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PATIENT PERSPECTIVE POST-ORTHOGNATHIC SURGERY

By

Jessica Tunstill Crews  
B.A., University of Pennsylvania, 2004  
DMD, University of Florida, 2009

A Thesis  
Submitted to the Faculty of the  
School of Dentistry of the University of Louisville  
in Partial Fulfillment of the Requirements  
for the Degree of

Master of Oral Biology

Department of Orthodontics  
University of Louisville  
Louisville, Kentucky

August 2011



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A Thesis Approved on

June 15, 2011

By the following Thesis Committee:

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Thesis Director (Eric Bednar)

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Sunita Chandiramani

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David Tasman

## DEDICATION

This dissertation is dedicated to my parents

Dr. Steve Tunstill

and

Mrs. Vicki Tunstill

without whom, I would not have reached this far or had the  
opportunities to be where I am today.

It is also dedicated to my husband

Matthew Crews

who has unselfishly and lovingly supported me throughout my entire  
academic career.

## ACKNOWLEDGMENTS

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## ABSTRACT

### PATIENT PERSPECTIVE POST-ORTHOGNATHIC SURGERY

Jessica T. Crews

June 15, 2011

The aim of the study is to determine factors contributing to satisfaction with orthognathic surgery. It was hypothesized that specific factors contribute to the patient's perception of success. 37 patients who had orthodontic/ orthognathic surgery treatment at U of L participated in a survey study. 91 different analyses were tabulated. The analyses were divided into three categories. Analyses with: two categorical, two numerical, and one numerical and one categorical variable. None of the analyses with two categorical variables had significance. For the analyses with one categorical and one numerical variable, one had statistical significance. For the two numerical variables, eleven factors had a statistically significant correlation to the patient's overall satisfaction. Six had a significant correlation to the patient's willingness to recommend the treatment. Research in this area will improve the perception of these procedures by catering not only to the clinicians, but equally as important, to the patient's view of successful treatment.

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## **CHAPTER 1 INTRODUCTION AND LITERATURE REVIEW**

### **A. Introduction**

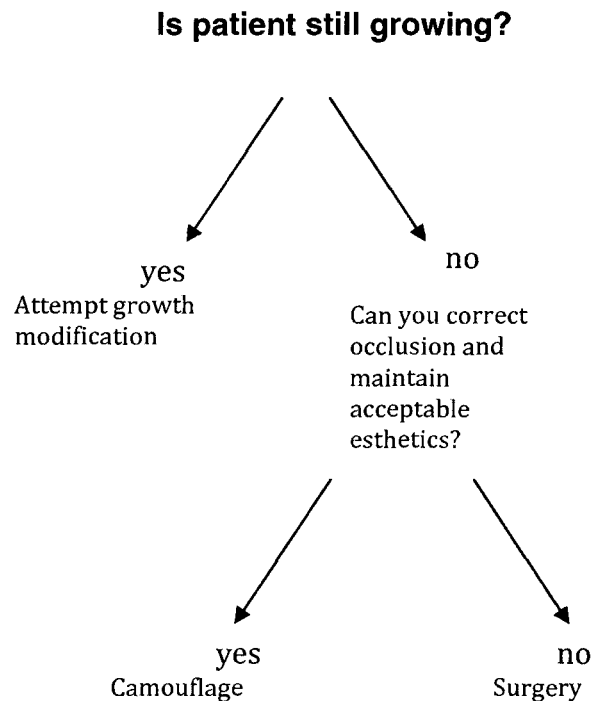
Orthognathic surgery is performed in conjunction with orthodontics for patients who have underlying skeletal jaw discrepancies whose dentoalveolar discrepancy is too severe to be treated with braces alone. Patients who are treatment planned for this combined surgical-orthodontic treatment have braces to decompensate their dentition in preparation for jaw surgery and continue to wear them after surgery to settle and perfect the occlusion. Decompensation is placing the dentition in the proper place relative to the underlying jawbones, the maxilla and mandible (Proffit, 2007).

Orthognathic surgery is recommended to about 10 percent of the patients that come to the University of Louisville's orthodontic program. Often, patients expect to simply get braces to straighten their teeth and are surprised when they are told that they could benefit from surgery to fix their bite and straighten teeth. Some often feel that the surgical procedures associated with this treatment are extreme, and perhaps unnecessary, and patients have many questions about the risks and benefits of the surgery. Although the clinician can do his or her best to explain these issues, knowing the experiences and feelings of people who have gone through similar treatment would be helpful.

## B. Literature Review

When a patient has a skeletal discrepancy, the first factor to determine is whether the patient is still growing. If they are, growth modification should be attempted. If not, the clinician must determine whether a patient can be treated with an acceptable result with braces alone. If not, orthognathic surgery is the best option for the patient (See figure 1 below).

**Figure 1. Three Treatment Options for Patients with Skeletal Jaw Discrepancies: Growth Modification, Camouflage, Surgery**



### 1. Growth Modification

If a patient with a skeletal discrepancy is identified early, the orthodontist can attempt growth modification to alter or redirect growth of the jaws and development of the dentition. Growing patients can benefit from growth

modification appliances such as functional appliances, headgear, and facemask therapy. These appliances have several different mechanisms. Some work by either restricting the growth of a procumbent or normal jaw so that the deficient jaw can catch up. Others modify the posture of a patients jaw in an attempt to reorganize the musculature and bony structures. For class II patients, growth modification is most effective and efficient during the patients growth spurt when growth is occurring at a rapid rate. For class III patients, growth modification is most effective when treatment is started in the early mixed dentition (Proffit, 2007).

## **2. Camouflage**

As growth slows, there is less opportunity to modify or alter the position of the teeth and jaws. Once fixing the discrepancy is no longer possible by growth modification, another option is to try and hide or camouflage the dental discrepancy while maintaining skeletal jaw relationships. Camouflage therapy often involves differential extraction patterns that help to disguise the underlying skeletal issue. Camouflage is often a compromise from ideal esthetics, occlusion, or both. However, this treatment can be acceptable in some cases (Proffit, 2007). Mihalik concluded in his study, "There is good evidence that the more the person perceives herself (or himself) as normal, the more likely he or she is to choose orthodontics alone and to be satisfied with the outcome. Conversely, patients who perceive themselves as outside the normal range are more likely to prefer surgery and to be dissatisfied with tooth movement alone" (2003). Another study by Meade identified other patient characteristics that

increase the likelihood of disappointment following surgery: “unrealistic expectations, emotional unpreparedness, and pressure from others to undergo surgery” (2010). All of these factors should be evaluated when considering patient selection for orthognathic surgery. The clinician must also keep in mind that no treatment is always an option as well. In cases with severe skeletal discrepancies when surgery is refused, no treatment may be the best option (Proffit, 2007).

