Original Article

Outcome of Orthognathic Surgery in Chinese Patients

A Subjective and Objective Evaluation

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ABSTRACT

Objective: To evaluate the outcome of orthognathic surgery by objective cephalometric measurement of posttreatment soft-tissue profile and by subjective evaluation of profile esthetics by laypersons and clinicians.

Materials and Methods: The sample consisted of 30 Chinese patients who had completed combined orthodontic and orthognathic surgical treatment. The posttreatment cephalograms of these patients were analyzed with respect to profile convexity, facial height, and lip contours and these were compared to the previously established esthetic norms. Line drawings of the soft-tissue profile were displayed to a panel comprising six laypersons and six clinicians who scored the esthetics of each profile using a 7-point scale.

Results: Complete normalization of cephalometric soft-tissue variables was not achieved with orthognathic surgery in most patients, with four of the six soft-tissue cephalometric measurements showing significant differences compared to the esthetic norms. There were good correlations in the esthetic scores between laypersons and clinicians, even though clinicians tend to rate the profiles more favorably. Facial convexity and facial height did not significantly influence the subjective scores of both the laypersons and clinicians. Lower lip protrusion was the only cephalometric variable that significantly influenced clinicians' assessment of profile esthetics ($P < .01$).

Conclusions: Profile convexity and lower facial height proportion had little influence on both lay and professional perception of profile esthetics. Lower lip position is the only cephalometric variable that significantly influenced clinicians' assessment of profile esthetics.

KEY WORDS: Orthognathic surgery; Soft-tissue cephalometric variables

INTRODUCTION

The aim of orthodontic surgical treatment of patients with dentofacial deformities is to achieve a harmonious skeletal, dental and soft-tissue relationship for the improvement of facial esthetics and function. However, in most, if not all cases, the patient is solely interested in the esthetic outcome of the treatment.[1–5] The soft-tissue change as a result of orthognathic surgery is of utmost importance to the patient, and dental professionals must bear that in mind when planning treatment.

Cephalometric norms are used for providing guidance to the clinician during diagnosis and treatment planning. This is even more so in orthognathic surgical treatment where there are obvious needs to identify the skeletal dysgnathia and soft-tissue facial disharmony by comparing with the normative values. The aim of treatment is to alter the skeletal and soft-tissue facial profile to approximate that of the esthetic norms, the so-called yardstick. However, the questions often asked are how valid are these cephalometric norms and was normalization of these cephalometric variables achieved in the majority of the orthognathic cases.

It is important to note that the normative cephalometric analyses used for the diagnosis and treatment planning of orthognathic surgical patients are specific to the ethnic groups from which the analyses were de-

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rived.[6–11] Using soft-tissue cephalometric analysis described by Legan and Burstone[12] and Holdaway,[13] Lew et al[14] reported that a Chinese normative soft-tissue profile with good facial esthetics would have a less prominent nose with an acute nasolabial angle associated with a greater upper and lower lip protrusion, a lesser upper lip curvature, and a reduced soft-tissue chin thickness when compared with a white profile.

Added to the complexity of assessing orthognathic surgical treatment outcome is the differing definition of beauty and facial attractiveness by laypersons and clinicians. Studies have shown that the perception of facial profile esthetics differs between patients, peers, and dental professionals.[15–20] It has also been suggested that clinicians could be more sensitive to certain aspects of the profile than laypersons and vice versa. Specific areas that may not be very crucial to the layperson may actually be very crucial to the clinicians. Moreover, cephalometric measurements that define facial profiles were found to be poorly correlated with the perception of facial esthetics.[21–23]

The aims of this study were to evaluate the outcome of orthognathic surgery by objective cephalometric measurement of posttreatment soft-tissue profile and by subjective evaluation of profile esthetics by laypersons and clinicians. Another aim of this study was to investigate the effects of soft-tissue cephalometric variables on assessment of postsurgical profile esthetics by laypersons and professionals.

MATERIALS AND METHODS

Sample Selection

The sample consisted of 30 Chinese patients (21 female, 9 male) with a mean age of 22.2 years (SD $\pm$ 7.0). This sample was selected from the cohort of patients who had undergone orthognathic surgery in 2001 in the National Dental Centre in Singapore. All patients met the following inclusion criteria:

1. They had undergone presurgical orthodontics and orthognathic surgery involving surgical stabilization with internal rigid fixation using titanium mini bone plates and monocortical screws.
2. They had lateral cephalograms taken after the completion of postsurgical orthodontics which were at least six months after the surgery. All radiographs were taken with teeth together in centric occlusion and lips in repose.
3. They did not have cleft lip and palate or other congenital craniofacial anomalies.

