Social, intellectual, psychological and attractiveness judgements of lay people about patients before and after combined orthodontic-orthognathic surgical treatment

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Abstract

Background: Facial appearance plays a significant role in the success of social interactions. There is a limited amount of evidence investigating the influence of combined orthodontic-orthognathic surgical treatment on the social judgments of lay people.

Objective: The aim of this study was to investigate whether changes in facial appearance following orthognathic surgery alter the social judgements made by lay people.

Ethical approval: Ethical approval was granted from the University of Sheffield School of Clinical Dentistry Research Ethics Committee on 17th August 2020 (Reference: 033775).

Materials & Methods: This cross-sectional, web-based survey involved clinical photographs of six Caucasian female patients pre and post combined orthodontic-orthognathic treatment. Three patients had a pre-treatment class 2 skeletal pattern and three patients had a pre-treatment class 3 skeletal pattern. Staff and students at the University of Sheffield, UK were invited to evaluate five personality traits: 1) Friendliness 2) Intelligence 3) Attractiveness 4) Self-Confidence 5) Trustworthiness using a 5-point Likert scale. The trait scores were summed to obtain a total social judgement score and a paired t-test was used to compare the total scores from pre and post treatment images.

Results: There were 261 responses to the survey of which 181 (75%) were completed fully. The total social judgement scores from after treatment images were higher compared with the pre-treatment images (mean diff 1.6; P<0.001) indicating more positive social judgements. The improvements in perceived social judgments were more notable for class 3 patients (mean diff 2.7) compared to class 2 patients (mean diff 0.7).

Conclusion: Social judgement scores were higher (more positive) from post-treatment images of patient faces than their pre-treatment images. The findings highlight the possible indirect benefits combined orthodontic-orthognathic surgical treatment may have on an individual in a social setting.

Keywords

Orthognathic Surgery, Facial attractiveness, Social Perceptions

Introduction

The face and a person's appearance play a significant role in human social life.[1] Studies have shown that first impressions with other people are innately related to the face[2] and are made very rapidly. It can take as little as 100 milliseconds for a stranger to make a judgement of another person's facial attractiveness, along with their personality, such as aggressiveness or trustworthiness.[3]

Orthognathic surgery is used to treat patients with skeletal discrepancies that are beyond the scope of orthodontic treatment alone, with the aim of normalizing facial features and increasing perceived facial attractiveness.[4] Patients who pursue orthognathic surgery have reported a desire to change their appearance to "fit in" and look "normal" in society.[5] Whilst there has been considerable research into the well-being of patients and the self-reported improvement in appearance following orthognathic surgery,[6] there is a limited amount of research investigating the effects of orthognathic treatment in terms of the social implications for patients.

Visible differences in a person's appearance can lead to negative social interactions.[7] It is therefore important we investigate whether the changes resulting from combined orthodontic-orthognathic surgical treatment influence the perceptions of others leading to potential positive or negative social implications for our patients.

The aim of the study was to investigate whether the social judgements made by lay people differ when they are shown images of the face before and after orthognathic surgery. The null hypothesis of the study was that there are no differences in the (positive/negative) social judgements made by lay people from images of the face before and after orthognathic surgery, in terms of the following personality traits: a) Friendliness b) Intelligence c) Attractiveness d) Self-confidence e) Trustworthiness.

Methods

The study was a cross-sectional, web-based survey. Ethical approval was obtained from the University of Sheffield School of Clinical Dentistry Research Ethics Committee before the start of the study (approved 17th August 2020). The survey included the extra-oral clinical photographs of six Caucasian female patients who had previously been treated with combined orthodontic-orthognathic surgical treatment at the Nottingham University Hospitals NHS Trust, UK and were a minimum of 7 months post-surgery. Patients were excluded if they had any underlying syndromic diagnosis, significant facial asymmetry or had received prior facial aesthetic procedures. The patients were chosen by a Consultant Orthodontist and a Specialty Registrar in Orthodontics to represent patients treated for either a class 3 skeletal pattern (n = 3) or a class 2 skeletal pattern (n = 3). The patients selected were deemed to provide a variation in pre-treatment attractiveness and post treatment 'real world' results, as judged by the research team. The patients provided their explicit consent for their clinical photographs to be used for the purposes of this research.

A series of 12 vignettes were produced with two photographs (front smiling and side-on non-smiling) for each patient pre- (Figures 1 & 2) and post-treatment (Figures 3 & 4). The post-treatment photographs were all taken following removal of fixed orthodontic appliances. The vignettes were constructed with a standardized background using Adobe Inc® Photoshop.

Respondents to the survey were identified through a volunteer's e-mail list at the University of Sheffield (UK). The list includes anyone at the university (undergraduate and postgraduate students, administrative and academic staff) who opted-in to receive messages about participating in research projects (approximately 1,500 staff and 6,000 students). Any person with a dental/psychology background was excluded from taking part in the study due to possible bias. It was felt this group may be more informed with prior knowledge and experience of Orthodontics and Orthognathic surgery and biased compared to a lay person.