### **3. Surgery**

#### **a. Indications**

Orthognathic surgery is indicated for patients that have skeletal jaw discrepancies when the patient is too old to attempt growth modification and/or the discrepancy is so severe that camouflage treatment would produce unacceptable esthetics. There is an envelope of discrepancy below showing the amount of tooth movement or correction that can be achieved by braces alone, braces with growth modification, and braces with orthognathic surgery. The inner circle represents the possible movement achievable with braces alone. The middle envelope represents braces combined with growth modification. This middle envelope shrinks as growth potential decreases. This is why timing is important when attempting growth modification. The outer envelope represents possible movement with orthognathic surgery.

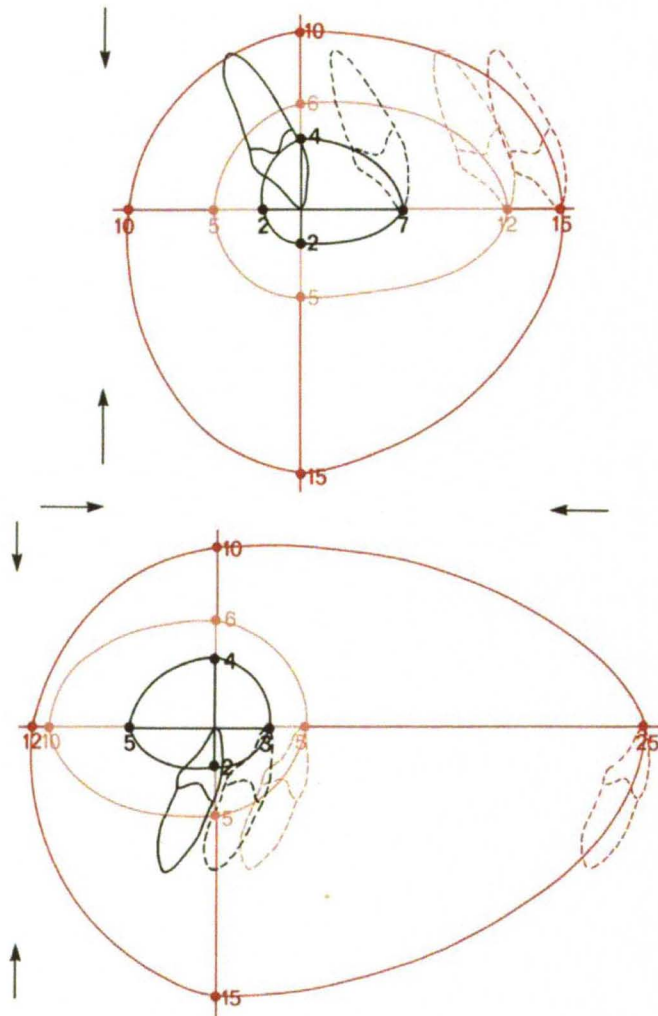


Figure 2. Envelope of Discrepancy55 (Proffit, William R.. *Contemporary Orthodontics, 4th Edition*. C.V. Mosby, 122006. 19.3).

Skeletal jaw discrepancies can be in the anterior-posterior, vertical, or transverse dimension. There are three anterior-posterior skeletal relationships that are traditionally defined: class I, class II, and class III. These skeletal relationships typically translate to a similar relationship seen dentally.



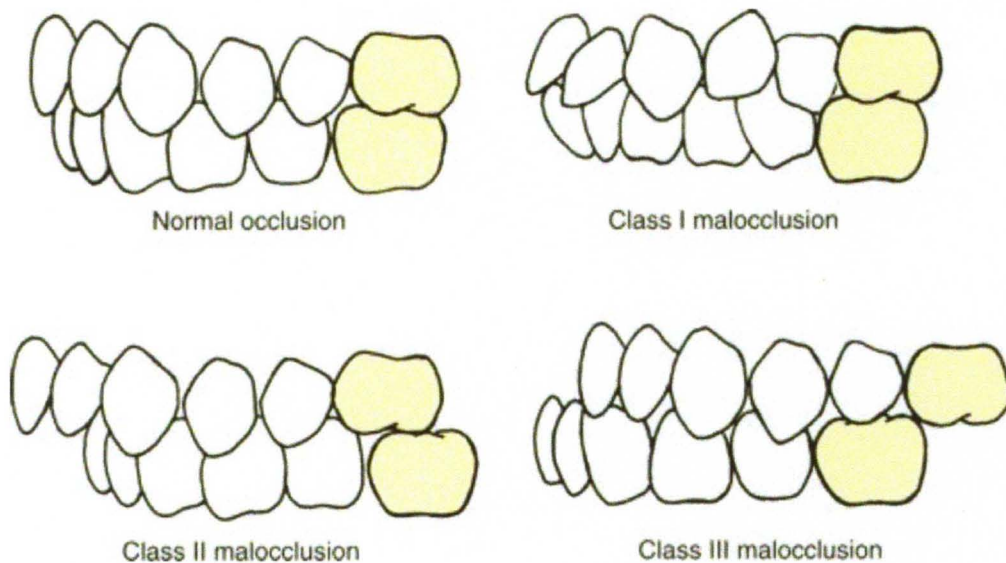


Figure 3. Angles Classifications (Proffit, William R.. *Contemporary Orthodontics, 4th Edition*. C.V. Mosby, 122006. 1.2).

A class I skeletal relationship is one in which the patient has relative balance between the size and relationship of the upper and lower jaws. This does not mean that the jaws are necessarily in an ideal location as you can have a patient in bi-maxillary protrusion, which indicates that both jaws are farther out relative to the cranial base. However, with these rare exceptions, a class I skeletal relationship is the treatment goal. A class II skeletal relationship is one in which either the maxillary or upper jaw is protrusive, the mandibular or lower jaw is retrusive, or it can be a combination of the two. A class III skeletal relationship is just the opposite of the class II skeletal relationship and involves a retrusive maxilla, protrusive mandible, or a combination. These AP relationships are commonly treated with maxillary surgery (typically a LeForte 1 osteotomy) mandibular surgery (typically a bilateral sagittal split osteotomy (BSSO)) or both. The mandibular surgery can either advance or setback the mandible as shown below (Proffit, 2007).

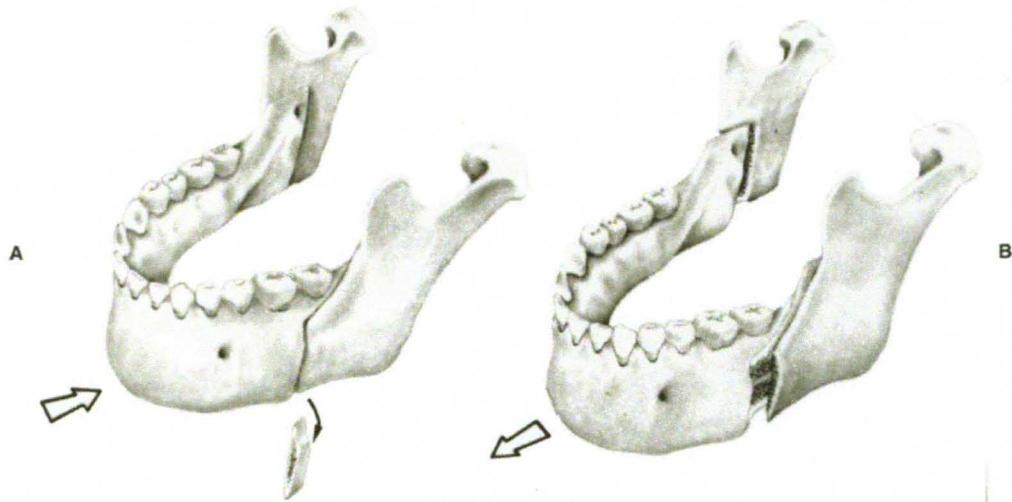


Figure 4. BSSO. (Proffit, William R.. *Contemporary Orthodontics, 4th Edition*. C.V. Mosby, 122006. 19.3).

