Original Article

Changes in quality of life and their relation to cephalometric changes in orthognathic surgery patients

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ABSTRACT

Objective: To evaluate correlations between presurgical and postsurgical changes in quality of life (QoL) and cephalometric hard and soft tissue changes in patients undergoing orthognathic surgery.

Materials and Methods: The study sample consisted of 30 patients (mean age 24.3 ± 4.5 years) with Class III malocclusion undergoing orthognathic surgery for mandibular setback with a median follow-up of 8.3 ± 1.2 months. Presurgical and postsurgical cephalograms were traced and Oral Health Impact Profile (OHIP) questionnaires were completed. Each questionnaire consisted of 14 items designed to evaluate functional, physical, psychological, and social impacts.

Results: Significant correlations between significant presurgical-to-postsurgical changes in individual items and OHIP parameters were found between labiomental angle (LA) and question 5 ("feeling self-conscious"; correlation coefficient [r] = 0.530), between LA and question 6 ("feeling tense"; r = 0.598), between nasion-pogonion and question 5 (r = 0.523), and between facial convexity and question 5 (r = −0.540). Hence, reduction of both LA and nasion-pogonion led to a significant decrease in the impact scores of items covering psychological discomfort, while reduced facial convexity led to increased impact scores.

Conclusions: Although the associations were moderate, changes in QoL following cephalometric modifications should be considered as a major concern when planning orthognathic surgery. Postsurgical changes to a more convex profile after mandibular setback should be emphasized before surgery to help patients become accustomed to their new appearance more easily without negatively affecting QoL. (*Angle Orthod.* 2012;82:235–241.)

KEY WORDS: Quality of Life; Cephalometry; Orthognathic surgery

INTRODUCTION

According to the World Health Organization, quality of life (QoL) can be defined as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns."[1] Questionnaires consisting of disease-specific or generic items are proven tools to assess these individual perceptions. Because generic measurement tools, for example, the Short-Form 36-item Health Survey (SF-36) or the EuroQol, have been reported to be invalid for sensitive changes in oral health and furthermore exhibit limited construct validity,[2–4] disease-specific measures with disease-related attributes have been developed with greater sensitivity to clinical conditions. One of the most widely used questionnaires is the Oral Health Impact Profile (OHIP), which measures individuals' perceptions of the social impact of oral disorders on their well-being.[5] The OHIP-14 questionnaire was developed as a shorter version of the OHIP-49 for use in settings in which the full battery of 49 questions might be inappropriate[6]; it focuses especially on oral health–specific aspects of functional limitation and physical disability, as well as psychological and social aspects of disability and handicaps.

Planning and outcome of orthognathic surgery should be consistent with objectives and normative values, and these may differ from patients' perceptions of improvement after surgery and of QoL in general.

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Unrealistic preoperative expectations and the degree to which the procedure is explained by the operating staff are possible reasons for this discrepancy.[7,8] This raises the question of whether comparison of an individual's perception concerning QoL with objective measurements can display this discrepancy or, in contrast, may show accordance. To date, studies investigating correlations between the perceptions of patients, whether there is a postsurgical improvement or not, and objective outcomes after orthognathic surgery as measured by the medical staff are not available.

Hence, the aim of this study was to evaluate relationships between presurgical and postsurgical changes in QoL, as assessed by OHIP-14, and cephalometric changes in hard and soft tissues. The results may improve clinicians' ability to explicitly address patients' perceptions of an improvement in QoL after orthognathic surgery.

MATERIALS AND METHODS

Patients

Patients with skeletal malformations displaying mandibular prognathia with Class III malocclusion were recruited at first presentation at our center. Exclusion criteria were: patients with matured cleft lip and palate, craniofacial syndromes, or posttraumatic deformity, and patients who were scheduled to undergo orthognathic surgery without orthodontic treatment or with additional features, eg, genioplasty or distractor devices. Therefore, orthognathic surgery consisted purely of bilateral sagittal split ramus osteotomy (BSSRO) to resolve mandibular setback. Condylar positioning devices were not used. Patients remained in the hospital for 5 days after surgery. Rigid fixation and an interocclusal splint were applied for 2 weeks. Afterward, the patients wore light training elastics for a 2-week period and were readmitted to their orthodontists. For follow-up, patients were assigned to our center again. For all patients participating in this study, presurgical and postsurgical cephalograms were available, and all patients completed OHIP-14 questionnaires.