Besides ethnicity, other demographic characteristics and types of surgical procedures were not considered during subject selection.
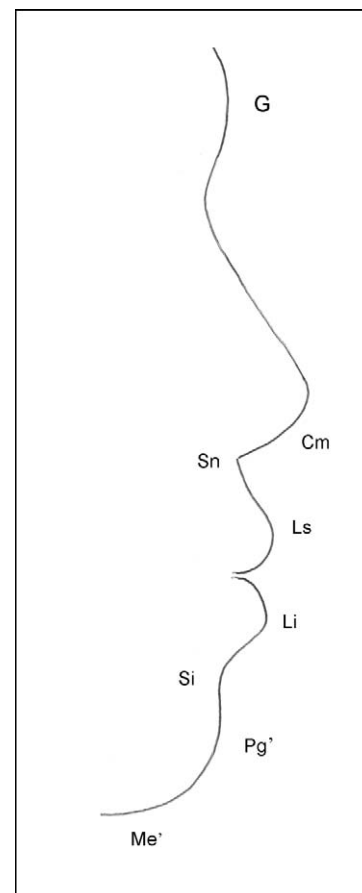
Figure 1. Soft-tissue cephalometric landmarks used in the study: G (gabella), Cm (columella), Sn (subnasale), Ls (labrale superius), Li (labrale inferius), Si (labiomental fold), Pg' (soft tissue pogonion) and Me' (soft tissue menton).

Method

The postsurgical cephalograms were digitized by a single examiner using the CASSOS 2001 software (SoftEnable Technolgy Ltd, Hong Kong). Cephalometric analysis was performed using soft-tissue landmarks shown in Figure 1. Three linear and two angular measurements and one ratio-related measurement were determined to assess profile convexity, lower facial height proportion, and lip position (Table 1). The cephalometric findings were compared to the esthetic norms for Chinese adults described by Lew et al.[14]

Line drawings of soft-tissue profile derived from the posttreatment cephalograms were displayed randomly to a panel comprising six laypersons and six clinicians (three oral surgeons and three orthodontists) who were asked to score the esthetics of each profile using a 7-point scale with 1 representing very unattractive and 7 very attractive.

Method Error and Statistical Analysis

Descriptive statistics were generated for the soft-tissue measurements of the postsurgical cephalograms

Table 1. Comparison of Posttreatment Soft-Tissue Cephalometric Measurements Against Esthetic Norms[a]

Soft-Tissue Variables	Norms		Present Study			P value
	Mean	SD	Mean	SD	Range	
Facial form						
Facial convexity angle (G-Sn-Pg'), degrees	10.5	3.5	6.75	6.45	−4.0–19.1	.0014
Vertical height ratio (G-Sn/Sn-Me')	1.0	0.1	1.05	0.10	0.80–1.26	.0349
Lip position						
Nasolabial angle (Cm-Sn-Ls), degrees	95	3	93	8	76.7–111.7	.1332
Upper lip to B-line (Ls to Sn-Pg'), mm	7.0	1.5	6.50	1.85	2.5–10.5	.1948
Lower lip to H-line (Li to Ls-Pg'), mm	0.5	1.0	2.43	1.55	0.1–7.2	<.0001
Mentolabial sulcus (Si to Li-Pg'), mm	3.5	2.0	5.07	1.11	3.5–8.3	.0002

[a] Lew et al.[14]

using SPSS version 10.0. The reproducibility of the measurements was determined by selecting 10 cephalometric radiographs at random and repeating the on-screen digitization by the same examiner one month after the initial digitization. No significant errors were found when the repeat measurements were evaluated with paired t-tests.

A two-sample t-test was used to test for significant differences between the mean cephalometric values and the esthetic norms. The layperson and clinician subjective scores were compared with the Wilcoxon signed ranks test. Spearman's rho correlation coefficient was used to assess the correlation between the layperson and clinician subjective scores. The same test was used to determine whether relationships exist between the soft-tissue cephalometric variables and the subjective esthetic scores. Statistical significance was set at $P < .05$.