Orthognathic surgery can be used to treat vertical problems as well, either increasing or decreasing face height. Decreasing face height can be done by maxillary superior repositioning (maxillary impaction). Vertical maxillary excess often results in a gummy smile. The amount of gingival display decreases with maxillary impaction. This is the most stable orthognathic surgery procedure. Once the maxilla is moved up, the mandible can autorotate up and forward. This procedure is often performed on patients with anterior open bites, vertical maxillary excess, or class II malocclusion due primarily to a mandible that has rotated down and back. (Proffit, 2007).

There are several ways to increase face height as well. Although face height can be increased by maxillary downgraft, this is a very unstable surgery as the resultant stretch of the muscles of mastication increases relapse tendency. A more stable way to increase face height is by advancing the mandible, allowing it to simultaneously rotate clockwise. This movement increases face height, but

also results in a higher mandibular plane angle, which may or may not be desired (Proffit, 2007).

Orthognathic surgery is also used to modify transverse relationships. Transverse problems can occur because of altered tongue posture or imbalanced musculature. These discrepancies can exist due to a constricted or overly expanded maxilla, mandible, or a combination of both. Although the width of the mandible can be modified, changing the width of the maxilla is much more common and less risky. The maxilla can be segmented and expanded transversely. Oftentimes when patients have a class II skeletal discrepancy that requires advancement of the mandible, maxillary expansion is also necessary to prevent posterior crossbites (Proffit, 2007).

Proffit outlines characteristics of patients who would most benefit from orthognathic surgery: "Severe skeletal discrepancy or extremely severe dentoalveolar problems, adult patient (little if any remaining growth), or younger patient with extremely severe or progressive deformity, good general health status (mild, controlled systemic disease acceptable)" (2007). After determining that a patient is a good candidate for orthognathic surgery based on physical parameters alone, examining the patient's motivations for pursuing surgery is beneficial as well. Several studies have looked at patient's perceptions of orthognathic surgery by considering their motives for having the procedure. These studies focus on how motivation influences the patient's concern for the risks of the procedure and willingness to have the surgery. One study concluded that the more esthetically driven the patient was, the less concerned he or she was of the risks. In addition, these patients more easily adjusted to the change in

appearance post-surgery relative to those who were motivated primarily by functionality (Flanary, 1985).

b. Benefits

By correcting skeletal discrepancies with orthognathic surgery, patients gain improvement in several potential categories: function, esthetics, and speech. Skeletal discrepancies can cause functional issues that affect a patient on a daily basis. For instance, patients with anterior open bites often present to clinic complaining that they are unable to bite into a sandwich or an apple. Patients with mandibular deficiency can have airway issues and suffer from conditions such as sleep apnea. Pahkala found in his study that the majority of patients who mentioned these factors in their reasons for seeking treatment reported a marked improvement in mastication, TMJ problems, and severe symptoms of dysfunction following the procedure (2007). From an insurance coverage perspective, the focus is often on improvements in function. However, Juggins pointed out, "Research has shown that most patients who request orthognathic treatment do so because of a desire to improve their facial or dental appearance and not because of concerns about occlusal function" (2005). In addition to these more obvious benefits, studies have seen major improvement in patient's psychological and social wellbeing following the procedure. Etsuko concluded, "The psychosocial dimension and all of its components (social interaction, communication, alertness behavior, emotional behavior) showed significant improvement from pre-surgery to two years post-surgery" (2003). The mental state of patients has also been shown to improve following surgery.

Typically, there is a small decrease in psychological wellbeing the first week or so post-surgery when dealing with the immediate post-surgical sequela. However, after this recovery period, patients show a gradual increase in wellbeing beyond the pretreatment level. This is represented diagrammatically below based on a study by Kiyak.

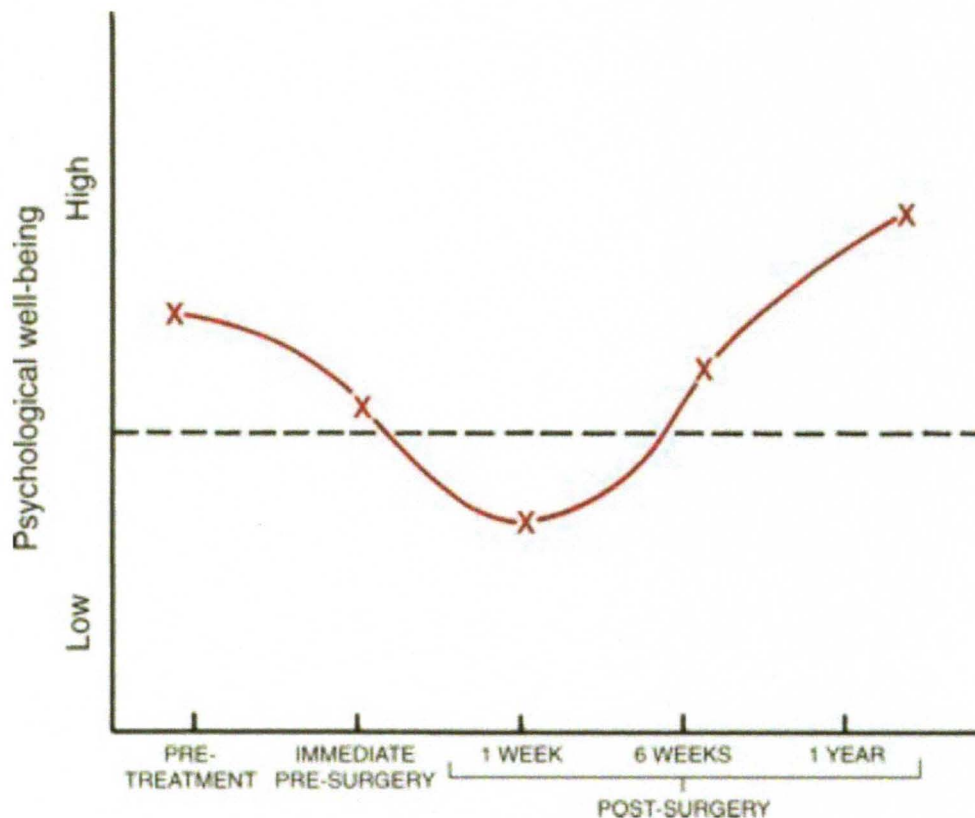


Figure 5. Post-Surgical Psychological well-being. (Proffit, William R.. *Contemporary Orthodontics, 4th Edition*. C.V. Mosby, 122006. 19.4.2).