Patient consent for this study was received, along with approval by the Institutional Review Board of our university.

Lateral Cephalometry

Subjects were positioned in a cephalostat, and the head holder was adjusted until the ear rods could be positioned into the ears without moving the patient. All radiographs were taken with the teeth together in centric occlusion and the lips in repose. No occipital supplement was used. According to the standard for cephalograms, the film distance to the x-ray tube was fixed at 150 cm, and the distance from the film to the midsagittal plane of the patient's head was set at 18 cm. After the radiographs were scanned and transferred to a computer, landmarks were identified manually using photographic software (Adobe Photoshop, version 7.0, Adobe Systems, San Jose, Calif). The cephalograms were traced by hand and landmarks identified using a modified version[9] of the soft tissue analyses developed by Legan and Burstone[10] and Lew et al.[11] A horizontal reference line was constructed by raising a line 7° from sella-nasion line, and a line perpendicular to this at nasion was used as the vertical reference line. Movements of hard and soft tissue landmarks from presurgery to postsurgery were measured in millimeters to the horizontal and vertical reference lines using the photographic software tools. The related angles were measured in degrees on the presurgical and postsurgical cephalograms. Differences were recorded as surgical changes.

Landmarks and Angles

The following hard tissue landmarks were identified on cephalograms: nasion (N), sella (S), point A (A), point B (B), lower incisor (L1), anterior nasal spine (ANS), hard tissue pogonion (Pg), and gnathion (Gn). N-Pg and N-B refer to the distances from the vertical reference lines perpendicular to points Pg and B, respectively (Figure 1). Cephalometric angles SNB, ANB, and NAPg were constructed and measured in degrees. Additionally, the following soft tissue landmarks were identified: labrale inferius (Li), labiomental sulcus (Si), and soft tissue pogonion (Pg′). Facial convexity, labiomental angle, and lower lip length were also constructed and were measured in degrees and millimeters as appropriate (Figure 2).

Questionnaires

Each questionnaire consisted of 14 items (OH-1 to OH-14) designed to capture measures of seven domains[6] (Table 1): functional limitation (OH-1, OH-2); physical pain (OH-3, OH-4); psychological discomfort (OH-5, OH-6, OH-10); physical disability (OH-7, OH-8, OH-14); psychological disability (OH-9); social disability (OH-11, OH-12); and handicap (OH-13). Altogether, two questionnaires were completed by each patient; one was completed before the application of orthodontic appliances, an average of 6.2 months (SD 1.2 months) before surgery, and the second an average of 8.3 months (SD 1.2 months) after surgery, when orthodontic appliances had already been removed to ensure continuity in the responses and to prevent bias. In the questionnaires given before the operation, subjects were asked how

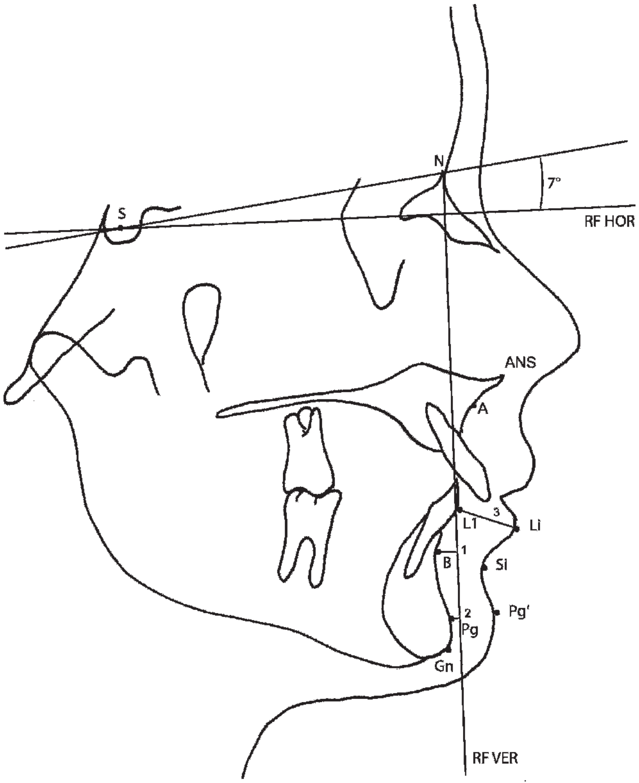

Figure 1. Hard and soft tissue landmarks and reference lines. RF HOR indicates horizontal reference line; RF VER, vertical reference line; 1, N-B distance; 2, N-Pg distance; and 3, Li-L1 distance. Full names of landmarks are given in the text.

