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Oral health-related quality of life following orthognathic surgery for class III correction its relationship with cephalometric changes

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Abstract. The aim of this study was to investigate the cephalometric changes following orthognathic surgery for class III correction and to compare these with the changes in patient perceptions of their oral health-related quality of life (OHRQoL). Twenty-nine severe skeletal class III patients, who were candidates for bilateral sagittal split osteotomy and Le Fort I osteotomy, completed the Persian version of the Oral Health Impact Profile OHIP-14 questionnaire before any orthodontic treatment (T0) and at 6 months after the surgery (T1). Cephalometric analyses were performed at T0 and T1 and the changes in 13 hard and soft tissue profile indices were assessed by means of the paired t-test. The correlation between facial changes following treatment and the OHIP-14 item scores were tested by Pearson correlation analysis. The increase in upper lip protrusion following surgery was correlated with an increase in OHRQoL, especially in the domains of pronouncing words, taste, and diet, as well as the total OHIP-14 score. However, the increase in upper lip length and the decrease in lower lip protrusion correlated positively with worsening of some of the OHIP items. Although orthognathic surgery led to ideal cephalometric results, the patients' OHRQoL was improved in some aspects and impaired in others.

Key words: orthognathic surgery; oral health-related quality of life; class III.

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One of the most important factors motivating patients to seek orthodontic-surgical treatment is facial aesthetics[1,2]. Different studies have demonstrated that patients with severe malocclusion, especially those requiring orthognathic surgery, have lower oral health-related quality of life (OHRQoL), mostly due to the great impact of facial aesthetics on patient self-confidence and social acceptance[3,4].

Orthognathic surgery may impair the patient's psychological state[5]. Besides

the functional and aesthetic outcomes, different factors such as interpersonal interactions, social acceptance, and post-surgical morbidity may affect OHRQoL[6–8]. Oland et al. stated that the pre-treatment motivation could significantly influence post-surgical satisfaction, and patients with oral function as the motivation showed the lowest satisfaction after orthognathic surgery[9].

Cephalometric norms and surgeon preference regarding the facial soft tissue are commonly the initial guidance to define the necessary movement of the jaw bases during orthognathic surgery. Unfortunately, the resultant facial changes after surgery may differ from the patient's expectations of aesthetics[10,11].

Different questionnaires have been developed to measure patient OHRQoL. These tools are used widely in different countries to evaluate the patient's point of view about the influence of medical and dental treatment on their daily life. Slade and Spencer introduced the oral health impact profile (OHIP) questionnaire to assess the levels of dysfunction, discomfort, and disability due to oral disorders[12]. Slade derived a subset of items from the OHIP-49 questionnaire to produce the OHIP-14 to measure functional limitations, social aspects of disability, and handicaps[13]. The OHIP-14 was translated into Persian and validated by Ravaghi et al. in 2010, and the Persian version of the OHIP-14 has been applied as a reliable questionnaire to measure OHRQoL of native Persian speakers since then[14].

Although different studies had been conducted to evaluate OHRQoL[2,5,7,11] or facial changes[6,15–17] after orthognathic surgery, the correlation of these aspects has not received much attention in the literature. Thus, the aim of the present study was to evaluate the cephalometric changes in the hard and soft tissues of patients undergoing orthodontic and surgical treatment for class III correction and to investigate their relationships with the changes in patient OHRQoL.

Methods

In this prospective cohort study, data from 29 severe skeletal class III patients (17 female and 12 male) seeking orthodontic treatment were gathered. After obtaining ethical approval from the ethics committee of the university, patients meeting the following criteria were included in the study: Persian patients who were skeletal class III (A-point–nasion–B-point (ANB) angle cephalometric measurement of 0° or less) and who were candidates for fixed orthodontic treatment along with orthognathic surgery. The patients were treated using a 0.022-inch MBT bracket system, and surgery consisted of a one-piece Le Fort I osteotomy for maxillary advancement along with mandibular setback by bilateral sagittal split osteotomy (BSSO) with rigid fixation. Patients with cleft lip and palate or any other craniofacial syndromes, an asymmetric face, or a temporomandibular disorder were excluded from the study.