All respondents were masked as to the purpose of the study. They were not informed the photographs were of combined orthodontic-orthognathic surgical treatment patients and the aim of the study was described as researching "the way in which people look at each other". The research team wanted the participants to be blinded to the fact the patients had undergone treatment to change their facial and dental appearance. Each respondent to the survey was shown the vignettes in the same randomized order, which was determined by the research team prior to the survey delivery. This prevented the possibility of a respondent viewing a patient's pre- and post-treatment clinical photographs in sequence.

The participants were asked to rate the individuals in the photographs on a 5-point Likert-type scale from 5 ("Very ...") to 1 ("Very un....") for five traits:

1. Friendliness – "How friendly does this individual appear?"
2. Trustworthiness – "How trustworthy does this individual appear?"
3. Intelligence – "How intelligent does this individual appear?"
4. Self-Confidence – "How self- confident is this individual?"
5. Attractiveness – "How attractive is this individual?"

These traits were chosen to assess four domains investigated in previous research: social competence, intellectual ability, psychological adjustment and attractiveness.[8,9] The respondent scores for the five traits, and for each of the 12 vignettes, were summed to produce a total social judgement score with a minimum of 5 and a maximum of 25. A higher score indicates a more favorable social judgement.

Sample size calculation

The primary outcome was to compare the pre- and post-treatment total social judgment scores. Based on a previous study, 140 completed respondents were required for the survey to complete a univariate analysis based on detecting a moderate effect size (0.5) with a power of 0.85 and significance level of 0.05.[10] There was no requirement to recruit extra participants to take into consideration of dropouts for this cross-sectional survey.

Statistical analysis

Partial responses were not included in the data analysis. Descriptive statistics were used to examine the total social judgement scores (combining the 5 individual personality trait scores) and the 5 individual personality trait scores from the before and after combined orthodontic-orthognathic treatment. The distribution of the data was confirmed as normal, and a paired *t* test was used to examine the null hypotheses that there was no difference in the total trait scores when comparing before and after combined orthodontic-orthognathic surgical treatment.

A mixed-design analysis of variance model or split-plot ANOVA was also undertaken to take into account both within patient factors and between patient factors. The dependent variable was the total social judgement score, the within-subject factors was treatment stage (pre v post-treatment) and the between-subject factors were the patient identifying number (1 to 6) and the skeletal pattern (class 2 or class 3).

Results

Demographic information for the patients whose clinical photographs were included in the survey is shown in Table 1.

The email inviting participation in the survey was estimated to have been sent to approximately 1,500 staff on the staff volunteers list and 6,000 students on the research studies list and 261 people responded (3%). Twenty participants were excluded because they met the exclusion criteria as they responded "Yes" to having a background related to dentistry or psychology. Of the remaining 241 survey participants, 181 (75%) fully completed the survey. The average time taken to complete the survey was 6 minutes 35 seconds.

The demographic data for the survey participants who fully completed the study are shown in Table 2. The largest proportion was in the age range 18-24 years old (34%). This was not an unexpected result given this age range is the most common age demographic at the University of Sheffield. Most of the survey respondents were female (72%) and the largest proportion were students (54%).

The total social judgment score descriptive data are shown in Table III. The mean total social judgment scores for all patients combined were 16.2 (SD 3.5) pre-treatment and 17.9 (SD 3.4) post-treatment. The mean differences are shown in Table IV. The mean difference in the combined pre- and post-treatment social judgement scores was 1.7 (95% CI 1.5-1.9), which was statistically significant (P<0.001). There was a larger increase between pre- and post-treatment in the social judgement scores for the class 3 patients (mean difference 2.7) compared with the class 2 patients (mean difference 0.7); however both were statistically significant.

The results of the mixed-design analysis of variance confirmed that there was a significant relationship between the total social judgement score and treatment stage (P>0.001) and the interaction between treatment stage and patient identifying number was significant (P>0.001). Figure 5 shows the estimated marginal means for the pre- and post-treatment total social judgement scores of the six patients. This indicates that the mean total social judgment scores increased in the post-treatment photographs for all patients except one (Patient 3), which actually decreased. Figure 6 shows the estimated marginal means for the pre- and post-treatment social judgement scores in the class 2 patients compared with the class 3 patients. This indicates a greater improvement in scores for the class 3 patients.

Changes in the individual traits are shown in Figures 7-11. There were clear improvements across the five individual personality traits for the class 3 patients post-treatment, but the changes were less pronounced for class 2 patients. The personality traits with the greatest positive change for the class 3 group post-treatment were friendliness, intelligence, attractiveness, and self-confidence.

Discussion

This study found that lay persons' social judgements of patients were higher following combined orthodontic-orthognathic surgical treatment than before. This agrees with previous studies that concluded patients are perceived more positively following orthognathic surgery [11,12] and that patients with correction of a class 3 malocclusion are particularly perceived to be more attractive, self-confident and friendly.[9] This previous study used both male and female patients as examples and found no differences between male and females, which justifies our decision to use the records only of female patients.

