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Perceptions of Orthognathic Surgery Patient's Change in Profile

A Five Year Follow-up

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ABSTRACT

Objectives: To compare pairs of silhouettes generated from presurgical and 5-year postsurgical cephalometric radiographs to evaluate whether orthodontists, oral surgeons, and lay persons perceive changes in profile resulting from orthodontics and mandibular advancement surgical treatment.

Materials and Methods: A survey-based method of data collection was used to evaluate 15 pairs of silhouettes. These silhouettes included 1 control pair and 14 surgically treated pairs representing mandibular advancements ranging from 0.11 mm to 10.13 mm. Collected data were analyzed to determine whether changes can be perceived and whether these changes were esthetically pleasing.

Results: The control silhouette pair was identified by 104 of 127 evaluators. For the 14 surgical treated silhouette pairs, the vast majority of evaluators (N = 127; 53 orthodontists, 32 oral surgeons, and 42 lay persons) were able to identify changes in profile and individual features. At least one group of evaluators was able to perceive significant ($P < .05$) improvement in the visual analog scale (VAS) score for all these silhouette pairs, except for the pair with 10.13 mm of mandibular advancement. This silhouette pair, which represented the largest mandibular advancement, was perceived to have a significant ($P < .05$) worsening in the VAS score by the lay person group. There were significant differences among the groups of evaluators. Esthetic improvement in profile was perceived for 13 of 14 surgically treated silhouette pairs.

Conclusion: In some cases, orthodontists, oral surgeons, and lay persons perceived changes in profile differently.

KEY WORDS: Profile, Surgery, Advancement, Mandibular, Orthodontics.

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INTRODUCTION Return to TOC

Combined orthodontic and orthognathic surgical treatment has become a common treatment modality for the correction of facial deformities and occlusal disharmonies. In a review of the literature concerning the psychological aspects of orthognathic surgery, Cunningham et al[1] cites multiple studies stating that esthetic improvement was the major motivating factor for patients undergoing surgery. Research has been conducted to assess perceptions of surgical outcomes. In general, studies have looked at pretreatment and posttreatment photographs or at digitally altered photographs simulating surgical outcomes and silhouettes.

Studies have found that surgical patients perceive their own profile changes differently than lay persons and dental professionals. Kiyak et al[2] showed that patients may not always be able to appreciate changes in profile even after successful surgical correction. Phillips et al[3] used patients' records to show a 7.8-mm visual analog scale (VAS) improvement in surgically treated Class II skeletal patients, whereas camouflaged patients showed no significant improvement in the VAS score. However, the results and retrospective nature of this study suggested that more attractive patients were camouflaged, whereas less attractive patients were treated surgically. Shelly et al[4] used the silhouettes of 34 surgically treated Class II patients and found a significant negative correlation between the initial esthetic score and the esthetic change perceived by lay evaluators and orthodontist evaluators.

Burcal et al[5] used digitally altered photographs to show that lay persons and patients recognized a 2-mm change at pogonion in 22% of retrognathic subjects, a 4-mm in 44% of retrognathic subjects, and a 6-mm change in 67% of retrognathic subjects. They also showed that dental professionals were 5%, 6%, and 15%, respectively, more accurate at recognizing changes at the three levels of advancement. Romani et al[6] also used digitally altered photographs and showed that orthodontists detected 1 mm of horizontal change in mandibles in 65.9% of subjects. The detection rate improved significantly to 93.9% at 3 mm of change and further improved to 97% at 5 mm of change.

Controlled research is needed to assess whether dental professionals can recommend orthognathic surgery as an option for observable esthetic improvement. Several factors will play a part in such a recommendation. Dental professionals must understand a patient's goals and perceptions of normal and how these differ from his or her own goals and perceptions. A positive and perceivable result depends on the soft tissue effect and the stability of the surgical correction, as well as achieving an amount of surgical correction great enough for patients, dental professionals, and lay persons to recognize.

This study compared pairs of silhouettes generated from presurgical and 5-year postsurgical cephalometric radiographs and used a control pair of silhouettes, a feature that was absent in many other studies. The purpose of this study was to evaluate whether profile changes resulting from treatment are detectable 5 years after surgery. This evaluation was done by comparing differences in the profile changes perceived by orthodontists, oral surgeons, and lay persons, as well as by determining how much hard tissue pogonion advancement and soft tissue profile change are needed to cause perceivable profile changes.