RESULTS

Objective Cephalometric Analysis

Cephalometric analysis (Table 1) of the posttreatment radiographs showed that profile convexity ranged from −4° to 19.1° with a mean value of 6.75°, which was significantly lower compared to the esthetic norm ($P < .01$). Mean values for upper lip to B-line and nasolabial angle were not significantly different from the norms, but the range was wide. Mean values for vertical height ratio ($P < .05$), lower lip to H-line ($P < .001$), and mentolabial sulcus ($P < .001$) were significantly above the norms.

Subjective Assessment

The esthetic scores between laypersons and clinicians showed good correlation ($r = .74$, $P < .001$), even though clinicians tend to rate the posttreatment profiles more favorably than laypersons (Figure 2). The laypersons' mean score was 3.52 (SD ± 0.71), which was significantly lower than the clinicians' mean score of 4.04 (SD ± 0.85) ($P < .001$).

Correlation Between Objective and Subjective Assessment

Correlation between posttreatment soft-tissue cephalometric measurements and subjective scores by clinicians and laypersons was poor in general (Table 2). Correlation scores of clinicians are consistently better than the corresponding laypersons' scores, even though the majority of the clinicians' scores still did not achieve significant level. Both profile convexity and lower facial height index had very low correlation with the clinicians' and laypersons' subjective scores that fail to reach significant level. Lower lip position showed the greatest correlation to the subjective scores, but significance level was found only for the clinicians' scores ($P < .01$).

DISCUSSION

Cephalometric Values Used in This Study

Cephalometric norms have been used routinely in clinical practice as a guide for the clinician during diagnosis and treatment planning and for assessing the outcome of treatment. Their usefulness is even more obvious in orthognathic surgical treatment where they serve as a yardstick that clinicians (orthodontists, oral
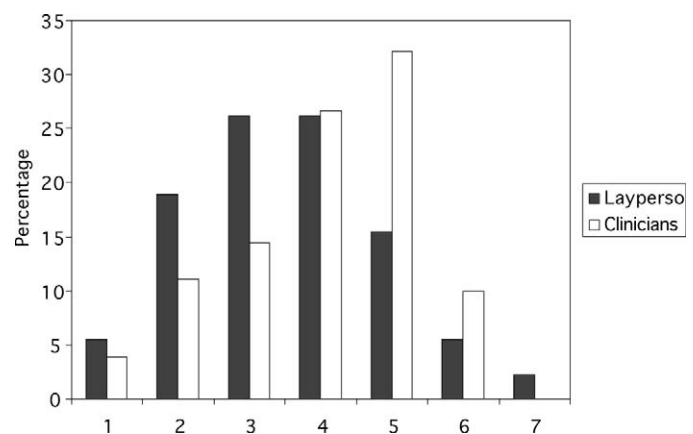

Figure 2. Subjective esthetic scores of laypersons and clinicians.

Table 2. Correlation Between Posttreatment Soft-Tissue Cephalometric Measurements and Subjective Scores by Clinicians and Laypersons

Soft Tissue Variables	Laypersons' Scores	Clinicians' Scores
Facial form		
Facial convexity angle (G-Sn-Pg'), degrees	0.012	0.047
Vertical height ratio (G-Sn/Sn-Me')	−0.144	−0.171
Lip position		
Nasolabial angle (Cm-Sn-Ls), degrees	0.158	0.192
Upper lip to B-line (Ls to Sn-Pg'), mm	−0.081	−0.260
Lower lip to H-line (Li to Ls-Pg'), mm	−0.320	−0.496**
Mentolabial sulcus (Si to Li-Pg'), mm	−0.078	−0.338

** $P < .01$.

and maxillofacial surgeons, and plastic surgeons) could use. The use of normative values was first suggested by Downs, who based his normative values on a group of subjects with untreated excellent occlusions. Later studies had derived normative values not just from individuals with clinically good occlusions but from individuals who also had good facial esthetics. The current study uses the normative values established by Lew et al[14] who obtained their data from a group of 48 Chinese subjects who had been judged by laypersons and clinicians to have esthetically pleasing profiles.

The sample consisted of young Chinese adults, which is appropriate for our study because it correlates with the age at which patients undergo orthognathic surgery. However, one limitation of these normative data is that the data are not gender specific, as the authors' intention was to develop cephalometric norms that could be easily used in clinical practice for either sex.

Treatment Outcome vs Esthetic Norms

The results of this study showed that there were significant discrepancies between the posttreatment results and the esthetic norms established by Lew et al.[14] There would be several reasons why the treatment outcome had fallen short of the esthetic norms. These would include: (1) lack of adequate dental decompensation leading to occlusal limitation to optimal surgical movements, (2) severe initial dysgnathia not amendable to complete normalization due to surgical limitations, (3) surgical relapse because the posttreatment cephalograms were taken more than 6 months after the surgery, and (4) failure to transfer the planned surgical movement to the operating table.