The participants' OHRQoL was assessed using the Persian version of the OHIP-14 questionnaire, which includes seven conceptual dimensions of OHRQoL: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and social handicap. There are two items in the questionnaire to measure each dimension and consequently the questionnaire consists of 14 items. Respondents choose one response code from 0 to 4 for each item, corresponding to 'never', 'hardly ever', 'occasionally', 'fairly often', and 'very often', respectively. The values of the 14 items are summed to calculate the final OHIP-14 severity score, which can range from 0 to 56.

The patients were instructed to complete the OHIP-14 questionnaire before any orthodontic treatment (T0) and at 6 months after the surgery (T1), and the OHIP-14 severity score was calculated.

To assess the impact of surgery on the patient's profile, a cephalometric analysis was performed. Patients were referred to the same radiology centre, and lateral cephalograms at the same magnification were obtained at T0 and T1. These lateral cephalograms were obtained in natural head position, with lips at rest and teeth in centric occlusion with light contact. Thirteen cephalometric indices were measured in the pre- and post-surgical phases by one examiner (Fig. 1; listed in Table 2). To assess the intra-examiner reliability, the measurements were repeated 1 month after the initial evaluation. The intra-examiner reliability was approximately 0.91, which shows a high reproducibility.

The statistical analysis was conducted using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov–Smirnov normality test was performed. The paired t-test was used to compare the changes in cephalometric indices. The correlation between facial changes due to treatment and OHIP-14 item scores was tested by Pearson correlation analysis.

Results

Over a 3-year period, data were collected from 29 severe skeletal class III patients with a mean age of 24.23 ± 4.2 years. The mean OHIP-14 item scores are shown in Table 1. Among the 14 items, there were significant changes in items OH-4, OH-8, OH-9, and OH-10 after orthognathic surgery.

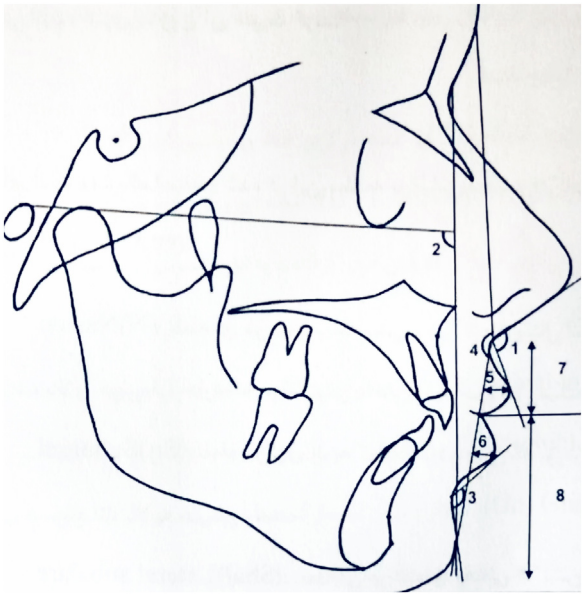

Fig. 1. Soft tissue cephalometric indices applied in this study: 1: nasolabial angle; 2: facial angle; 3: mentolabial angle; 4: convexity angle; 5: upper lip protrusion; 6: lower lip protrusion; 7: upper lip length; 8: lower lip length.

Table 1. Changes in OHIP-14 item scores before and after the surgery.