MATERIALS AND METHODS Return to TOC

Surgical Subjects

The radiographs used in this study were obtained from a prospective randomized clinical trial[7] that examined hard and soft tissue stability after surgery using either rigid or wire fixation. Two cephalograms were used: a preoperative (T0) and a 5-year postoperative (T5).

All patients had underwent bilateral sagittal split osteotomy. Inclusion criteria for this study were the presence of presurgical and 5-year postsurgical lateral cephalometric radiographs. Exclusion criteria were incomplete or poor quality records or the presence of a genioplasty.

Fourteen surgical subjects were used in this study. Their mandibular advancements ranged from 0.11 mm to 10.13 mm. Measurements were made with an x-y coordinate system and templates described by Dolce et al.[7,8] Surgical subjects were selected based on the quality of the records, and an effort was made to assure that the majority of surgical subjects had advancements between 1 mm and 6 mm. Previous studies have shown that this range of advancement is critical to the recognition of esthetic change in profile after surgical advancement of the mandible.[3,5] Surgical subjects had their profiles traced from their cephalometric radiographs. The tracings were then scanned, set to a standard size, converted into a silhouette, and oriented to the Frankfort horizontal plane.

These silhouettes were then used to create a survey. Presurgical and postsurgical silhouettes were placed beside each other. Seven pages of the survey had silhouettes from T0 on the left side of the page and silhouettes from T5 on the right side of the page. Seven other pages of the survey had silhouettes from T5 on the left side of the page and silhouettes from T0 on the right side of the page. The control pair of silhouettes had T5 silhouettes from the patient with 4.74 mm of advancement on both the right and left sides of the page. A 100-mm visual analog scale (VAS) was used to assess the level of esthetic improvement, if any. An example of a survey page is presented in Figure 1. Linear measurements (amount of hard tissue pogonion advancement) were obtained from data in a previously published study.[7]

Evaluator Subjects

The presurgical and postsurgical profile silhouettes were assessed by 53 orthodontists, 32 oral surgeons, and 42 lay persons. The orthodontists and oral surgeons were randomly chosen from professional directories. Randomization was achieved by generating a list of random numbers and using these numbers to pick professionals from their directories. Surveys were mailed to 421 orthodontists and 460 oral surgeons. Survey packets included an informed consent letter, a self-addressed and stamped envelope, and a copy of the survey. Orthodontists and oral surgeons received no compensation for their participation.

A convenience sample of lay persons was obtained in the Shands Hospital lobby, the University of Florida College of Dentistry student clinic lobby, a neighborhood in Jacksonville, Fla, and an elementary school in North Palm Beach, Fla. Lay person evaluators received a coupon for a free movie rental from Blockbuster Video as compensation for their participation. The inclusion criterion was the acceptance of the informed consent. Exclusion criteria were rejection of informed consent, inability to follow survey instructions, or failure to return the survey.

Evaluator Demographics

Demographic information was collected from all evaluators. This information included age, education, gender, and race.

Statistical Method

The number of evaluators that saw differences between silhouette pairs and features of silhouette pairs were calculated. These totals were then separated into their respective evaluator groups. To assess group differences, the chi-square and Fisher exact tests were used. The level of significance was set at $P < .05$.

The mean and standard deviation in VAS score were calculated for each silhouette. The mean and standard deviation in VAS differences (postsurgical minus presurgical) were calculated for each silhouette pair. These means and standard deviations were then separated by evaluator groupings to assess group differences.

To assess differences in postsurgical-minus-presurgical VAS scores, paired *t*-tests were used. Evaluator group differences in postsurgical-minus-presurgical VAS scores were assessed by Kruskal Wallis and pairwise Wilcoxon rank sum tests. Age differences among evaluator groups were assessed with Kruskal Wallis tests. The level of significance was set at $P < .05$.

RESULTS Return to TOC

Demographics

The response rate for the orthodontists and oral surgeons was 12% and 7%, respectively. The mean age of the lay persons, oral surgeons, and orthodontist was 46 ± 14.8, 49 ± 12.6, and 53 ± 13.2, respectively. Differences in the mean ages of the evaluator groups were not significant. Statistical analysis of education, gender, and race were not considered because of expected differences among the groups.