The increased positive changes in perception seen across the personality domains for the class 3 patients may be due to the changes in the facial appearance being more noticeable by lay people for this group of patients. The class 3 patients in our sample had a more severe skeletal discrepancy compared to the class 2 patients in terms of their ANB cephalometric measurements. The ANB values for the class 3 patients were further from the considered norm compared to the class 2 patients. The average pre-orthognathic ANB value for the class 3 patients was -5.6° and for the class 2 patients +6.2°. The class 3 patients all required bimaxillary surgery to correct their skeletal discrepancy. Whereas the class 2 patients all required a mandibular advancement only. It could be postulated that the bimaxillary surgery created more of a change to the dimensions of the lower facial third, resulting in more 'noticeable' changes which registered with the lay person viewers.

A study by Naini and colleagues noted that mild degrees of chin retrusion and protrusion are not noticeable by lay people.[13] The facial changes following bimaxillary surgery may lead to patients being perceived more positively as there may have been a greater degree of facial change towards a more "familiar" face for lay people. However, it is still unclear why the class 3 patients were perceived more favorably than the class 2 patients following orthognathic treatment.

Furthermore, the prevalence of class 2 profiles is more common than class 3 in the UK and Europe.[14] It has been suggested that the global prevalence of class 2 malocclusion is around 20% and class 3 malocclusion is 5%.[14] Lay people in our study population may be more accustomed to seeing others with a class 2 profile, seeing this facial profile as a variation of average rather than of deformity. As class 3 profiles are less prevalent in the population, lay people may experience a more negative response when viewing this profile due to being less accustomed to this appearance. Therefore, class 3 patients may be perceived more positively post treatment as the class 3 features may be less

noticeable following treatment. A study by Cooper et al. (2006) found that an individual's experience may influence their perception of attractiveness. They studied the development of adult judgements of attractiveness and found that individuals perceived faces which they see in their everyday lives to be more attractive.[15]

The positive post-treatment ratings following combined orthodontic-orthognathic surgical treatment could be a result of a patient's post-treatment smile and dental aesthetics being improved following surgery. Prior studies have shown the role a person's dental appearance can have on how they are perceived by others in society. [16,17] The dental appearance and tooth alignment of the patients included in our study were visibly different following combined orthodontic-orthognathic surgical treatment. These visible differences could have impacted how they were perceived by the survey participants. A cross-sectional survey by Olsen & Inglehart found that patients who have a normal occlusion are rated as more attractive and intelligent compared to those with a malocclusion.[18]

Only one patient demonstrated a lower mean total social judgment score post-treatment compared with pre-treatment. This patient was treated for a class 2 skeletal pattern and there might be a few reasons why her score decreased post-treatment. Firstly, her score was relatively high pre-treatment (second highest), but she had some other notable external changes post-treatment, that might have affected her score including the addition of a nasal ring and a change in the arrangement of her hair. There is some evidence to suggest nasal and other facial piercings can have an influence on the social judgements and perceptions of others. A study found that those with facial piercings were rated to be less physically attractive and intelligent compared to those without piercings.[19] Furthermore, having a nose piercing has been associated with lower ratings of sociability, character and trustworthiness when judged by students and potential employers from a university setting. [20]

Limitations

The proportion of people sent a message about the survey who responded was low, but similar to other internet surveys. Web-based surveys characteristically have low response rates when compared to other forms of surveys.[21] A limitation of a survey with a low response rate is the risk of non-response bias. A review of the literature by Groves (2006) found no clear link between response rates and non-response bias.[22] Due to the nature of our study, there was no reason to believe the views of those who did participate in the survey significantly differed from those that did not. A university volunteers e-mail list was used to invite participants to take part in the study and no incentives were used to try to increase the response rate.

For this study the frontal smiling clinical photographs from before and after surgery alongside the lateral non-smiling photographs of the patients were used. The research team used these images because the appearance of the face, including the teeth and facial expressions all play an important role in how we interact and communicate with others in society.[23] In terms of assessing a person's personality trait such as attractiveness and trustworthiness, it is therefore appropriate to assess people with a commonly used facial expression, such as a smile instead of a neutral face, as this is synonymous with an everyday life interaction. Frith explained how facial expressions are used to show emotions, communicate with others and how a person's facial expressions and appearance can be related to how we are perceived by others. It is not surprising that expressions may affect trait judgements and facial appearance can affect perception of emotions. For example, a face with a happy expression is more likely to be perceived as being trustworthy.[23] It could be argued that including smiling photographs could introduce a confounding factor which could affect how the images are perceived.

The use of clinical photographs has been stated to be a valid and reproducible method for assessing perceptions of dental and facial attractiveness.[24] This method is the most common for studies investigating the influence of orthognathic surgery on the perceptions of personality traits.[25] However, in everyday life, we do not see others solely from a static front or side position. It could be argued that assessing photographs of a person is not reflective of an everyday face-to-face interaction where other factors could influence a person's perception following an interactive social encounter. Therefore, this method of assessment may lack some external validity and our results must be interpreted with a degree of caution. However, our study was focused on obtaining an 'instant' impression from viewers rather than an in-depth view of the subjects through conversation. Conversely, meeting subjects face to face may introduce multiple confounding factors, not related to the face, when making social judgements.

