investigated previously.[35, 37, 38, 40] Multiple linear regression analysis showed that decreasing mandibular plane angle and mandibular length after orthognathic surgery was associated with a better OQLQ. In the current study, a decrease in facial angle had a weak negative correlation with OQLQ. The ANB angle changed 7 degrees on average after surgery moving the skeletal profile towards a Class II. This might explain why OQLQ was negatively correlated since literature states that 30% of patients struggle to adjust to their new appearance.[46] This outcome however contradicts previous studies.[33, 35] In both groups, patients with a worse OQLQ at baseline were likely to end up with an improved OQLQ, but still worse than others who started with a relatively better OQLQ. Brunault et al. reported that significant depression before surgery is associated with poorer QoL scores.[47] These findings suggest including psychological assessment as screening tool for orthognathic surgery.

Strengths of the current study are that QoL was measured using OQLQ which is condition specific. It was longitudinal and it corelated quantum of OQLQ change with cephalometric changes. It also used multiple linear regression analysis to determine cephalometric predictors of the overall OQLQ scores after surgery. The limitations are a non-randomized selection and use of 2D cephalometric radiographs. Future studies can be conducted on diverse populations with a larger sample size to have more generalizability.

CONCLUSIONS

- The results of this study demonstrate a correlation between the change in certain cephalometric predictors and OQLQ following orthognathic surgery.
- Better OQLQ in Class II patients may be predicted by decreasing SNA.
- Decreasing mandibular length and mandibular plane angle following surgery may indicate improved OQLQ in Class III patients.
- The current study's findings may help clinicians during treatment planning by enabling them to focus on particular cephalometric parameters that can enhance patients' OQLQ.

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No funding was received for the study.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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