Overall Perceptions of Profile Change

The vast majority of evaluators were able to perceive changes in all surgically treated silhouette pairs. Of the 127 evaluators, 104 (82%) correctly identified the control pair of silhouettes as not being different. Many evaluators were able to perceive changes to individual features. The majority of these changes took place at the chin, the lower lip, and the upper lip. However, many evaluators perceived changes to the nose and the forehead (Table 1).

Overall VAS mean scores arranged by the amount of hard tissue pogonion advancement are presented in Figure 2a, and overall VAS mean scores arranged by change in soft tissue Glabella-Subnasale-Pogonion (Gb-Sn-Pg) are presented in Figure 2b. While the largest VAS improvements occurred for surgically treated silhouette pairs with 3.20 mm, 7.38 mm, and 8.69 mm of advancement, the pair with 10.13 mm of advancement was perceived to have a worsening in the VAS score. All three sets of evaluators perceived no significant change in the VAS score for the control pair of silhouettes.

Orthodontists' Perceptions of Profile Change

The majority of orthodontists detected changes in profile and individual features (Table 1). Of the 53 orthodontist evaluators, 47 (89%) correctly recognized the lack of change in the control pair of silhouettes. Orthodontist evaluators perceived significant improvements in all surgical treated silhouette pairs except for the pairs with 9.56 mm and 10.13 mm of advancement. The worsening in the VAS score for the 10.13-mm pair and the improvement for the 9.56-mm pair did not reach statistical significance.

Oral Surgeons' Perceptions of Profile Change

The majority of oral surgeons detected changes in profile and individual features (Table 1). Of the 35 oral surgeon evaluators, 25 (78%) correctly recognized the lack of change in the control pair of silhouettes. Oral surgeon evaluators perceived significant improvements in all surgically treated silhouette pairs except for the pairs with 2.43 mm, 5.24 mm, and 10.13 mm of advancement. The pairs with 2.43 mm and 5.24 mm of advancement were perceived to have nonsignificant improvement in the VAS score. The pair with 10.13 mm of

advancement was perceived to have a nonsignificant worsening in the VAS score.

Lay Persons' Perceptions of Profile Change

The majority of lay persons also detected changes in profile and individual features (Table 1). Of the 42 lay person evaluators, 32 (76%) correctly recognized the lack of change in the control pair of silhouettes. Lay person evaluators perceived significant improvements in all surgically treated silhouette pairs except for the pairs with 2.27 mm, 2.43 mm, 4.74 mm, 5.24 mm, and 10.13 mm of advancement. The pair with 2.27 mm of advancement was perceived to have a nonsignificant worsening in the VAS score. The pairs with 2.43 mm, 4.74 mm, and 5.24 mm of advancement were perceived to have nonsignificant improvement in the VAS score. The pair with 10.13 mm of advancement was perceived to have a significant worsening in the VAS score.

Evaluator Differences

No evaluator group differences were seen when evaluating the detection of changes to the silhouettes as a whole. However, there were multiple evaluator group differences when individual facial feature evaluations were considered. All silhouette pairs had at least one significant group difference for one feature except the control pair and the surgically treated silhouette pairs with 0.11 mm, 3.80 mm, 6.81 mm, and 6.81 mm of advancement. The pairs with 4.74 mm, 5.25 mm, 7.38 mm, and 8.69 mm of advancement all had three features reach significance with regard to evaluator groups differences. These results and the significant group differences are presented in Table 1.

Evaluator groups were significantly different in their perception of profile change for surgically treated silhouette pairs representing 2.27 mm, 3.20 mm, 4.74 mm, and 10.13 mm of mandibular advancement, when evaluating the pairs with the VAS. Figure 3 depicts the significant evaluator differences in the VAS scores for these pairs. For pairs with 2.27 mm and 4.74 mm of advancement, lay persons perceived significantly less improvement in the VAS score than their orthodontist and oral surgeon counterparts. For the pair with 3.20 mm of advancement, lay persons perceived significantly less improvement than oral surgeons, but their perceptions were similar to those of orthodontists. For the pair with 10.13 mm of advancement, lay persons perceived a significantly greater amount of worsening in the VAS score than the orthodontists.