The analysis of the individual craniofacial pattern in relation to esthetic norms is certainly a helpful method of determining which parameters are most responsible

for the skeletal and soft-tissue disharmony, thereby representing an additional diagnostic tool in surgical planning. However, it always has been argued that normative data are not meant to be template goals which clinicians should strive to achieve in all cases. It would be inappropriate to suggest specific surgical decisions based solely on the cephalometric data given by these norms without considering the patient's chief complaint and psychosocial concern, as well as the function of the occlusion and the temporomandibular joints. Probably, there is more value in knowing the variation that exists in cephalometric parameters than there is in knowing the mean values themselves. Besides, the presence of statistically significant differences in the mean cephalometric variables does not necessarily mean that clinically important differences exist. In fact, in one study, Burcal et al[24] have reported that a 6-mm change had to occur before it was observed by two out of three laypersons.

Layperson vs Professional Assessment of Profiles

Defining beauty and attractiveness is a complex issue, and it is increasingly recognized that what is considered attractive to patients and the layperson may not be what orthodontists and surgeons perceive as attractive based on their experience and training.[15–20] Studies in the literature have shown varied results regarding differences in the perception of facial attractiveness by clinicians and laypersons. However, comparison between studies must be done with care because methods may differ significantly, particularly with regard to the use of line profile drawings or photographs. In this study, line drawings of the cephalometric profiles were used instead of the standardized photographic portraits so as to minimize the distracting effect of other facial features (eg, hairstyle, hair color, and complexion) in the subjective assessment of esthetics by the panel. For the same reason, the dentoosseous portion of the lateral cephalograms was also not shown.

It has been reported that dental professionals are conditioned to take an overly critical view of any deviation from normal facial appearance, but this is not in agreement with the present findings. The present study found that clinicians tend to rate the posttreatment profiles more favorably compared to laypersons, although there was good correlation between the esthetic scores of clinicians and laypersons. One possible explanation is that clinicians tend to adopt a less critical attitude when assessing posttreatment results because experience and training would have influenced their expectation of the outcome of such complex treatment. The variability of soft-tissue response to skeletal repositioning is known to all clinicians and

a less stringent assessment of the posttreatment profile is not surprising.

Influence of Soft-tissue Cephalometric Variables on Subjective Scores

The influence of antero-posterior discrepancies on facial attractiveness as measured by the facial convexity angle was examined in this study. Studies have suggested that the antero-posterior dimension was one of the most important factors in judging facial attractiveness.[19,25] This is not in agreement with the present findings which showed poor correlation between profile convexity and subjective assessment of profile attractiveness by both clinicians and laypersons.

The influence of vertical facial proportion on perception of facial attractiveness has also been investigated by several studies[26–28] with varied findings. Some studies have reported that a reduced lower facial proportion was more acceptable than an increased lower facial proportion, but there are also studies that have demonstrated otherwise. The findings of this study showed that an increased lower facial proportion was perceived to be more unattractive, but the correlation was poor and did not reach significant level.

The mean lower lip position found in this sample was significantly higher than the esthetic norm, whereas the mean upper lip position was close to the norm. This may indicate that there was a general imbalance of the upper and lower lip positions in some of these postsurgical patients with the lower lip significantly more protrusive compared to the upper lip. This relative protrusion of the lower lip would explain the significant correlation between the lower lip position and the clinicians' subjective scores.

The general lack of strong correlations between cephalometric variables and the perception of profile attractiveness in this study supports the findings of other studies which have shown that the attractiveness of a face can hardly be explained by objective parameters but is, instead, affected by many nonmetric factors such as face color, facial expression, and cultural environment of the beholder.[23]

CONCLUSIONS

- Complete normalization of cephalometric soft-tissue variables was not achieved with orthognathic surgery in most patients with four of the six soft-tissue cephalometric measurements showing significant differences compared to the esthetic norms.
- There was good correlation between clinicians' and laypersons' assessment of posttreatment profile esthetics, even though clinicians tend to rate the profiles more favorably.
- Profile convexity and lower facial height proportion

had little influence on both the lay and professional perception of profile esthetics. Lower lip position is the only cephalometric variable that significantly influenced clinicians' assessment of profile esthetics.

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