Facial attractiveness of skeletal Class II patients before and after mandibular advancement surgery as perceived by people with different backgrounds

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SUMMARY The purpose of this study was to determine the perceived level of improvement in facial attractiveness as assessed by people with different backgrounds in skeletal Class II patients treated by mandibular advancement with bilateral sagittal split osteotomy (BSSO). The frontal and lateral pre- and post-operative photographs of 10 Caucasian patients were selected. Changes in frontal and profile attractiveness were assessed by 10 orthodontists, 10 art students, and 10 laypersons. Frontal and lateral pre- and post-operative photographs were randomly distributed throughout two surveys. For each photograph, the evaluators ranked the attractiveness of face, chin, and lips on visual analogue scales. A third survey was administered to orthodontists only, by presenting the same pre and post-operative photographs but paired side-by-side with pre- and post-operative status disclosed. Overall, attractiveness scores after BSSO showed an 11.5 per cent improvement (95 per cent confidence intervals: 9.4–13.5 per cent) on the lateral post-operative photographs and a 7.5 per cent improvement (95 per cent confidence intervals: 5.4–9.5 per cent) on the frontal post-operative photographs. Attractiveness scores differed significantly between the groups (P = 0.015), with orthodontists being more generous with their improvement ratings and the art students tending to give a more critical assessment. There were no significant differences between male and female evaluators (P > 0.05). Ratings of before–after attractiveness almost doubled when the pre- and post-operative status was disclosed as compared to blinded evaluations, thus indicating that prior knowledge of pre- and post-treatment status markedly influences aesthetic evaluations, with a bias towards a more favourable outcome.

Introduction

Orthognathic surgery aims to achieve a harmonious skeletal, dental, and soft tissue relationship to improve both function, and facial aesthetics for patients with jaw discrepancies. For the majority (41–89 per cent) of Class II patients, aesthetics is the chief complaint when seeking orthognathic surgery and is thus of primary importance (Kiyak, 1991). The assessment of an individual’s appearance as perceived by their peers and the possible improvement with orthognathic surgery are important considerations when planning treatment. Therefore, it is important to know both the professionals and the layperson’s opinion on the facial appearance of patients before and after mandibular advancement surgery as the perception of aesthetic improvement might differ between groups.

Facial aesthetics is an important factor in our daily social interactions. Attractive people are regarded as more popular and having a nicer personality. Furthermore, they are expected to be more intelligent and have more socially desirable characteristics (Baldwin, 1980). The reverse stereotype appears to be widely held also and that the unattractive are less likeable, less trustworthy, less intelligent, less successful, and are perceived as more aggressive and antisocial.

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 agree with what orthodontists and surgeons perceive as attractive based on their experience and training (Chew et al., 2007). Several studies have shown that the perception of facial attractiveness differs between patients, peers, and dental professionals (Dunlevy et al., 1987). It has also been suggested that dental professionals may be more sensitive to certain aspects of the profile than laypersons and vice versa. Some studies have reported that orthodontists have a heightened and perhaps biased view, especially of the facial profile (Lines et al., 1978; Burcal et al., 1987; Dunlevy et al., 1987; Kerr and O’Donnell 1990; Romani et al., 1993). Orthodontists and oral surgeons, by nature of their training and work, may be sensitive to disharmonies in aesthetics (Juggins et al., 2005). Some authors have reported laypersons as having more critical perceptions of profile aesthetics than professionals (Dunlevy et al., 1987; Arpino et al., 1998;
Shelly et al., 2000). Others have reported laypersons as being less discriminating than those with dental training and demonstrate the greatest variation in what they consider attractive (Bell et al., 1985; Kerr and O’Donnell 1990; Johnston et al., 2005). On the other hand, Shelly et al. (2000) and Maple et al. (2005) reported agreement between laypeople and professionals in their perception of facial aesthetics.

It can be expected that the rating of attractiveness may be also influenced by prior knowledge of pre-treatment status. To the best of our knowledge, no study has investigated this.

The purpose of this study was to analyse the aesthetic evaluations by orthodontists, art students, and laypersons of frontal and lateral photographs of patients who have undergone bilateral sagittal split osteotomy (BSSO). Our hypotheses were firstly that mandibular advancement with BSSO improves facial aesthetics, secondly that there are differences in the ratings of facial attractiveness between panels, and finally that knowledge of pre-treatment status has an effect on attractiveness rating.

Material and methods

Ethical approval was obtained at the departmental level (Category B) from the University of Otago, Faculty of Dentistry, Department of Oral Diagnostic and Surgical Sciences. All patients undergoing orthodontic treatment and orthognathic surgery at the Faculty of Dentistry sign an informed consent prior to treatment. The patients in this study have consented to their clinical information, including radiographs and photographs to be used for any research or presentations associated with the University of Otago.