DISCUSSION Return to TOC

This study shows that changes in soft tissue profile can be perceived 5 years after surgery by groups of evaluators, including orthodontists, oral surgeons, and lay persons, in a patient population with a wide array of mandibular advancements. The results reveal that the three groups had differing preferences and sensitivities to horizontal change in mandibular position and that the majority of evaluators were able to identify a lack of significant change in the control silhouette pair.

VAS Differences Between Hard and Soft Tissue Arrangement

Studies have found a 1:1 relationship between hard tissue surgical advancement and soft tissue change.[9–12] However, results from this study indicate that a predictable 1:1 ratio of hard tissue to soft tissue movement may not be occurring 5 years after surgery. This is demonstrated by differences in the distribution of VAS changes when comparing data arranged by hard tissue and soft tissue change values.

Previously published data supports the idea that the amount of advancement and time can play a role in the ratio of hard tissue to soft tissue change. A study by Van Sickels et al[12] suggested that a 1:1 ratio of movement may not be occurring when the hard tissue advancement exceeds 8 mm. Mobarak et al[11] showed that significant relapse occurred 3 years after surgery and felt that a 1:1 ratio may be too optimistic a prediction for treatment planning purposes. Other factors that may be at work include the impact of individual features, small changes because of head position or lip posture, and significant differences among evaluator groups.

Perceptions of Change in Soft Tissue Profile

This study agrees with previously published reports[3–6] in that the evaluators were able to detect even the smallest changes in profile when evaluating silhouette pairs generated from cephalometric radiographs. However, this study shows that all evaluators were potentially more sensitive to overall changes in profile than previously reported because the vast majority of evaluators recognized as least some amount of change in all surgically treated silhouette pairs.

When considering individual features, there appears to be a trend toward recognizing changes in features, such as upper lip, lower lip, and chin, because the majority of changes detected lie in these three areas. These results appear to be logical because the chances of affecting forehead or nasal contour by mandibular advancement would seem to be rather small at best. It is likely that changes in forehead contour were the result of changes in head positioning, whereas changes in nasal contour could have resulted from a change in lip support brought about by a new relationship among the nose, lips, teeth, and jaws. It should also be noted that the majority of evaluators successfully identified the control pair of silhouettes. Previous studies have not examined changes less than 1 mm, and no comparison of control data can be done because previous studies have not used a control.

Multiple significant improvements in the VAS score were also found. Significant improvements in the VAS score were found for every surgically treated silhouette pair by at least one group of evaluators. However, the VAS score did not change significantly for the control pair. This would suggest that the significant change in the VAS score for the patient with 0.11 mm of hard tissue pogonion advancement is truly being detected. This study also showed that there may be a limit to how far the mandible can be advanced before a particular patient experiences a worsening in profile, as perceived by various groups of evaluators. No other studies have shown any worsening in profile after surgical correction.

Evaluator Differences

Significant differences among evaluator groups were found in this study. Previous studies have not found such differences.[3,4,6] Another study by Burcal et al[5] showed a trend toward dental professionals being more accurate and sensitive in their identification of changes in profile; however, no statistical analysis was done to support these observations. Arpino et al[13] showed that orthodontists were significantly more accepting of deviations than oral surgeons, surgical patients, and acquaintances of surgical patients. This study found that there were multiple evaluator group differences when detecting changes in individual features but no group differences when detecting overall changes in profile. The forehead (8 significant differences) and nose (7 significant differences) were the most common places to see differences in the detection of change. This could result from different esthetic priorities of the various evaluator groups, or one or more groups may not have focused as heavily on areas that were not directly involved in jaw surgery. It is also interesting to note that no significant differences among evaluator groups were found for the lower lip, and significant differences were only found for the upper lip and chin when the advancement was 4.74 mm or greater. There appears to be a trend toward lay persons being more sensitive to changes in the upper lip, whereas orthodontists were more sensitive to changes in chin contour or position.

This study also showed that a greater number of significant improvements in the VAS score were perceived by orthodontists than by oral surgeons and, in turn, that oral surgeons perceived more than lay persons. This would seem to agree with Burcal et al[3] because the professional groups were able to perceive improvements in patients with small surgical advancements and small soft tissue changes. However, it could also be suggested that orthodontists were merely more willing to accept small improvements, and their evaluations were inflated because of their acceptance of greater deviations from normal. This idea would tend to agree with the results presented by Arpino et al.[1]

In general, when significant differences were present, significantly less improvement in the VAS score was perceived by lay persons than by their professional counterparts. This could mean that the lay persons could not perceive the changes occurring or that they did not view an improvement in facial convexity as being important. It is possible that the lay persons may have focused on individual features, such as nose, forehead, or chin, when evaluating improvements in esthetics or that these features had an overriding effect on their evaluation.