frequently they had experienced the impact of that domain in the preceding 12 months. After the operation, patients had to complete the questionnaires to determine the impact of the operation on QoL during the previous month. Each item was scored on a 5-point scale as follows: never, score 0; hardly ever, score 1; occasionally, score 2; fairly often, score 3; very often, score 4. The higher the score recorded, the poorer the QoL. For analysis, mean scores were derived from the

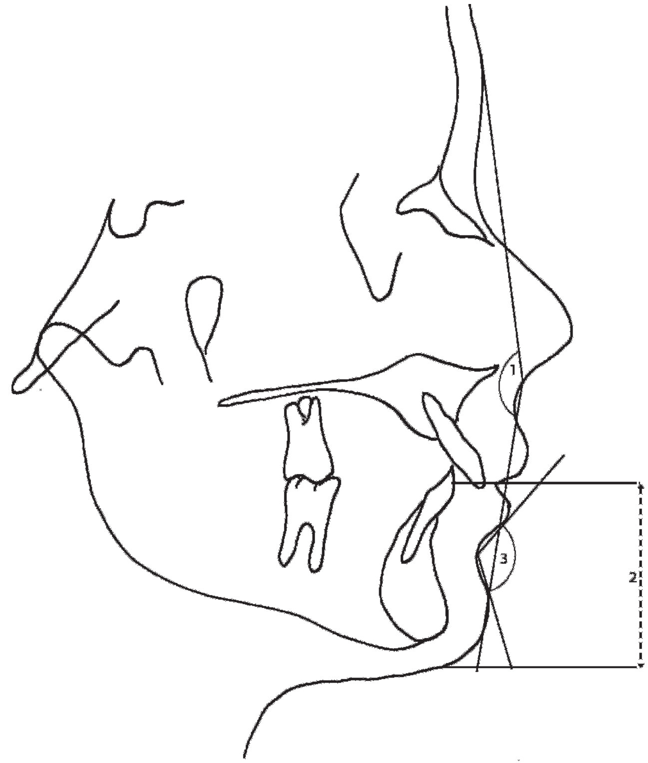

Figure 2. Soft tissue measurements of angles and distances. 1 indicates facial convexity; 2, lower lip length; and 3, labiomental angle.

scores given separately to individual questions in each of the questionnaires.

Statistical Analysis

The collected data were subjected to statistical analysis using the PASW statistical software package (version 18.0, SPSS, Chicago, Ill). The Kolmogorov-Smirnov normality test was performed to determine whether the samples conformed to a normal distribution. Differences between groups were evaluated

Table 1. Questionnaire Consisting of OHIP-14 Items (OH-1 to OH-14) for Presurgical and Postsurgical Assessment of Quality of Life

Item	How Often Have You Had Problems with Your Teeth, Mouth, or Dentures? Please Answer Using the Following Scores: 0 (Never), 1 (Hardly Ever), 2 (Occasionally), 3 (Very Often), 4 (Fairly Often)
OH-1	Have you had trouble pronouncing any words because of problems with your teeth, mouth, or dentures?
OH-2	Have you felt that your sense of taste has worsened because of problems with your teeth, mouth, or dentures?
OH-3	Have you had painful aching in your mouth?
OH-4	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth, or dentures?
OH-5	Have you felt self-conscious because of problems with your teeth, mouth, or dentures?
OH-6	Have you felt tense because of problems with your teeth, mouth, or dentures?
OH-7	Has your diet been unsatisfactory because of problems with your teeth, mouth, or dentures?
OH-8	Have you had to interrupt meals because of problems with your teeth, mouth, or dentures?
OH-9	Have you found it difficult to relax because of problems with your teeth, mouth, or dentures?
OH-10	Have you been a bit embarrassed because of problems with your teeth, mouth, or dentures?
OH-11	Have you been a bit irritable with other people because of problems with your teeth, mouth, or dentures?
OH-12	Have you had difficulty doing your usual job because of problems with your teeth, mouth, or dentures?
OH-13	Have you felt that life in general was less satisfying because of problems with your teeth, mouth, or dentures?
OH-14	Have you been totally unable to function because of problems with your teeth, mouth, or dentures?