The participants who rated the photographs in our study were all recruited from a university population. To avoid demand characteristics with the study, the participants of the survey were blinded to the independent variable that the subjects had received orthodontic treatment and orthognathic surgery. A demand characteristic is a subtle cue that may influence the behavior of a participant in a study. Whilst the demographic of the University of Sheffield is diverse and may be similar to other university populations across the UK, the results may not be generalizable to the entire adult population of the UK. Furthermore, due to the cross-sectional nature of the study we cannot assume causality of our findings.

The study only included six Caucasian female patients who had received combined orthodontic- orthognathic surgical treatment from a single UK hospital. Using a greater number of patients with differing pre- and post-treatment facial changes could have strengthened the study, but would have prolonged the time taken to complete the survey.

Furthermore, including a range of different malocclusions, such as those with severe anterior open-bites or patients with significant facial asymmetry may have improved the generalizability of the study to all patients undergoing combined orthodontic-orthognathic surgery. The patients included in the study were selected by the research team who wanted to include a variation of patients both in terms of pre-treatment attractiveness and the post treatment 'real world' results. This could have introduced an element of selection bias in the study as they were not chosen at random.

Conclusions

The female Caucasian patients included in our study were perceived more positively by lay people following combined orthodontic-orthognathic surgical treatment. There were positive improvements for all five personality traits for class 3 patients. The changes in perceptions for class 2 patients were less obvious than the class 3 patients. Class 3 patients were perceived to be more friendly, more attractive, more intelligent and more self-confident following orthognathic surgery. The findings of the study provide further insight into the possible social implications of combined orthodontic-orthognathic surgical treatment.

Conflict of interest

None declared. The research team did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. All authors have no conflict of interest to declare.

Data Availability

I have read the journal's requirements for reporting the data underlying my submission (data policy in EJO Author instructions). The data underlying this article are available in the article.

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11. A stacked bar chart comparing the ratings for the self-confidence personality trait for the pre and post orthognathic images for the Class 2 and 3 group

Tables

Table 1

Demographic data of the orthognathic patients used for the survey

Patient	Gender	Ethnicity	Skeletal Class	Surgical Procedure	Age at initial records
1	Female	Caucasian	3	Bimaxillary osteotomy	21yrs 8 m
2	Female	Caucasian	3	Bimaxillary osteotomy	16yrs 7m
3	Female	Caucasian	3	Bimaxillary osteotomy	15yrs 10m
4	Female	Caucasian	2	Mandibular osteotomy	15yrs 11m
5	Female	Caucasian	2	Mandibular osteotomy	16yrs 8m
6	Female	Caucasian	2	Mandibular osteotomy	18yrs 11m

Table 2

Shows the demographic data of the study participants who fully completed the survey (N=181)

		N	%
Age (years)	18-24	62	34
	25-34	40	22
	35-44	23	13
	45-54	34	19
	55-64	18	10
	65-74	4	2
Gender	Male	46	25
	Female	130	72
	Transgender male	1	1
	Gender variant/non-conforming	2	1
	Prefer not to say	2	1
Occupation	Student	98	54
	Staff	80	44
	Other	3	2

Table 3

Descriptive statistics for the Total Social Judgement Scores

Skeletal Class		Pre-treatment	Post-Treatment
All	Mean	16.2	17.9
	SD	3.5	3.4
	95% CI	16.0 to 16.9	17.7 to 18.0
	Median	16	18
	Minimum	0	8
	Maximum	25	25
Class 2	Mean	15.8	16.5
	SD	3.5	3.2
	95% CI	15.5 to 16.1	16.2 to 16.7
	Median	16	16
	Minimum	0	8
	Maximum	25	25
Class 3	Mean	16.5	19.2
	SD	3.5	3.1
	95% CI	16.2 to 16.8	19.0 to 19.5
	Median	17	19
	Minimum	8	9
	Maximum	25	25

Table 4

Mean difference between the total trait scores for pre and post orthognathic images

	Mean difference	95% Confidence Interval	p value
Difference between pre and post orthognathic total trait scores	1.67	(1.47-1.86)	<0.001*

Figures

Figure 1

The pre-surgical vignettes for the Class 2 group
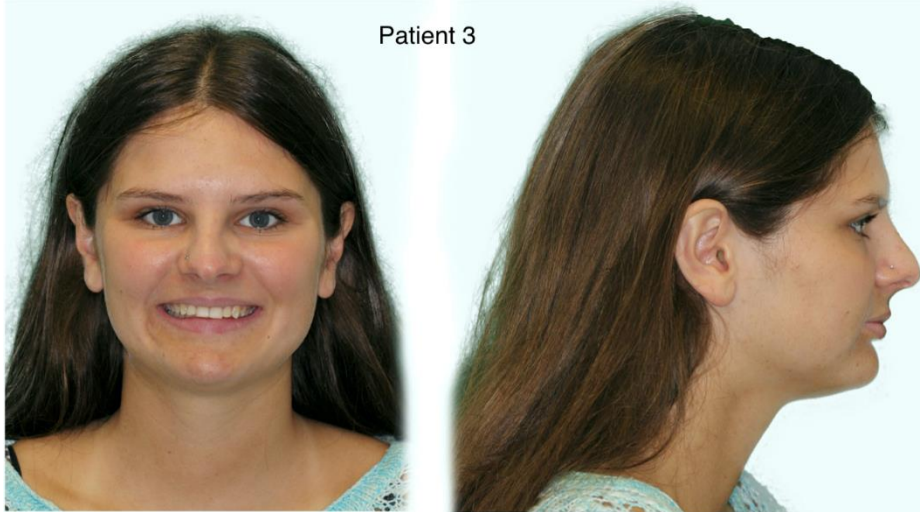
Patient 1