One study demonstrated that, in general, patients who had orthognathic surgery show a statistically significant decrease in personality disturbances, which included categories such as neurosis, psychosis, and personality disorders two years following the procedure. There was a marked improvement in the patient's self-concept, which looked at the patient's "self-esteem, self-satisfaction, self-



identity, physical self, family self, social self, and total self-conflict” (Flanarya, 1990). This study concluded that orthognathic surgery has a positive influence on mental health. A study by Hatch et al further supports this idea, concluding that, “This ‘improvement’ extends to a surprisingly wide variety of psychological characteristics and is progressive throughout the first two years after surgery” (1999).

### c. Risks

There are many risks associated with orthognathic surgery. Before a patient decides how they would like to be treated, the clinician has a responsibility to ensure that the patient fully understands these risks. The risks of surgery include temporary or permanent nerve damage, mal-union, non-union, infection, TMJ issues, and the necrosis of teeth, among others. In addition, orthognathic surgery patients are subject to the risks of general anesthesia, which in rare cases can be fatal.

The most commonly reported risk is nerve damage. Any surgery involving the mandible greatly increases the patient’s risk for permanent nerve damage. Phillips pointed out in her study that for patients who had a BSSO of the mandible, the incidence of nerve damage to the inferior alveolar nerve approached 100% immediately after surgery. She states, “Altered sensation is the most frequent patient-reported post-surgical sequela: more than 60% of patients report persistent altered sensations 6 months after surgery, and these alterations can negatively affect orofacial function and daily activities” (2009). Patient age also influences the risk of permanent nerve damage. Although

waiting until end of the growth spurt before performing orthognathic surgery is critical, especially in the case of mandibular excess, the older the patient is at the time of surgery, the higher his or her risk for permanent nerve damage becomes (Travessa, 2008).

Another obvious sequela to surgery is the post-surgical swelling and pain during the recovery period. Several studies have followed patients closely in their recovery phase to see how long it takes them to recover different aspects of function, while also assessing the duration and intensity of pain, swelling, and other complications. These studies have shown that the pain and swelling tend to abate on average in about two to three weeks, while the return to normal activities, such as chewing or exercising, tends to take four to six weeks post-surgery before the patient reports marked improvement (Stoker, 2006). Other studies examined which procedures require the longest healing time and result in increased pain and other post-surgical sequela. They found that two-jaw surgeries require the most recovery time and also result in more pain and suffering. Other factors that affect recovery time include the amount of blood that is lost during surgery and the total length of the surgery (Jaskolka, 2008).

#### d. Stability

The stability of the orthognathic surgery must be considered and discussed as the patient also influences treatment planning for the doctor. Stability varies considerably depending on the procedure and the extent of movement that is necessary (See figure 6). The most stable procedure is the upward movement of the maxilla followed closely by the forward positioning of

the mandible, as long as the movement is less than ten millimeters. The least stable movement is expansion, or widening, of the maxilla (Bailey, 2004). Bailey concluded in her study, "Three procedures are in the problematic category, defined as a 40%-50% chance of 2-4mm postsurgical change and a significant chance of more than 4mm change: mandibular setback, downward movement of the maxilla, and maxillary expansion." However, she also mentioned that, even with these "problematic procedures," at least half of the patients end up with a stable result (2004). Patients should be informed about the stability of the procedure that they are considering, as it could have a substantial influence on their treatment decision.

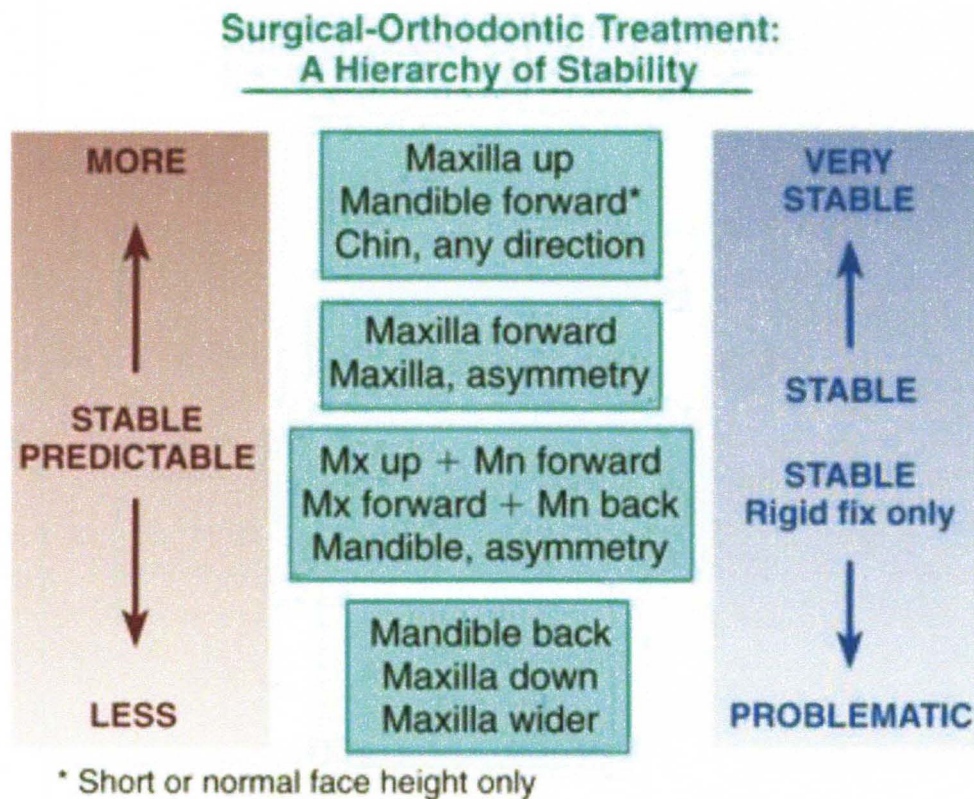


Figure 6. Stability Hierarchy. (Proffit, William R.. *Contemporary Orthodontics, 4th Edition*. C.V. Mosby, 122006. 19.7.5.1).



### **C. Significance**

One of the first and most important questions asked by those considering surgery is whether patients who had orthognathic surgery are happy with their decision. The goal of this research study is to answer this question. Although there are several studies mentioned above that report on a patient's experience with the post-surgical sequela or seek to determine the reasons patients are seeking orthognathic surgery, there is not much literature available on certain criteria that directly relate to a patient's overall satisfaction with the procedure. One prospective study by Meade evaluated patient's satisfaction with orthognathic surgery from both the parent and patient perspectives. This study correlated the patient's enthusiasm for who they thought they could become after surgery, an idea termed "possible selves," to their overall satisfaction post-surgery. The study concluded, the more energized the patient, the more satisfied they were post-surgery (2010). No additional factors, such as the age or sex of patient were taken into account. Determining these additional factors that lead to increased satisfaction will allow us to better inform and prepare patients, and, potentially, identify those individuals that are better suited to have the procedure.