Table 2. Presurgical to Postsurgical Changes in Cephalometric Parameters

Parameters	Presurgery		Postsurgery		Difference		P
	Mean	95% CI[a]	Mean	95% CI[a]	Mean	95% CI[a]	
SNB (°)	82.99	81.25 to 84.72	80.98	79.35 to 82.61	2.01*	1.19 to 2.82	.017
ANB (°)	−1.18	−2.47 to 0.11	1.34	−0.13 to 2.81	−2.52*	−3.45 to −1.58	.011
NAPg (°)	3.26	−0.02 to 6.54	−0.38	−3.95 to 3.19	3.64*	2.05 to 5.22	.024
N-B (mm)	0.17	−1.59 to 1.93	2.18	0.41 to 3.959	−2.01*	−2.79 to −1.22	.015
N-Pg (mm)	−2.48	−3.67 to −1.28	1.85	−0.19 to 3.893	−2.48	−3.67 to −1.28	.076
ANS-Gn (mm)	39.89	38.89 to 40.88	40.24	39.03 to 41.44	−0.35	−0.93 to 0.23	.499
Facial convexity (°)	177.38	174.61 to 180.15	170.09	167.48 to 172.69	7.29*	5.35 to 9.22	.001
Labiomental angle (°)	132.23	128.89 to 135.56	126.78	123.58 to 129.97	5.45*	3.37 to 7.52	.013
Lower lip protrusion (mm)	11.43	9.86 to 12.99	10.02	8.62 to 11.41	1.41*	0.93 to 1.88	.007
Lower lip length (mm)	29.77	28.94 to 30.59	28.75	27.86 to 29.63	1.02	0.29 to 1.74	.132
Pg′-Pg (mm)	8.66	7.99 to 9.32	8.89	8.23 to 9.54	−0.23	−0.60 to 0.14	.493
Si-B (mm)	7.44	7.06 to 7.81	7.42	6.96 to 7.87	0.02	−0.17 to 0.21	.905
Li-L1 (mm)	7.52	7.31 to 7.72	7.84	7.56 to 8.11	−0.32	−0.62 to −0.01	.247

* Significant at the level $P < .05$ (two-tailed).
[a] CI indicates confidence interval.

using the paired *t* test. Results were considered significant if $P < .05$ and highly significant if $P < .001$. The Pearson correlation analysis was used to assess the degree of correlation between presurgical-to-postsurgical changes in OHIP-14 item scores and soft and hard tissue changes. Reliability of the cephalometric measurements was determined by random selection of 10 cephalograms, on which the tracings were repeated by a second senior examiner. No significant errors were found when the repeat measurements were evaluated with the *t*-test. The interindividual correlation (Pearson correlation) of data determined by the investigators was 0.94 for cephalometric tracings, demonstrating high reliability of the procedure.

RESULTS

Patients

The prospective study sample consisted of 30 patients with Class III malocclusion undergoing BSSRO for mandibular setback (mean age 24.3 years, standard deviation [SD] 4.5 years; 17 female and 13 male patients) with an average setback of 7.6 mm (SD 2.5 mm). The median follow-up period between presurgical and postsurgical evaluation was 8 months (mean 8.3 months, SD 1.2 months). Significant differences between female and male patients were not detected in cephalometry or through evaluation of the OHIP-14 questionnaires (*t*-test). Therefore, gender was not considered further. With respect to sociodemographic items, 11 patients had received a education through primary school and 19 patients through high school. Thirteen patients were trainees/apprentices, 15 patients were college students, and two patients planned an academic career. No significant differences could be detected between patients' educational levels or planned careers and OHIP-14 ratings (*t*-test).