Patient 3

Patient 5

Figure 2

The pre-surgical vignettes for the Class 3 group

Patient 2
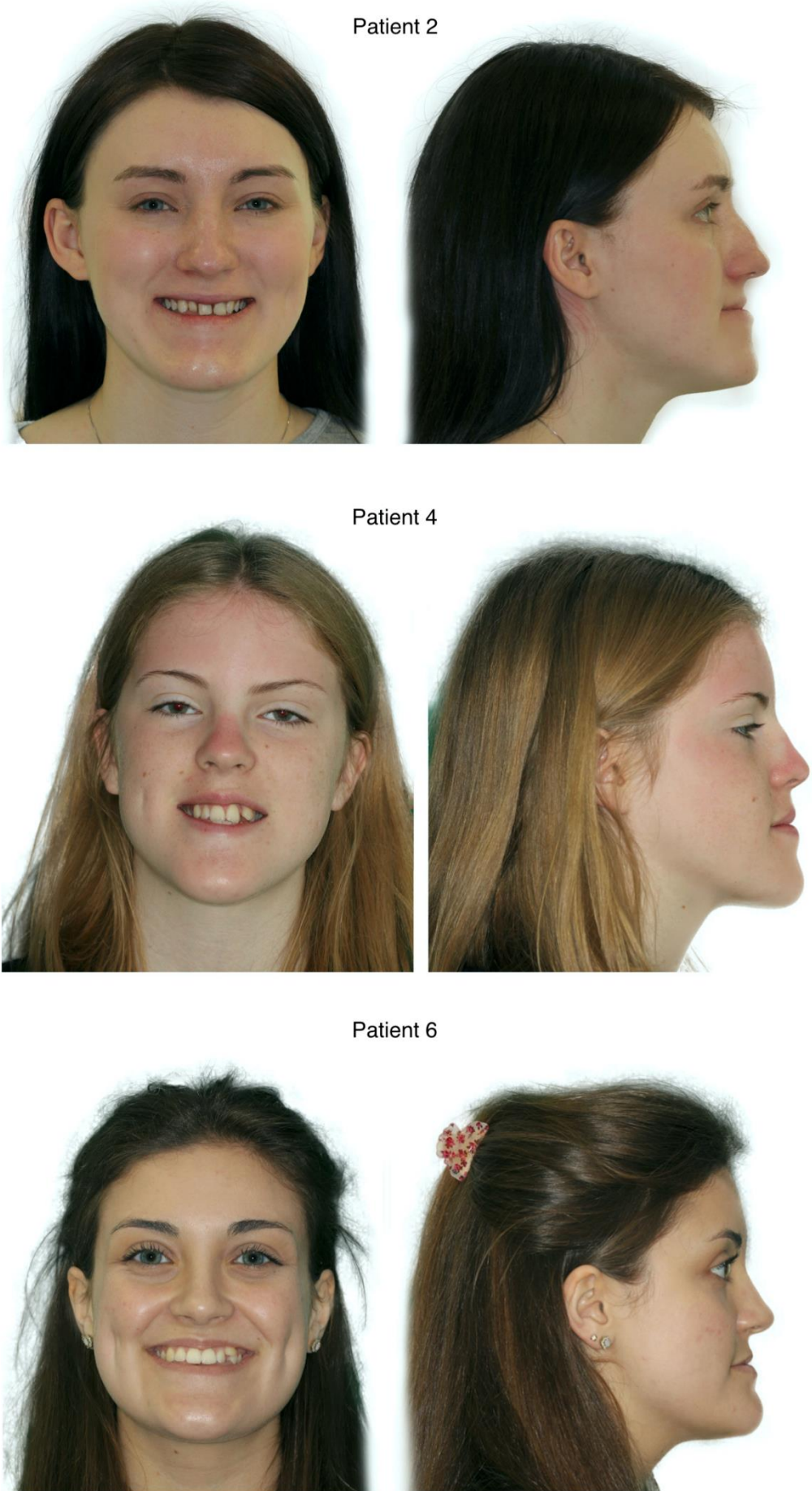
Patient 4

Patient 6

Figure 3