Patients

A sample of 10 Class II patients (five males and five females) was randomly selected from a pool of patients who had received mandibular advancement surgery (BSSO without bimaxillary procedures) at the University of Otago. The age range of the patients was from 16 to 20 years old. Cephalometric analysis had indicated that all the patients had a skeletal Class II pattern, which was mainly due to an insufficient mandibular length. The mean overjet before surgery was 5.3 ± 2.8 mm and the mean overbite was 105 ± 21.2 per cent. Overall, there was a mean 6.7 ± 0.6 mm mandibular advancement after surgery.

Groups of evaluators

Three groups of evaluators were selected and composed of orthodontists, arts students, and laypersons. Each group contained five males and five females. A convenient sample of 10 orthodontists (31–58 years of age) was selected to represent the orthodontic group. Ten art students from the Otago Polytechnic School of Fine Arts were recruited to represent the art student group (18–46 years of age). The layperson group consisted of 10 patients from the Otago University School of Dentistry (29–63 years of age), who were recruited from urgent care clinics.

Aesthetic rating

Four pre- and post-operative frontal and lateral photographs from each patient were obtained from their notes. The photographs were printed in full colour and of standard size (6" × 4"). The evaluators were asked to look at each frontal or profile photograph and to score the overall facial attractiveness, the attractiveness of the chin, and the attractiveness of the lips. Attractiveness was scored by using 100 mm visual analogue scales (VASs) anchored on the left by the descriptor ‘very unattractive’ and on the right by ‘very attractive’. The evaluators were instructed to view the photographs and to record an overall rating by marking on the scale where their rating of the patient’s attractiveness would fit. Two assessors (DN and RS) measured the VASs. The measurements were then repeated a minimum of 4 weeks later and the mean between the two scores was regarded as the aesthetic rating.

Study design

This study was divided into two parts. In part 1 of the study, a two-step balanced block survey was administered. In order to minimize comparison between the pre- and post-operative photographs, each frontal and lateral pre-operative photograph was randomly assigned a letter (either A or B), and the post-operative photograph was given the alternative letter. The photographs were also randomly assigned a number from 0 to 99. In step 1, the first survey included the 20 photographs that were designated as ‘A’ and then the photographs were assembled in ascending order from the randomized number they were assigned. The evaluators were given an explanatory letter about the study and were given 2 weeks to complete and return the survey. The second step comprised the second survey, which consisted of the 20 photographs assigned ‘B’.

For part 2 of the study, a third survey was designed. The photographs in this survey comprised the same 40 photographs but arranged in a matched pair with their pre- and post-operative status disclosed. This survey was only distributed to the orthodontic group.

All the surveys were posted out with at least 4 week interlude to minimize recall bias and fatigue. All the photographs were returned with the surveys and destroyed to protect patient privacy.

Statistics

Attractiveness scores were analysed by multivariate and one-way analysis of variance. When appropriate, post hoc tests were performed and the P-values were Bonferroni
corrected. All the analyses were performed by commercial software (SPSS 15.0, Chicago, IL, USA). Level of significance was set at \( P < 0.05 \).

**Results**

There was a 100 per cent response to the survey from the 30 evaluators. The mean improvement in the attractiveness scores on the lateral view was 11.5 per cent (95 per cent confidence intervals: 9.4–13.5 per cent), while the mean improvement on the frontal view was 7.5 per cent (95 per cent confidence intervals: 5.4–9.5 per cent), the difference being statistically significant \( (P = 0.01) \).

Overall, the three groups of evaluators differed significantly \( (P = 0.015) \) in their perception of how much aesthetic change had occurred from pre-treatment to post-treatment. Descriptive statistics for changes in the attractiveness scores for the overall face, neck, and lips is given in Table 1. In general, art students tended to be the most critical as they gave the smallest improvement scores, whereas the orthodontist recognized significantly greater improvements. *Post hoc* tests, however, indicated a significant difference for attractiveness ratings of the overall face only between the orthodontists and art students \( (P = 0.003) \).

The attractiveness ratings did not differ between genders of patients \( (P = 0.768) \), as well as between gender of evaluators \( (P = 0.989) \), and there was no significant interaction between the gender of patients and the gender of evaluators \( (P = 0.813) \). The attractiveness ratings were not influenced by age of evaluators \( (P = 0.836) \).

In a subsequent survey performed 4 weeks later, attractiveness ratings were re-assessed by orthodontists only, with the photographs presented as matched pairs next to each other, and the pre-operative and post-operative status fully disclosed. Attractiveness scores obtained with paired photographs were significantly higher \( (P < 0.001) \) than those obtained with photographs presented in a random order, and there was no significant difference between the scores lateral and frontal photographs \( (P = 0.05) \). Descriptive statistics for changes in the attractiveness scores for the overall face, neck, and lips is given in Figure 1. The changes between the random and paired conditions mostly consisted of an increase in post-operative attractiveness scores. A slight reduction in pre-operative attractiveness scores, however, could also be noted, especially for the attractiveness of the chin.