Presurgical to Postsurgical Changes in Cephalometric Parameters

Surgical outcomes, as assessed by hard and soft tissue cephalometry before and after BSSRO, revealed expected changes in angles and distances in accordance with the mandibular setback procedure performed (Table 2). A significant decrease was found postoperatively in the hard tissue measurements SNB angle ($P = .017$) and NAPg angle ($P = .024$) and in the soft tissue measurements facial convexity ($P = .001$), labiomental angle ($P = .013$), and lower lip protrusion ($P = .007$). Significant increases were found postoperatively in the hard tissue parameters ANB angle ($P = .011$) and N-B

Table 3. Presurgical to Postsurgical Changes in OHIP-14 Item Scores

Items	Presurgery		Postsurgery		Difference		P
	Mean	95% CI[a]	Mean	95% CI[a]	Mean	95% CI[a]	
OH-5	1.42	1.01 to 1.83	0.68	0.41 to 0.96	0.73*	0.29 to 1.18	.022
OH-6	1.47	0.99 to 1.95	0.84	0.51 to 1.17	0.63*	0.14 to 1.11	.045
OH-10	1.26	0.66 to 1.86	0.47	0.18 to 0.75	0.78*	0.27 to 1.31	.027
OH-11	1.21	0.67 to 1.75	0.52	0.24 to 0.81	0.68*	0.18 to 1.17	.043

[a] CI indicates confidence interval.
* Significant at the level $P < .05$ (two-tailed).

Table 4. Correlations Between Surgical Changes or Scores on OHIP-14 Items and Cephalometric Parameters

Parameter[a]	OH-2	OH-3	OH-4	OH-5	OH-6	OH-7	OH-8	OH-9	OH-10	OH-12
SNB	*n.s.*	−0.447*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
NAPg	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	0.564*	0.537*	*n.s.*	*n.s.*	0.529*
N-Pg	*n.s.*	0.563*	*n.s.*	0.523*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
ANS-Gn	*n.s.*	*n.s.*	*n.s.*	0.448*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Facial convexity	*n.s.*	*n.s.*	*n.s.*	−0.540*	*n.s.*	*n.s.*	*n.s.*	−0.462*	*n.s.*	*n.s.*
Labiomental angle	0.527*	*n.s.*	0.831**	0.530*	0.598*	0.368	0.480*	*n.s.*	*n.s.*	0.504*
Lower lip protrusion	*n.s.*	−0.508*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Lower lip length	*n.s.*	−0.776**	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	−0.511*	*n.s.*	*n.s.*
Pg′-Pg	*n.s.*	*n.s.*	−0.562*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	0.535*	*n.s.*
Si-B	0.599*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*

[a] Parameters providing at least one significant correlation; *n.s.* indicates not significant.
* Significant at the level $P < .05$ (two-tailed); ** significant at the level $P < .001$ (two-tailed).

(P = .015). In contrast, the distances between hard and soft tissue landmarks of the lower face (Pg≠-Pg, Si-B, and Li-L1) showed no significant change as a result of surgery.

Presurgical to Postsurgical Changes in OHIP-14 Scores

Changes in OHIP-14 scores (Table 3) revealed significant decreases between presurgical and postsurgical findings with respect to items covering the areas of psychological discomfort (OH-5, P = .022; OH-6, P = .045; and OH-10, P = .027) and social disability (OH-11, P = .043). For all other OHIP-14 items covering the areas of psychological disability, handicap, physical disability, physical pain, and functional limitation, no significant differences were seen between presurgical and postsurgical scores. Items involving these unaffected areas had lower presurgical scores (0.36 to 1.15) compared to the items that did change significantly from presurgery to postsurgery (1.21 to 1.47). Although the areas of psychological discomfort and social disability had a greater impact on patients' QoL than physical or functional aspects and displayed a significant improvement postoperatively, they revealed postsurgical scores (0.47 to 0.84) that were comparable to the areas of psychological disability, handicap, physical disability, physical pain, and functional limitation (0.52 to 1.26; P = .245, respectively).

Correlations Between Changes in OHIP-14 Scores and Cephalometric Parameters

Correlation coefficients (r) between presurgical and postsurgical OHIP-14 scores and cephalometric parameters revealed significant changes in several cases (Table 4). In particular, presurgical to postsurgical changes of OHIP-14 item scores were mostly significantly correlated with cephalometric changes of the labiomental angle. The greater the change in the labiomental angle, the greater the change in OHIP-14 scores involving functional limitation (OH-2, r = 0.527), physical pain (OH-4, r = 0.831), psychological discomfort (OH-5, r = 0.530; OH-6, r = 0.598), physical disability (OH-8, r = 0.480), and social disability (OH-12, r = 0.504). Other typical cephalometric changes found after mandibular setback, such as reduction of the SNB angle, facial convexity angle, lower lip protrusion, and lower lip length, revealed negative correlations, with changes in scores of the items OH-3 ("experiencing painful aching"), OH-5 ("feeling self-conscious"), and OH-9 ("difficulty in relaxing"). In contrast, an increased N-Pg distance, which was also a typical finding after mandibular setback as a consequence of the backward movement of the hard tissue landmark Pg, was positively correlated with changes in items OH-3 (r = 0.563) and OH-5 (r = 0.523).