### **D. Purpose**

This research study's specific aims include:

- Determining if there are any specific factors that either increase or decrease a patient's overall satisfaction with the orthognathic surgery experience

- Obtaining general demographic information on patient's that are seeking orthognathic surgery
- Determining the surgical goals of the patient's seeking treatment
- Identifying the incidence of certain side effects and complications among the patients surveyed
- Determining overall satisfaction rates of the patient pool that have been treated at the University of Louisville

### **E. Hypothesis**

#### Null Hypothesis:

There are no identifiable factors that can be correlated with a patient's overall satisfaction rate with orthognathic surgery.

#### Alternative Hypothesis:

Certain factors can be identified that directly relate to a patient's satisfaction or dissatisfaction with the surgery.

## **CHAPTER II**

### **MATERIALS AND METHODS**

#### **A. Overview**

This investigation was a survey study to determine patient's perspectives post-orthognathic surgery. The sample included 37 patients who had either their orthognathic surgery and/or comprehensive orthodontics completed at the University of Louisville. This study was approved by the Institutional Review Board at the University of Louisville, Louisville, Kentucky, on February 13, 2011. (IRB #10.0662)

#### **B. Sample**

There were 144 patients from the past five years that had been treated for a combined orthodontic/orthognathic surgery treatment with either the orthodontics, surgery, or both preformed at the University of Louisville. All of these patients were contacted as long as they were over the age of eighteen. Of those contacted, only 50 responded. Of these 50 patients, 37 completed the survey.

#### **C. Inclusion/Exclusion Criteria**

The inclusion criterion for this study is that the patient had to have a combined surgical and orthodontic treatment with one or both being completed at the University of Louisville. The exclusion criterion was that the patient could not be

under the age of 18 at the time of the survey. The patients were prescreened and, if they were under the age of 18, they were not contacted for participation.

#### **D. Data Collection**

Because of the wide range of patients, from a socioeconomic standpoint, there were three options to complete the survey: verbally, hard-copy, or internet via Survey Monkey ([www.surveymonkey.com](http://www.surveymonkey.com)). An informed consent form was the first page for all of the survey methods (See Appendix A). No personal health identifiers were collected and the website did not store IP addresses. All of the information collected was stored on a secure drive at the University of Louisville Orthodontics Department. The survey included fourteen questions: six on patient demographics, two on surgical goals and treatment, three on complications and side effects, two on financial considerations, and one on esthetic feedback. The patients were asked to complete a table rating, on a ten-point scale, how they viewed certain aspects of their lives (facial profile, smile, overall appearance, oral function, TMJ problems, self-confidence, personal motivation, interpersonal relationships) both before and after surgery. In addition, the patients were asked to rate, on a ten-point scale, three questions indicating their satisfaction with the overall experience of the combined orthodontics/ orthognathic surgery treatment (See Appendix B).

#### **E. Statistical Analysis**

The data was compiled for the 37 individuals who received the combined orthognathic/orthodontic treatment. 91 analyses were computed to look for

relationships between the variables themselves and between the variables and the patient's overall satisfaction rate and willingness to recommend the treatment to others. There were 91 different analyses (Appendix C) that can be grouped into three different categories as follows:

- 1) Analyses with categorical variables for both the response and the explanatory variable (7 analyses)
- 2) Analyses with one categorical variable and one numerical variable (26 analyses)
- 3) Analyses with numerical variables for both the response and the explanatory variable (58 analyses)

For the analyses that had categorical variables for both the response and the explanatory variable, contingency tables were tabulated which included the totals, frequencies, and column percentages (See Appendix D). In addition, either the chi-squared test or the Fisher exact test was used to calculate the p-values (Agresti, 2002).

For the analyses that had one categorical and one numerical variable, the above information was collected for the numerical variables falling within each category level (Appendix E). In addition, t-tests were used to calculate the p-values (Strasser, 1999, Hothorn, 2006, Hothorn 2008, Student, 1908). Outliers were detected using boxplots. Because the number of subjects was relatively low (37) compared to the number of analyses (91), multivariable analysis was not

attempted to adjust for other significant variables in any of the analyses (Anderson, 2001).

For the analyses that had numerical variables for both the response and the explanatory variable, descriptive statistics were collected and included the mean, median, standard deviation, maximums, and minimums (See Appendix F). Two different tests were tabulated, the Pearson Product Moment Test (Pearson) and Spearman's Rank Test (Spearman), to calculate the correlation coefficients and the associated p-values. Results were calculated for both tests since the Spearman is better when the data has fewer categories and the Pearson is more accurate when the data is linear. In addition, the 95% confidence intervals were calculated for the Pearson correlation numbers (Strasser, 1999, Hothorn, 2006, Hothorn 2008). The false discovery rate (FDR) multiple testing correction was calculated for the Spearman p-values. The FDR adjusts for the large number of analyses starting with the lowest p-value. Scatter plots of each of the analyses were used to identify any outliers. For the analyses that were statistically significant after the FDR was calculated ( $FDR < 0.05$ ), the most extreme outlier was removed and the analysis was repeated to ensure statistical significance (Benjamini, 1995) (See Appendix G).

Because this is an explanatory study with a small number of subjects, 37, less emphasis should be placed on the p-values and more emphasis should be placed on the effect size statistics, such as correlation coefficients, means/medians, standard deviations, and confidence intervals. For non-

significant p-values ( $p > 0.05$ ), the null hypothesis should not be concluded to be true. Also, spurious p-values can be an issue due to the large numbers of analyses; therefore, the multiple testing correction, or FDR test, was calculated for the analyses with both numerical variables, which was the majority of the analyses (58/91) (Anderson, 2001).