The post-surgical vignettes for the Class 2 group

Patient 1

Patient 3

Patient 5

Figure 4

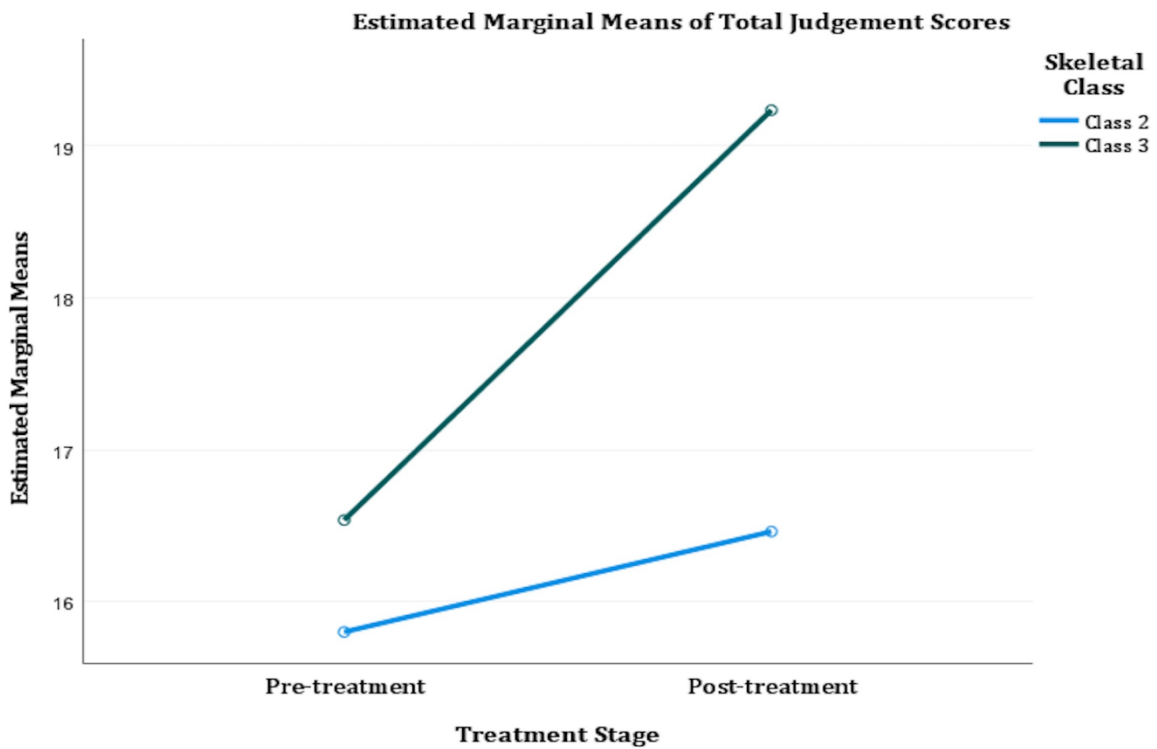The post-surgical vignettes for the Class 3 group