Parameters[a]	Score, mean (SD)		*P*-value[b]
	Pre-surgical	Post-surgical	
OH-1	1.86 (0.95)	1.93 (1.19)	0.811
OH-2	1.55 (0.87)	1.76 (1.05)	0.410
OH-3	2.28 (1.38)	2.21 (1.20)	0.768
OH-4	2.66 (1.1.7)	1.93 (1.13)	0.004*
OH-5	2.97 (1.29)	2.41 (1.26)	0.76
OH-6	1.83 (1.00)	1.45 (0.78)	0.051
OH-7	2.14 (0.99)	1.83 (1.13)	0.286
OH-8	2.31 (1.13)	1.83 (1.03)	0.022*
OH-9	2.76 (0.98)	1.63 (0.92)	<0.001*
OH-10	2.07 (1.13)	1.38 (0.73)	0.003*
OH-11	2.00 (0.96)	1.72 (1.10)	0.270
OH-12	1.52 (0.78)	1.66 (1.01)	0.23
OH-13	1.76 (0.91)	1.41 (0.98)	0.80
OH-14	1.31 (0.60)	1.21 (0.49)	0.45
OHIP-14 (female)	30.17 (8.79)	22.23 (4.82)	0.014*
OHIP-14 (male)	27.66 (13.35)	27.33 (8.17)	0.031*
OHIP-14 (total)	29.00 (8.50)	24.48 (9.52)	0.005*

SD, standard deviation.
[a] OH-1 to OH-14 represent each of the 14 items of the OHIP-14 questionnaire.
[b] The level of significance was set at.
* $P < 0.05$.

Table 2. Pre-surgical to post-surgical changes in cephalometric indices.

Parameters	Mean (SD) values		*P*-value[a]
	Pre-surgical	Post-surgical	
SNA angle (°)	78.91 (4.99)	82.41 (5.70)	<0.001*
SNB angle (°)	81.4 (5.81)	79.65 (5.03)	0.002*
ANB angle (°)	−2.59 (3.67)	3.09 (1.46)	<0.001*
Nasolabial angle (°)	105.77 (11.22)	105.93 (9.89)	0.902
Mentolabial angle (°)	146.39 (17.97)	134.74 (19.23)	0.001*
Facial angle (°)	90.66 (5.91)	89.93 (7.22)	0.530
Convexity angle (°)	163.05 (32.54)	156.94 (31.53)	<0.001*
Upper lip length (mm)	20.30 (0.31)	22.41 (0.36)	0.001*
Lower lip length (mm)	50.21 (0.89)	48.40 (0.62)	<0.001*
Upper lip protrusion (mm)	1.65 (2.06)	3.22 (3.34)	0.002*
Lower lip protrusion (mm)	4.24 (4.08)	1.67 (6.65)	0.06
Wits appraisal (mm)	−8.47 (4.61)	−1.51 (3.11)	<0.001*
Jarabak index (%)	62.47 (4.71)	64.20 (4.64)	0.013*

ANB, A-point–nasion–B-point angle; SNA, sella–nasion–A-point angle; SNB, sella–nasion–B-point angle.
[a] The level of significance was set at.
* $P < 0.05$.

Changes in cephalometric parameters from pre- to post-surgical phase

Descriptive and analytical data for the pre- and post-surgical cephalometric indices are shown in Table 2. There were significant increases in sella–nasion–A-point (SNA) angle, ANB angle, Wits appraisal, upper lip protrusion, upper lip length, and Jarabak index after the surgery ($P < 0.05$), while there were significant decreases in sella–nasion–B-point (SNB) angle, mentolabial angle, convexity angle, lower lip length, and lower lip protrusion ($P < 0.05$).

Correlation between cephalometric parameters and OHIP-14 questions

Table 3 shows the correlations between cephalometric changes and OHIP-14 items. Increased upper lip protrusion was found to be negatively correlated with difficulty in pronouncing words (OH-1), worsening of taste (OH-2), dissatisfaction with diet (OH-7), and total OHIP-14 score (OH sum).

Increased upper lip length correlated positively with experiencing difficulty in doing usual work (OH-12). Decreased lower lip protrusion correlated positively with worsening of taste (OH-2), feeling self-conscious (OH-5), feeling a bit embarrassed (OH-10), feeling a bit irritable with other people (OH-11), experiencing difficulty in doing usual work (OH-12), finding life less satisfying (OH-13), totally unable to function (OH-14), and total OHIP-14 score (OH sum) (Table 3).

Discussion

In recent years, many studies have been designed to assess the facial changes after orthognathic surgeries[6,15–17]. However, any changes in oral conditions can have a strong impact on the patient's psychological, social, and functional health, which is referred to as oral health-related quality of life[2]. OHRQoL should be considered in the evaluation of treatment outcomes alongside objective findings, since obtaining only ideal objective norms may not be satisfactory from the patient's viewpoint[10,11,18].