**Discussion**

Overall, the amount of change in facial attractiveness of patients undergoing orthognathic surgery for Class II

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**Table 1** Mean and standard errors of means (SEMs) for changes in attractiveness scores (visual analogue scale per cent) between the three groups of evaluators.

<table>
<thead>
<tr>
<th>Groups of evaluators</th>
<th>Overall face</th>
<th>Chin attractiveness</th>
<th>Lips attractiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontists</td>
<td>Mean</td>
<td>SEM</td>
<td>Mean</td>
</tr>
<tr>
<td>Laypersons</td>
<td>11.0</td>
<td>2.2</td>
<td>7.0</td>
</tr>
<tr>
<td>Art students</td>
<td>14.2</td>
<td>2.0</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12.6</strong></td>
<td><strong>1.5</strong></td>
<td><strong>9.2</strong></td>
</tr>
</tbody>
</table>

**Figure 1** Attractiveness scores [visual analogue scale (VAS) per cent] for overall facial attractiveness (a), chin attractiveness (b), and lips attractiveness (c) obtained from orthodontists when the photographs were presented as matched pairs with the pre- and post-operative status disclosed (paired condition) and when they were presented in a random order (random condition). Columns and error bars represent means and standard deviations. Data obtained from lateral and frontal photographs were pooled.
skeletal malocclusion is consistent with previous findings, albeit slightly higher improvements (Phillips et al., 1995; Shelly et al., 2000).

A review by Pogrel (1991) showed that most of the analyses used in the planning of orthognathic surgery cases are orthodontic in nature. Little input is derived from the perceptions of artists or the general public. There have been several studies to determine whether professionals and the general public differ in their perceptions of facial attractiveness. Some authors have reported general agreement between clinicians and the public (Dunlevy et al., 1987; Kerr and O’Donnell 1990; Romani et al., 1993; Shelly et al., 2000). Other reports suggest that professionals and laypeople perceive facial aesthetics differently (Lines et al., 1978; Cochrane et al., 1999).

Our findings indicated that the ratings of facial attractiveness vary among groups of evaluators with different background, and significant differences were found between orthodontists and art students. Considering orthodontists are taught to critically evaluate profile aesthetics, one would expect that the untrained eyes of laypersons would be less critical. However, our study found the opposite; art students and laypersons were more critical in evaluating aesthetic improvements than orthodontists, which agrees with a previous study where orthodontists tended to give higher rating scores than laypersons (Spyropoulos and Halazonetis, 2001). In another study, laypersons judged 25 per cent of all mandibular advancement subjects to be unimproved after surgery, while orthodontists only judged subjects with the smallest amounts of surgical movements to be unimproved following surgery, suggesting that laypersons are more difficult to impress despite the amount of surgical change (Dunlevy et al., 1987). Even in Class I profiles, laypersons tended to give more critical aesthetic ratings of Class I profile than orthodontists (Maple et al., 2005). However, our finding conflicts with some of the existing literature. One study found lay judges (art students and parents) tended to be more generous in evaluating profiles than orthodontists (Kerr and O’Donnell, 1990).

The position of the chin in patients who have received BSSO is of utmost importance for the aesthetic improvement of these patients. The chin provides harmony and character to the face. A strong chin or prominent jaw line is considered to be aesthetically pleasing, especially in males (Baldwin, 1980). Our study showed that there was a significant perceived improvement in the attractiveness of the chin after BSSO. The three groups tended to rate the improvement of the chin similarly, which concurs with a study by Romani et al. (1993), which found that both orthodontist and laypersons appeared to have the same sensitivity to mandibular change.

Attractiveness ratings were not influenced by the gender of the evaluators. Our findings were consistent with other studies in the literature (De Smit and Dermaut 1984; Knight and Keith, 2005). Additionally, male and female judges did not differ in their use of the VAS for pre- or post-treatment scores (Phillips et al., 1995). One study suggested that for female patients, facial expression had more of an influence on ranking than for male patients. It could be speculated that clinicians and non-clinicians were influenced when ranking the female faces by preferences, such as in hair; however, our study found that there was no significant difference among female and male patients; therefore, this bias was of little consequence in our study (Knight and Keith, 2005).