DISCUSSION

Skeletal disfigurement has a negative impact on a patient's social life.[12] In particular, dentoskeletal Class III malocclusion results in unesthetic alterations of soft tissues, which may cause psychological and interpersonal problems.[13] Therefore, it seems reasonable to offer orthognathic surgery to subjects with dentofacial deformities to improve their psychological well-being and QoL. Orthognathic surgery for Class III malocclusion aims to achieve both functional and esthetic improvements, including stable occlusion and a reduction in lower facial area and chin prominence to harmonize the profile. Hence, it is generally assumed that orthognathic surgery will result in an improved QoL. Therefore, the findings of this study seem contradictory in that, on the one hand, positive correlations were found between cephalometrically measured changes and changes in OHIP-14 scores for psychological discomfort, physical disability, social disability, and functional limitation, whereas on the other hand, other typical cephalometric changes found after mandibular setback, such as reduction of the SNB

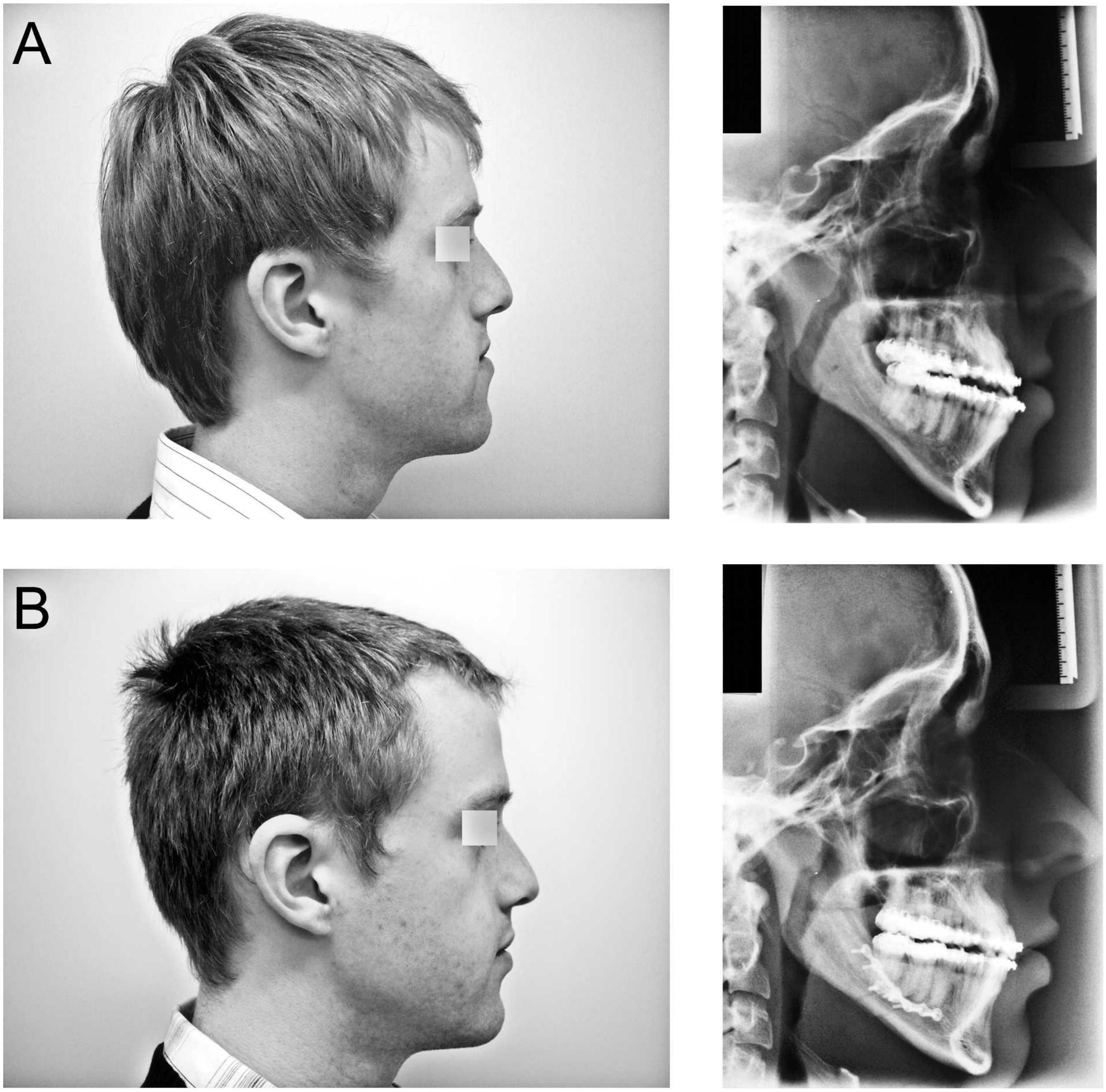

Figure 3. Example of presurgical (A) to postsurgical (B) significant changes in profiles and corresponding cephalograms. The reduction in the parameters nasolabial angle, facial convexity, and N-Pg had a significant impact on patients' QoL.

angle, facial convexity angle, lower lip protrusion, and lower lip length, revealed negative correlations with changes in scores, demonstrating significant negative impacts on presurgical to postsurgical changes in physical pain, psychological disability, and psychological discomfort. Obviously, some cephalometrically measured changes toward a less prominent mandible led to significant negative effects on the QoL. One reason could be that significant correlations between changes in item scores and cephalometric parameters do not take into account the fact whether the postsurgical changes themselves were also significant. If they were not significant, their negative impact on OHIP-14 scores was not a result of the surgery. Hence, three cephalometric hard and soft tissue parameters (N-Pg, labiomental angle, facial convexity) were found to affect presurgical to postsurgical changes in QoL moderately but significantly in this study (Figure 3). ''Self-consciousness'' seems to play an important role in QoL, since 50% to 75% of orthognathic surgery patients feel self-conscious before treatment.[14,15] With respect to the OHIP-14 questionnaire used in this study, items covering the areas of psychological discomfort, especially OH-5 (''feeling self-conscious''), are mostly and significantly affected by changes in cephalometric parameters caused by mandibular setback. Hence, ''feeling self-conscious'' could be directly linked to the cephalometric parameters labiomental angle, N-Pg, and facial convexity in this study.