The results of this study showed that orthognathic surgery may improve OHRQoL in both male and female patients, which is in agreement with the results of some previous studies[3,19–21]. Regarding the sex of the participants, some studies have reported that there were improvements in self-esteem among female patients following surgery, whereas this effect was not observed in male patients[22,23]. In the current study, female patients had higher total OHIP-14 scores before surgery than male patients, which means lower OHRQoL. Esperão et al. reported that women are also more affected by the negative effects of malocclusions on OHRQoL than men[7]. Furthermore, it has been reported that women pay more attention to the details of facial aesthetics than men and that their self-perceived surgical treatment needs are higher than those of men, which means that females seek cosmetic surgeries more than males[24,25]. There is probably a relationship between the lower OHRQoL in female candidates for orthognathic surgery and the higher social sensitivity regarding their profiles than those of men. Moreover, the subjects included in this study were class III patients and it has been shown that a protrusive mandible is more accepted in males than in females[25].

In this study, the SNA angle, SNB angle, Wits appraisal, mentolabial angle, upper and lower lip length, upper and lower lip protrusion, Jarabak index, and convexity angle showed significant changes in the post-surgical phase. Rustemeyer et al. also reported significant changes in the ANB and SNB angle, facial

Table 3. Correlations between cephalometric changes and OHIP-14 items.

Parameter	OH-1	OH-2	OH-3	OH-4	OH-5	OH-6	OH-7	OH-8	OH-9	OH-10	OH-11	OH-12	OH-13	OH-14	OH sum
SNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SNB	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANB	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nasolabial angle	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Facial angle	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Convexity angle	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mentolabial angle	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Upper lip length	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.601[a] 0.001[b]	NS	NS	NS
Lower lip length	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Upper lip protrusion	−0.455[a] 0.013[b]	−0.4[a] 0.013[b]	NS	NS	NS	NS	−0.384[a] 0.04[b]	NS	NS	NS	NS	NS	NS	NS	−0.407[a] 0.029[b]
Lower lip protrusion	NS	−0.509[a] 0.005[b]	NS	NS	−0.396[a] 0.034[b]	NS	NS	NS	NS	−0.516[a] 0.004[b]	−0.396[a] 0.034[b]	−0.436[a] 0.018[b]	−0.504[a] 0.005[b]	−0.525[a] 0.003[b]	−0.568[a] 0.001[b]
Wits appraisal	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Jarabak index	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS, statistically non-significant.
[a] Pearson correlation.
[b] *P*-value.

convexity, lower lip protrusion, and mentolabial angle following orthognathic surgery[3]. On the other hand, Rustemeyer and Martin reported no significant changes in the mentolabial angle in class III patients in another photogrammetry study[26]. This discrepancy in results may be due to wide individual variations in the nasolabial and mentolabial angles, which has been reported in a photogrammetric analysis[27].

The data in the present study revealed that some of the cephalometric changes could be correlated with OHRQoL. Increased upper lip protrusion, for example, was found to be correlated with improvements in pronouncing words. Baherimoghaddam et al. also showed that upper lip prominence had a positive correlation with OHRQoL[19]. Proffit et al. claimed that skeletal class III malocclusion might cause some distortion in pronunciation of labiodental fricatives[28]. Accordingly, any increase in positive overjet could have a positive impact on speech, which in turn could lead to improved quality of life in severe class III patients.

The correlation of lower lip prominence and increased self-consciousness was mentioned by Rustemeyer et al.[3], and is in accordance with the findings of the present study. Maxillary advancement and mandibular setback usually cause considerable facial changes. Although most patients come to terms with these changes, Türker et al. claimed that about 30% of patients had trouble accepting their post-surgical face even 2 years after surgery[29]. In contrast, Baherimoghaddam et al. reported a positive correlation between decreased lower lip protrusion and OHRQoL[19]. This difference in results may be due to the longer follow-up period in their study than in the present study and the study performed by Rustemeyer et al.[3].