Patient 2
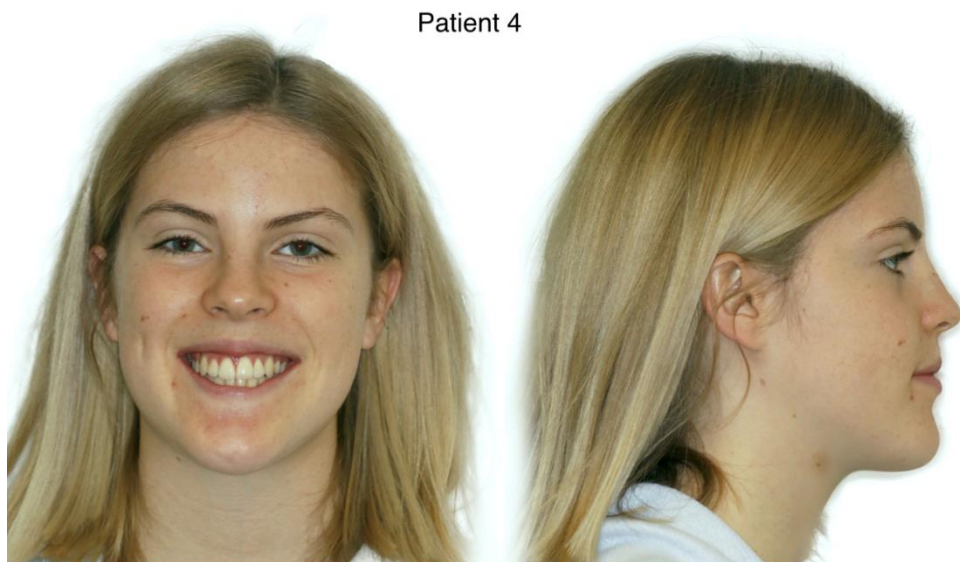
Patient 4

Patient 6

Figure 5

The estimated marginal means for the pre- and post-treatment total social judgement scores of the six patients
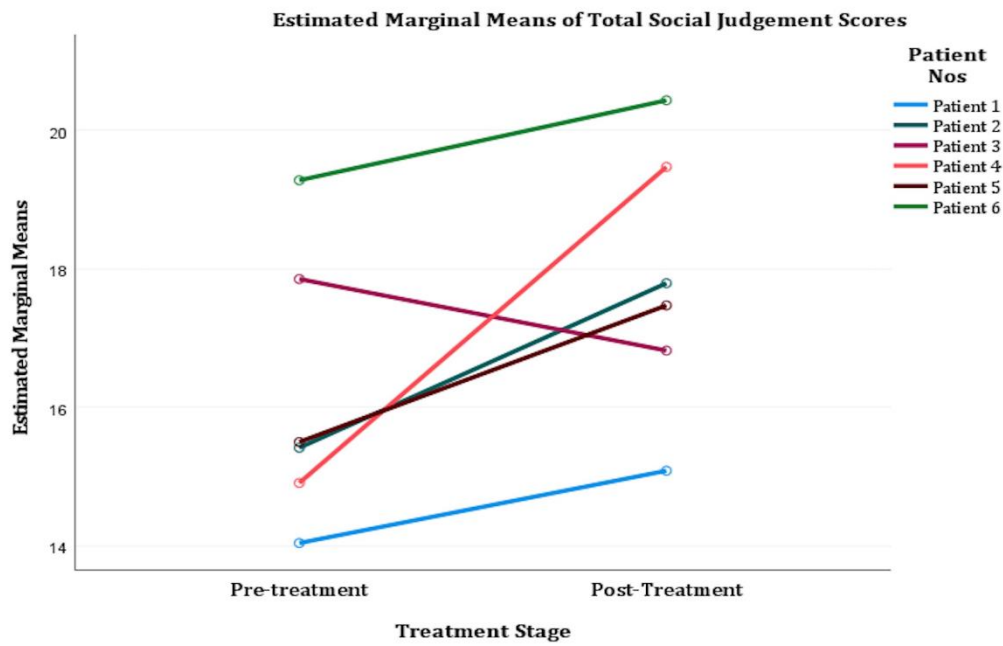
Figure 6

The estimated marginal means for the pre- and post-treatment social judgement scores in the class 2 patients compared with the class 3 patients
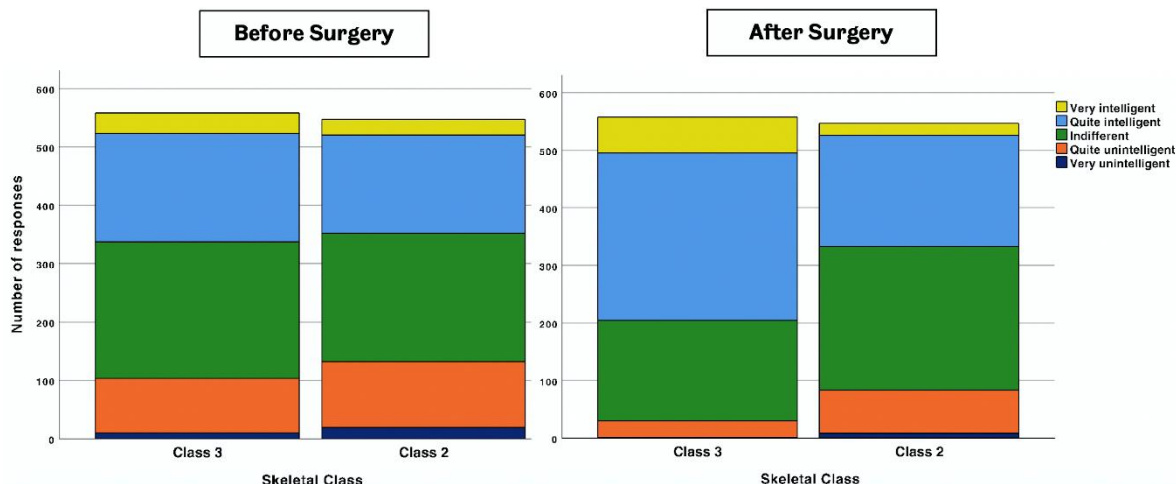
Figure 7