CONCLUSIONS Return to TOC

- Surgical changes were perceivable 5 years after surgery.
- There were significant differences among the groups of evaluators.
- Of the 127 evaluators, 104 were able to identify the control pair of silhouettes. However, the surgically treated silhouette pair with the smallest mandibular advancement (0.11 mm) showed significant improvement in the VAS score when evaluated by orthodontists, oral surgeons, and lay persons.
- This study suggests that excessively large changes in hard tissue pogonion and soft tissue Gb-Sn-Pg may lead to less esthetic improvement or a worsening in profile esthetics.

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TABLES Return to TOC

Table 1. Percent of Lay Persons/Oral Surgeons/Orthodontists Who Detected Differences in Individual Features and *P* Value for Significant Differences Among Groups

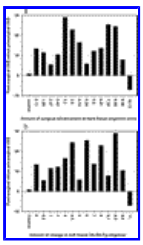
Surgical Advancement/Soft Tissue Gb-Sn-Pg Change[a]	Forehead	Nose	Upper Lip	Lower Lip	Chin
Control	10/3/4	10/12/9	2/6/2	2/6/4	7/19/4
0.11 mm/0 degrees	52/34/42	36/41/38	81/81/68	88/84/91	45/62/40
1.09 mm/1 degree	24/6/4	59/34/26	29/44/36	64/75/75	81/91/83
	$P = .0050$	$P = .0037$			
2.27 mm/0.5 degrees	63/16/30	45/26/21	64/45/42	81/81/81	83/94/87
	$P = .0001$	$P = .0296$			
2.43 mm/8.5 degrees	14/6/6	31/41/11	90/94/92	52/62/53	36/53/57
		$P = .0061$			
3.20 mm/8.5 degrees	70/41/45	67/69/60	64/53/55	76/84/89	86/97/94
	$P = .0009$				
3.80 mm/8 degrees	67/41/51	59/66/53	43/47/26	69/66/66	52/75/60
4.74 mm/4 degrees	21/3/6	30/12/9	55/41/36	59/65/72	57/100/89
	$P = .0203$	$P = .0168$			$P < .0001$
5.24 mm/5 degrees	24/6/2	51/25/13	78/66/53	71/78/66	39/56/40
	$P = .0014$	$P = .0004$	$P = .0400$		
5.90 mm/3 degrees	29/9/6	45/47/38	69/91/74	64/84/74	55/75/72
	$P = .0043$				
6.81 mm/7 degrees	36/28/26	21/25/11	90/78/83	74/75/77	50/59/42
7.38 mm/6 degrees	67/25/43	64/56/57	52/53/30	83/87/92	57/84/77
	$P = .0015$		$P = .0412$		$P = .0198$
8.69 mm/4.5 degrees	48/19/24	64/34/26	74/50/47	86/87/92	38/59/47
	$P = .0126$	$P = .0007$	$P = .0229$		
9.56 mm/8 degrees	21/22/9	38/31/21	79/50/55	71/84/87	50/81/68
			$P = .0185$		$P = .0174$
10.13 mm/11 degrees	31/16/13	43/37/17	76/84/66	86/91/91	79/97/98
		$P = .0158$			$P = .0020$

[a] Gb-Sn-Pg indicates Glabella-Subnasale-Pogonion.

FIGURES Return to TOC

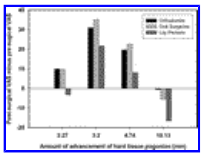
Click on thumbnail for full-sized image.

Figure 1. Example of a survey page



Click on thumbnail for full-sized image.

Figure 2. (a) Mean changes in the visual analog scale for silhouette pairs, arranged by advancement of hard tissue pogonion. (b) Mean changes in the visual analog scale for silhouette pairs, arranged by change in soft tissue Gb-Sn-Pg



Click on thumbnail for full-sized image.

Figure 3. Significant differences in the visual analog scale scores for silhouette pairs among evaluator groups

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