In the studies mentioned above, the position and length of the upper lip were not addressed, while in the current study, the relationships between any changes in the upper lip position and length and OHRQoL were assessed. Increased upper lip length correlated positively with experiencing difficulty in doing usual work, while on the other hand, decreased lower lip protrusion correlated with worsened taste, increased self-consciousness, increased embarrassment, being more irritable with people, increased difficulty doing their usual job, less satisfaction with life, increased inability to function, and the total sum of the OHIP-14.

Some of these observations could be attributed to a delay in the patients' adaptation to their new jaw position. Since orthognathic surgery is a major facial surgery with many potential complications, there could be many confounding parameters that can affect the patient's post-surgical quality of life. For instance, there may be some temporary disturbance in taste, hearing, and masticatory function, as well as limitations in maximum mouth opening and lip sensitivity[30–35]. Besides, patients may suffer from the discomforts due to scarring in the vestibulum. Taste worsening may be due to neurosensory alterations of the inferior alveolar nerve following mandibular sagittal osteotomy, which is reported to remain in 15% to 75% of cases at about 1 year after the surgery[30,31]. A study by Ellis et al. showed that the bite force of patients who needed surgical correction of mandibular prognathism was lower than the normal range, but that this showed a steady increase after surgery, approaching normal values within 2 to 3 years[33]. In other studies, neurosensory alterations of the inferior alveolar nerve associated with sagittal osteotomy of the mandibular ramus were not considered as disabling by the patients subjectively, and the sensitivity of the lower lip started to return to normal following recovery of inferior alveolar nerve neurosensory function even within 2 months[34,35].

With regard to the findings of this study, any alterations made to manage a skeletal deformity should not be considered as a definite factor in the improvement of the patient's OHRQoL. This issue should be considered in patient management, especially for those who believe that facial changes after the surgery will alleviate all of the complications in their social and interpersonal life. Recent research has addressed the difference between the patient's and the clinician's perceptions of the ideal profile and any need for orthognathic surgery treatment. However, these studies mostly emphasized the differences in aesthetic preferences. According to the current study, another reason for this difference could be attributed to the concept of OHRQoL, which is a comprehensive concept and can represent different aspects of a patient's health and function. Thus, orthodontists and surgeons should not just focus on the post-surgical occlusal relationship and consider the occlusion as a centre to orthognathic surgery.

According to the findings of this study, the position of the lips had a prominent role in the post-surgical OHRQoL of patients. Hence it is recommended that surgeons pay more attention to the prediction of the anteroposterior position and

length of the lips while performing model surgery, rather than just relying on parameters of an ideal occlusion and hard tissue cephalometric analysis. Choosing and applying precise computer-assisted three-dimensional soft tissue treatment planning and prediction software could be advantageous and should become a part of any orthognathic surgery process[36]. It is also recommended that clinicians discuss various aspects of OHRQoL with the patients before planning the surgery in order to clarify the possible improvement and impairment in any domain of quality of life for the patients.

This study was limited to class III patients and did not consider those with any other skeletal problems. Accordingly, it is recommended that further studies be performed to evaluate the effects of orthognathic surgery for the correction of different types of dentofacial deformity on patient OHRQoL. Moreover, the authors propose conducting a condition-specific study for various domains of the OHIP-14 to more precisely determine the relationships between surgical alterations and OHRQoL.

In conclusion, orthognathic surgery improved the patients' OHRQoL when the total score was considered. Corrective surgery for class III patients that led to upper lip protrusion could enhance the pronunciation of words, improve taste, and increase satisfaction with diet. Decreased lower lip protrusion following orthognathic surgery correlated positively with feeling self-conscious, feeling a bit embarrassed, feeling a bit irritable with other people, and some other aspects of OHRQoL.

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Competing interests

The authors declare no competing interests.

Ethical approval

The project was reviewed by the Research Ethics Committee of Tehran University of Medical Sciences and was accepted according to the letter of ethical approval with reference number IR.TUMS.VCR.REC.1395.1592.

Patient consent

Not required.

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