## CHAPTER III

### RESULTS

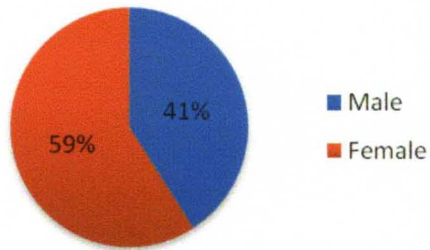
#### A. Demographics and Patient Summary

Thirty-seven patients who had combined orthognathic / orthodontic treatment participated in the survey. These patients had the following characteristics:

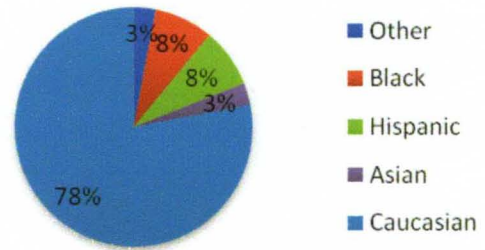
- Age at time of survey participation ranged from 18 to 56 with a mean of 26
- Age range at time of surgery was 13 to 56 with a mean of 23
- 78.38% Caucasian, 8.11% Hispanic, 8.11% Black, 2.70% Asian, 2.70% other
- 24.32% worked in a dental related occupation
- 59% female, 41% male
- Primary reason for seeking treatment: 68% function, 32% esthetics
- Type of surgery: 51.35% two-jaw surgery, 32.43% maxillary (upper jaw surgery), 16.22% mandibular (lower jaw surgery) (See Figures 7-11 below)



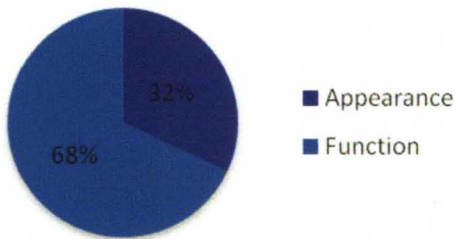
**Figure 7. Sex Distibution**



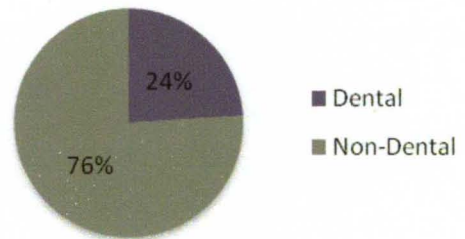
**Figure 8. Race Percentages**



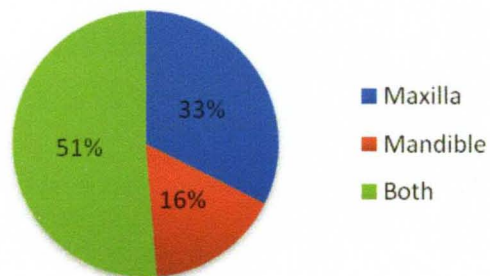
**Figure 9. Primary Reason for Seeking Treatment**



**Figure 10. Percentage in Dental Occupation**



**Figure 11. Jaw Distribution**



The overall percentage of the patient's perceived change in the eight categories surveyed (profile, smile, overall appearance, TMJ issues, self-confidence, personal motivation, and interpersonal relationships) was calculated. The percentage of individuals who were happy they had the treatment and would recommend it to others was also tabulated. Finally, the overall satisfaction of the patients surveyed was reported (See Tables 1-3 below).

	Improvement (% <sup>A</sup> , #)	No Change <sup>B</sup> (%, #)	Worse <sup>C</sup> (%, #)
Profile Change	81.08, 30	16.22, 6	2.70, 1
Smile Change	89.19, 33	5.41, 2	5.41, 2
Overall Appearance Change	83.78, 31	13.51, 5	2.70, 1
Oral Function Change	83.78, 31	10.81, 4	5.41, 2
TMJ Change	37.84, 14	51.35, 19	10.81, 4
Self Confidence Change	78.38, 29	18.92, 7	2.70, 1
Personal Motivation Change	51.35, 19	48.65, 18	0.00, 0
Interpersonal Relationship Change	59.46, 22	35.14, 13	5.41, 2

<sup>A</sup>Improvement = Rating after surgery - rating before surgery > 0  
<sup>B</sup>No Change = Rating after surgery - rating before surgery = 0  
<sup>C</sup>Worse = Rating after surgery - rating before surgery < 0

	Yes <sup>A</sup> (% , #)	Neutral <sup>B</sup> (%, #)	No <sup>C</sup> (% , #)
Are you glad you had the treatment?	94.59, 35	0.00, 0	5.41, 2
Would you recommend this treatment to others?	91.89, 34	8.11, 3	0.00, 0

<sup>A</sup>Yes = Ranking > 0  
<sup>B</sup>Neutral = Ranking = 0  
<sup>C</sup>No = Ranking < 0,

Table 3. Overall Patient Satisfaction			
	Satisfied <sup>A</sup> (%,#)	Neutral <sup>B</sup> (%, #)	Dissatisfied <sup>C</sup> (%, #)
Overall satisfaction with treatment	97.30, 36	0.00, 0	2.70, 1
<sup>A</sup> Satisfied = Ranking > 0 <sup>B</sup> Neutral = Ranking = 0 <sup>C</sup> Dissatisfied = Ranking < 0,			

## B. Statistical Analysis Results

As mentioned in Section E of Chapter II, the 91 analyses fell into three different groups: those with two categorical variables (7), those with one categorical variable and one numerical variable (26), and those with both numerical variables (58). The 91 analyses are listed in Appendix A.

### a. Two Categorical Variables

For the analyses with two categorical variables, individual charts were tabulated. None of the p-values were statistically significant for the analyses involving two categorical variables. This is likely due to the fact that analyses with categorical data have less power than those with numerical data. Also, because the data was further subdivided into multiple categories for these analyses, even fewer counts resulted, especially for those analyses with more than two levels. Significant observations for this study include the following:

- All but one subject reported positive feedback on their treatment.

- The majority of the patients surveyed (67.6%) said that their main reason for seeking treatment was for an improvement in function; the remaining sought treatment primarily for esthetic reasons.
- 83.8% of the patients surveyed had some sort of paresthesia, or loss of sensation, following the procedure. Of these patients, 90.3% said that the paresthesia either did not affect them or it had only a slight effect on a daily basis. A breakdown of the type of procedure that resulted in paresthesia is as follows: 51.6% had two-jaw surgery, 16.1% had surgery involving the mandible, or lower jaw, only, and 32.3% had surgery involving the upper jaw only.
- 74.2% of the patients who experienced paresthesia partially regained sensation and 25.8% fully regained sensation at some point following the procedure.

The analyses with two categorical variables have been summarized in Appendix

#### b. One Categorical and One Numerical Variable

There were 26 analyses that involved one categorical and one numerical variable. Of the 26 analyses, only one had a statistically significant p-value ( $p < 0.05$ ). This analysis (p-value of 0.033) was for the relationship between the gender of the patient and the patient's willingness to recommend the treatment to others. Females (mean: 4.3) were more likely to recommend the treatment than males (mean 3.7); however, the FDR multiple testing correction was not

calculated for this group of analyses. The results for these analyses are listed in Appendix D.

c. Both Numerical Variables

For the analyses with two numerical values, 25 had statistically significant p-values ( $p\text{-value} < 0.05$ ). When the FDR multiple testing correction was calculated, 18 of these remained statistically significant ( $FDR < 0.05$ ). Scatter plots of significant analyses were formulated to identify extreme outliers. The outliers were removed and the analyses were recalculated to ensure statistical significance. The full results can be viewed in Appendix E. Eleven analyses with a statistically significant FDR value had Q5, or the overall satisfaction rate, as the explanatory variable. Based on these statistically significant results, the conclusion can be made that the alternative hypothesis, which stated that certain factors could be identified that directly relate to a patient's satisfaction or dissatisfaction with the surgery, is accurate. These identified factors in this study included: profile at the end of treatment, profile change, smile change, appearance at the end of treatment, appearance change, function at the end of treatment, function change, confidence at the end of treatment, interpersonal relationship change, satisfaction with having had the procedure, and willingness to recommend the procedure to others.