Biases resulting from unblinded assessments are well documented in medical literature, but there is no evidence to support their importance in orthodontic clinical trials. In the second part of this study, we investigated the impact of random versus unblinded evaluations (i.e. with pre- and postoperative status disclosed) of attractiveness scores in skeletal Class II patients. Aesthetic evaluations in skeletal Class II patients were significantly influenced by a prior knowledge of the pre–post status. Ratings of pre- and postoperative attractiveness changes almost doubled when performed under unblinded condition as compared to random evaluations. Indeed, when the photographs obtained before and after surgery were presented as matched pairs, the orthodontists strongly overestimated the attractiveness of the post-operative photographs, but they also tended to slightly underestimate the attractiveness of the pre-operative photographs. To the best of our knowledge, these observations have never been reported in the orthodontic literature and may have significant research implications as they clearly show that prior knowledge of pre- and post-treatment status markedly influence the outcome of aesthetic evaluations, with a bias towards a more favourable outcome. This emphasizes the need not to disclose the pre- and post-treatment status of orthodontic patients to evaluators assessing their aesthetic outcome in orthodontic clinical trials.

Although clinical assessment of orthognathic surgery outcomes requires examination in three dimensions, quantitative measurement of a dentofacial deformity is still predominantly carried out in the lateral view. Research indicates a difference between clinician and layperson assessment, with laypersons placing less weight on the lateral view than clinicians (Juggins et al., 2005). Phillips et al. (1992) found that the perception of attractiveness is affected by the view presented with no particular view consistently favoured. They recommended using multiple views of subjects, supporting the presentation of material used in our study.

The use of the unmarked VAS proved to be a simple and rapid method for assessing the perceptions of facial attractiveness. The VAS has several advantages over other methods that have been used in previous panel assessments of facial attractiveness. VAS is more sensitive to small changes than simple descriptive ordinal scales. Additionally,
ratings can be given quickly and the scores analysed as continuous measures. Recording the results as continuous variables in millimetres allows more freedom in the analysis of data and permits more powerful parametric statistics to be used (Howells and Shaw 1985; Phillips et al., 1992; Phillips et al., 1995; Maple et al., 2005). The rating scores can detect differences in overall perception of facial attractiveness between the groups and yet the use of mean evaluators scores and the subsequent paired analysis decreases the variability observed among judges and focuses the analysis on the change measures. The difference between the pre-treatment and post-treatment mean scores indicates the direction of change as well as the extent of change (Phillips et al., 1992). In addition, the VAS can minimize biases towards preferred values as found with numeric or equal-appearing interval scales (Howells and Shaw 1985; Michiels and Sather, 1994).

There are limitations when using the VAS to measure a subjective phenomenon, such as facial attractiveness. For example, it is difficult to ensure that all the evaluators interpreted the anchor points of very unattractive and very attractive in exactly the same way or that comparable positioning of marks on the scale implies the same feeling by the same or different evaluators. Finally, it is uncertain how many millimetres of difference in facial attractiveness are required to be clinically relevant and/or meaningful (Maple et al., 2005).

Our findings may suffer from some limitations that need to be carefully evaluated. In our study design, we preferred the use of photographs to profile silhouettes because we were assessing both the frontal and the profile attractiveness as people tend to judge a person’s beauty by viewing them from the front. By using photographs, however, we were unable to eliminate all extrinsic and intrinsic distracting variables (such as hair style, make-up, and skin complexion). These variables could influence an evaluator’s aesthetic score rating.

Our study used the orthodontic evaluators for the ‘side-by-side’ comparison because it was convenient to re-use this particular group. It would have been technically difficult to contact the other groups for a second evaluation.

An unfortunate limitation in our method of analysis is that changes in features of the face occur with time. The average time between before and after photographs was 2 years. Over a period of 2 years, one would observe changes such as facial shape and skin complexion. For a more meaningful assessment, one would need to know the immediate effect of BSSO, irrespective of time, growth, and maturity. However, it is difficult to assess the aesthetic improvement in an immediate post-operative setting since the facial oedema will take more than 3 months to disappear completely. Initially, the gross oedema will settle fast but the final facial appearance is not achieved until all traces of oedema subside. Post-operative assessment at 6 months would be appropriate.

Finally, a potential problem of this study could be the relatively small sample size of evaluators and patients groups. Replication of this study at another institution to confirm our results and increase the total sample size should be encouraged.

Conclusions

The results of this study indicate a perceived improvement of facial attractiveness in patients after BSSO treatment by orthodontists, art students, and laypersons in New Zealand. This information is invaluable to clinicians in treatment planning and advising patients on the results of their surgery. Patients are mostly judged by their peers; therefore, it is critical to understand how laypersons perceive aesthetic changes after BSSO. All three groups found BSSO to achieve an improved aesthetic outcome. Orthodontist found the greatest improvement, while art students gave the least. Therefore, it is important for clinicians not to overestimate the benefits of BSSO for improving facial aesthetics to their patients as their perception of aesthetic improvement is usually greater than the general public. Overestimation of the benefits could result in patient dissatisfaction despite satisfactory outcomes from an orthodontic and surgical point of view. Prior knowledge of pre- and post-treatment status markedly influence the outcome of aesthetic evaluations, with a bias towards a more favourable outcome.

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