One explanation for the negative correlation between facial convexity and the score of OH-5 (''feeling self-conscious'') might be that, in spite of the fact that most patients who undergo orthognathic surgery readily accept the change in their appearance and are highly satisfied with the outcome, up to 30% of patients have difficulty getting used to their appearance, even 24 months after surgery.[16] In particular, correction of the lower facial area by mandibular setback in Class III patients to achieve an improved facial profile with a reduced facial convexity angle and a less accentuated chin may lead to an extreme alteration in appearance.[17] On the one hand, the radical change in the profile with reduction of the facial convexity angle may contribute significantly to the delay in getting used to the new appearance, which was shown through the negative correlation with the changes in self-consciousness scores, whereas on the other hand, profile changes, including reduction of the labiomental angle and extension of the N-Pg distance, positively affected the QoL. Indeed, this led to a significant decrease of the impact scores of OH-5 and OH-6 postoperatively and therefore to increased psychological comfort.

However, other unknown, very individual factors may play important roles in patient satisfaction and perceived improvement in QoL. Correction of a facial deformity should not be the major determinant of an improved social life. Therefore, medical staff should decide in each individual case whether orthognathic surgery might be beneficial, especially for patients who assume that the surgery would solve most of their problems.

CONCLUSIONS

- Significant correlations were found between changes in cephalometric parameters and item scores in the OHIP-14 questionnaire. In particular, the postsurgical reduction of the labiomental angle and reduced accentuation of the chin after BSSRO for mandibular setback could be directly linked to reduced psychological discomfort (eg, ''feeling self-conscious'' and ''feeling tense'') in patients' QoL.
- Postsurgical changes to a more convex profile after mandibular setback should be more heavily emphasized to patients, and more information should be provided to the patients by the operating staff before surgery to help patients get used to their new appearance more easily without negative impact on their QoL.

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