Six of the statistically significant FDR values had Q4, or how willing the patient was to recommend the treatment to others, as the explanatory variable. These included: satisfaction with their function at the end of treatment,

confidence at the end of treatment, personal motivation at the end of treatment, interpersonal relationships at the end of treatment, perceived interpersonal relationship change, and satisfaction with having had the procedure. One other statistically significant relationship was the patient's perceived change in appearance to the patient's interpersonal relationship change. Significant FDR values are summarized in Table 4 below.

<b>Table 4: Significant FDR Values<sup>A</sup></b>	
<b>Patient More Likely to Recommend Treatment to others if perceived improvement in...</b>	<b>Patient more likely to have overall satisfaction with treatment if perceived improvement in...</b>
Function Post-Surgery (.009)	Profile Post-Surgery (.009)
Confidence Post-Surgery (.009)	Profile Change form Pre to Post-Surgery (.003)
Motivation Post-Surgery (.038)	Smile Change from Pre to Post-Surgery (.029)
Interpersonal Relationships Post-Surgery (.013)	Appearance Post-Surgery (.013)
Interpersonal Relationship Change from Pre to Post-Surgery (.040)	Appearance Change from Pre to Post-Surgery (.009)
How happy the patient was to have the surgery (.000)	Function Post-Surgery (.009)
	Function Change from Pre to Post-Surgery (.039)
	Confidence Post-Surgery (.005)
	Interpersonal Relationship Change from Pre to Post-Surgery (.003)
	How happy the patient was to have the surgery (.000)
	How likely they were to recommend the surgery (.003)
<sup>A</sup> Significant FDR less than or equal to 0.050	

## **CHAPTER IV**

### **DISCUSSION**

This study is primarily an explanatory study looking for variables that resulted in a patient being more or less satisfied with having had combined orthognathic surgery/orthodontic treatment. Although there were a relatively low number of subjects (37) from the University of Louisville patient pool who were available and willing to participate in this survey, several relationships were seen among the variables.

Eleven factors had a statistically significant correlation with patient overall satisfaction rate with the procedure. This substantiates the alternative hypothesis. The factors included the following: patient perceived profile, appearance, function, confidence at the end of treatment, patient's perceived change in profile, smile, appearance, function, interpersonal relationship change by the end of treatment, satisfaction with having had the procedure, and willingness to recommend the procedure to others (See Table 4).

Six factors had a statistically significant correlation to whether a patient would recommend the treatment to others. These factors included the following: the patient's perceived function, confidence, personal motivation, interpersonal relationships at the end of treatment, patient's perceived change in interpersonal relationships after the procedure, and satisfaction with having had the procedure (See Table 4). Factors that might have had some relationship with the patient's



overall satisfaction rate, but did not according to this study included the patient's perception of TMJ issues, such as popping, clicking, or locking, before or after the surgery, the patient's age at time of surgery, and the time that elapsed since the patient had the surgery. However, the lack of a statistical relationship may be due to the limited sample size.

Knowing the factors that result in increased satisfaction could allow clinicians to prescreen and identify patients that may be more inclined to have a positive experience. Based on our results, if the patient's primary reason for seeking surgery is because of TMJ problems, orthognathic/orthodontic treatment may not be the best option. Based on this study, 37.8% of patients reported an improvement in TMJ issues, 51.4% reported no change, and 10.8% reported an increase in TMJ issues. However, if patients are seeking improvement in function (83.8% satisfaction), appearance (83.8% satisfaction), smile (89.2% satisfaction), or profile (81.1% satisfaction), orthognathic/orthodontic treatment might be the right choice for them.

In discussions with patients, the fear of paresthesia, or loss of sensation, is often the main explanation given for not wanting surgery. Nevertheless, even though 83.8% of the patients surveyed ended up with some degree of paresthesia, 97.3% still reported that they were satisfied with having had the procedure, 94.6% said that they were glad they had the treatment, and 91.9% said they would recommend the treatment to others.

Of the 37 patients who participated in the survey, one reported overall dissatisfaction with the combined orthodontic/orthognathic treatment. In addition,

one other patient regretted having the procedure, but still reported overall satisfaction. None of the patients surveyed said that they would not recommend the treatment to others. Therefore, based on the limited sample size, we can conclude that patients are satisfied with combined orthognathic/orthodontic treatment, despite the risks involved; however, further investigations with a larger patient pool would be necessary to substantiate this conclusion.

## **CHAPTER V**

### **CONCLUSIONS**

#### **A. Summary:**

The specific aim of this paper was to determine if there are any factors that directly relate to a patient's overall satisfaction with having had combined orthognathic surgery/orthodontic treatment. Although the number of subjects surveyed was relatively low, there were eleven factors that had statistically significant p-values even after the FDR multiple testing correction.

#### **B. Conclusions:**

In this study, there were eleven factors that directly related to the patient's overall satisfaction with having had the combined orthodontic/orthognathic treatment. Therefore, the alternative hypothesis can be accepted and the null hypothesis rejected. The alternative hypothesis stated that certain factors can be identified that directly relate to a patient's satisfaction or dissatisfaction with the surgery.

Six factors influenced a patient's willingness to recommend the treatment to others. The information obtained from results of this study could be used to prescreen patients who may be more inclined to be satisfied with the treatment. As mentioned above, in this study, the patient's overall satisfaction had little relationship to whether or not they developed paresthesia, which merits further investigation, as it is pertinent to patient discussions if it can be validated in larger

studies. Future studies with a larger patient pool would be needed to further explore the factors that directly influence a patient's satisfaction with orthognathic surgery.

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## APPENDIX



## Appendix A

### Patient's Perspective Post-Orthognathic Surgery

12/15/10

Dear potential study participant,

You are being invited to participate in a research study by answering the attached survey about the factors that make a patient happy or disappointed after jaw surgery (orthognathic surgery). There are no known risks for your participation in this research study. The information collected may not benefit you directly. The information learned in this study may be helpful to others. The information you provide will help to provide more information to patients who are considering having the surgery. Your completed survey will be stored at the University of Louisville's dental school in a locked cabinet. The survey will take approximately 10 minutes time to complete.

Individuals from the Department of Orthodontics, the Institutional Review Board (IRB), the Human Subjects Protection Program Office (HSPPO), and other regulatory agencies may inspect these records. In all other respects, however, the data will be held in confidence to the extent permitted by law. Should the data be published, your identity will not be disclosed.

Taking part in this study is voluntary. By completing this survey you agree to take part in this research study. You do not have to answer any questions that make you uncomfortable. You may choose not to take part at all. If you decide to be in this study you may stop taking part at any time. If you decide not to be in this study or if you stop taking part at any time, you will not lose any benefits for which you may qualify.