A stacked bar chart comparing the ratings for the friendliness personality trait for the pre and post orthognathic images for the Class 2 and 3 group
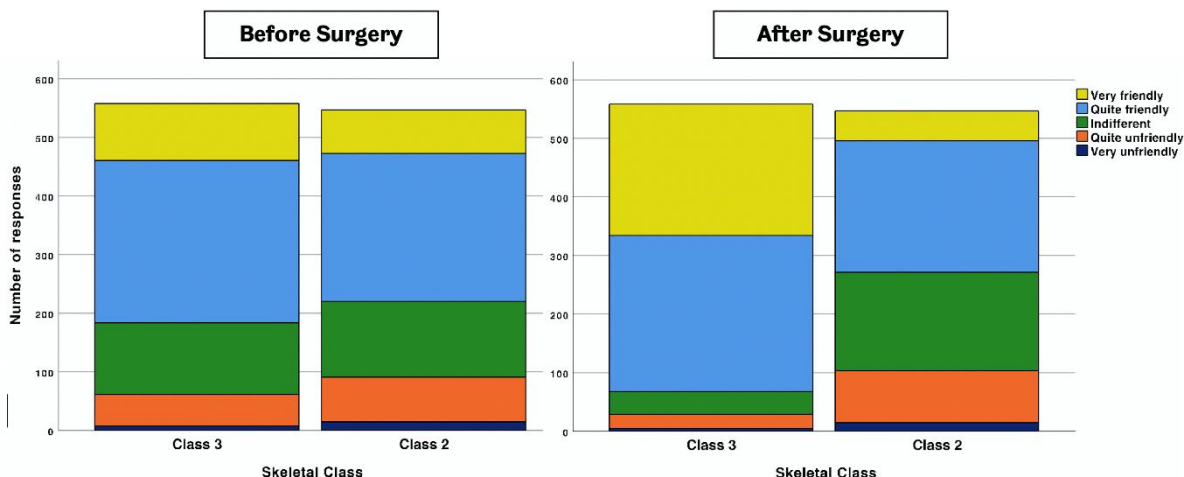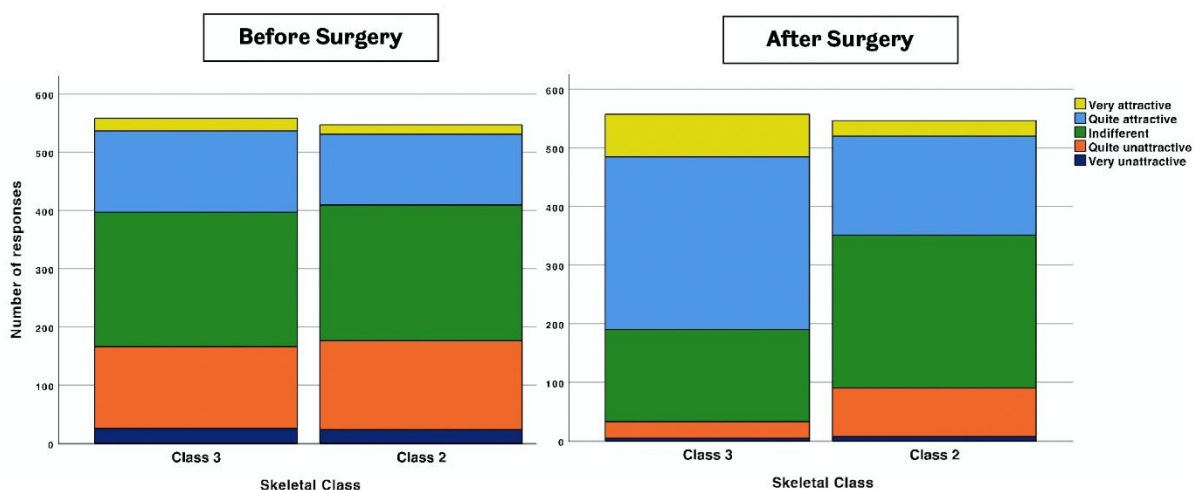

Figure 8

A stacked bar chart comparing the ratings for the intelligence personality trait for the pre and post orthognathic images for the Class 2 and 3 group
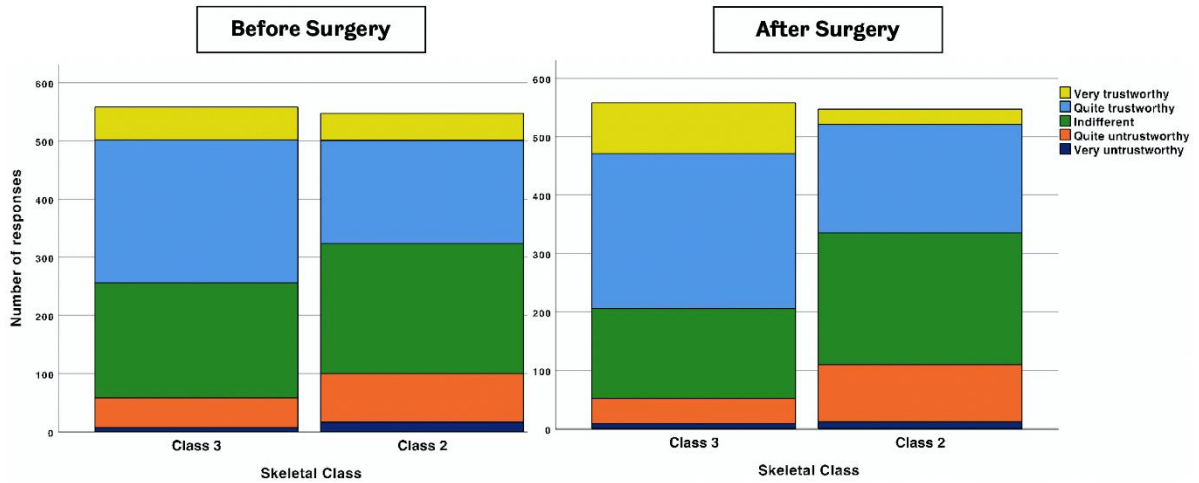

Figure 9

A stacked bar chart comparing the ratings for the attractiveness personality trait for the pre and post orthognathic images for the Class 2 and 3 group

Figure 10

A stacked bar chart comparing the ratings for the trustworthiness personality trait for the pre and post orthognathic images for the Class 2 and 3 group

Figure 11

A stacked bar chart comparing the ratings for the self-confidence personality trait for the pre and post orthognathic images for the Class 2 and 3 group