If you have any questions, concerns, or complaints about the research study, please contact: Jessica Crews (904-477-0823)

If you have any questions about your rights as a research subject, you may call

the Human Subjects Protection Program Office at (502) 852-5188. You can discuss any questions about your rights as a research subject, in private, with a member of the Institutional Review Board (IRB). You may also call this number if you have other questions about the research, and you cannot reach the study doctor, or want to talk to someone else. The IRB is an independent committee made up of people from the University community, staff of the institutions, as well as people from the community not connected with these institutions. The IRB has reviewed this research study.

If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24-hour hot line answered by people who do not work at the University of Louisville.

Sincerely,

Eric Bednar  
Jessica Crews

Appendix B  
**Patient's Perspective Post-Orthognathic Surgery**

1. Gender
  - a. Male
  - b. Female
  
2. What race/ethnicity are you?
  - a. Black
  - b. Asian
  - c. Caucasian
  - d. Hispanic
  - e. Other
  
3. Do you work in a dental-related occupation?
  - a. Yes
  - b. No
  
4. In which dental-related occupation do you work?
  - a. Dental Hygienist / assistant
  - b. Dental administration
  - c. Dentist / dental student
  
5. How old are you now?  
\_\_\_\_\_ years old
  
6. How old were you when you had your surgery?  
\_\_\_\_\_ years old
  
7. What was your primary reason for having the surgery?
  - a. Improved appearance
  - b. Improved function
  
8. Which jaw did the surgery involve?
  - a. Maxilla (upper jaw)
  - b. Mandible (lower jaw)
  - c. Both jaws

Did you have any loss of sensation or feeling after your surgery?  
surgery?

- a. Yes
- b. No

10. How much of an effect does the loss of sensation or feeling have on a daily basis?

- a. None
- b. Slight
- c. Moderate
- d. Severe

11. Did you regain any of the lost sensation or feeling?

- a. No
- b. Partially
- c. Fully

12. Was the procedure covered by your insurance?

- a. Yes
- b. No

13. Approximately how much did you pay out of pocket for the procedure?

\$\_\_\_\_\_

14. What kind of feedback on your appearance did you receive from others (family, friends, etc.) after the procedure?

- a. Positive feedback
- b. Negative
- c. Both positive and negative
- d. None

<b>Instructions:</b> For the following questions, please use the ten-point scale to indicate how you felt about certain aspects of your life.	Unacceptabl					Neutral					Ideal
	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Facial Profile <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facial Profile <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smile <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smile <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall Appearance <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall Appearance <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral Function <b>BEFORE</b> surgery (Chewing, speaking, ect.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral Function <b>AFTER</b> surgery (Chewing, speaking, ect.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TMJ Problems <b>BEFORE</b> surgery (pain, popping, clicking, locking)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TMJ Problems <b>AFTER</b> surgery (pain, popping, clicking, locking)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Self-Confidence <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Self-Confidence <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personal Motivation <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Personal Motivation <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interpersonal Relationships <b>BEFORE</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interpersonal Relationships <b>AFTER</b> surgery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<b>Instructions:</b> For the following questions, please use the ten-point scale to indicate your overall experience with combined surgical and orthodontic treatment.	<b>Absolutely NOT</b>					<b>Neutral</b>					<b>Absolutely</b>
	<b>-5</b>	<b>-4</b>	<b>-3</b>	<b>-2</b>	<b>-1</b>	<b>0</b>	<b>+1</b>	<b>+2</b>	<b>+3</b>	<b>+4</b>	<b>+5</b>
Are you glad that you had the treatment?	○	○	○	○	○	○	○	○	○	○	○
Would you recommend this treatment to others?	○	○	○	○	○	○	○	○	○	○	○
Overall I am satisfied with my treatment.	○	○	○	○	○	○	○	○	○	○	○

## Appendix C

Table xx: Analyses

Analysis	Variable	Explanatory	Question
1	Gender	Q4	Does gender affect whether a patient would recommend surgery to others?
2	Gender	Q5	Does gender affect overall satisfaction rate?
3	Race	Q4	Does race affect whether a patient would recommend surgery to others?
4	Race	Q5	Does race affect overall satisfaction rate?
5	Dentist	Q4	Does being in a dental field affect whether a patient would recommend surgery to others?
6	Dentist	Q5	Does being in a dental field affect overall satisfaction rate?
7	Age	Q4	Does patient's current age affect whether a patient would recommend surgery to others?
8	Age	Q5	Does patient's current age affect overall satisfaction rate?
9	Q1	Q4	Does patient's age at time of surgery affect whether a patient would recommend surgery to others?
10	Q1	Q5	Does patient's age at time of surgery affect overall satisfaction rate?
11	Q2	Q4	Does years since surgery affect whether a patient would recommend surgery to others?
12	Q2	Q5	Does years since surgery affect overall satisfaction rate?
13	Reason	Q4	Does the patient's primary reason for surgery affect whether a patient would recommend surgery to others?
14	Reason	Q5	Does the patient's primary reason for surgery affect overall satisfaction rate?
15	Jaw	Q4	Does the jaw the surgery involved affect whether a patient would recommend surgery to others?
16	Jaw	Q5	Does the jaw the surgery involved affect overall satisfaction rate?
17	Paresthesia	Q4	Does whether the patient has paresthesia affect whether a patient would recommend surgery to others?
18	Paresthesia	Q5	Does whether the patient has paresthesia affect overall satisfaction rate?
19	Extent	Q4	Does the extent of paresthesia affect whether a patient would recommend surgery to others?
20	Extent	Q5	Does the extent of paresthesia affect overall satisfaction rate?
21	Regain	Q4	Does the extent to which the patient regained sensation affect whether a patient would recommend surgery to others?
22	Regain	Q5	Does the extent to which the patient regained sensation affect overall satisfaction rate?
23	Coverage	Q4	Does whether the patient had insurance coverage affect whether a patient would recommend surgery to others?
24	Coverage	Q5	Does whether the patient had insurance coverage affect overall satisfaction rate?
25	Feedback	Q4	Does the type of feedback the patient received affect whether a patient would recommend surgery to others?
26	Feedback	Q5	Does the type of feedback the patient received affect overall satisfaction rate?
27	Profile_T1	Q4	Does the patient's perception of his profile before surgery affect whether a patient would recommend surgery to others?
28	Profile_T1	Q5	Does the patient's perception of his profile before surgery affect overall satisfaction rate?
29	Profile_T2	Q4	Does the patient's perception of his profile after surgery affect whether a patient would recommend surgery to others?
30	Profile_T2	Q5	Does the patient's perception of his profile after surgery affect overall satisfaction rate?
31	Profile_Change	Q4	Does the patient's perception of his profile change affect whether a patient would recommend surgery to others?
32	Profile_Change	Q5	Does the patient's perception of his profile change affect overall satisfaction rate?
33	Smile_T1	Q4	Does the patient's perception of his smile before surgery affect whether a patient would recommend surgery to others?
34	Smile_T1	Q5	Does the patient's perception of his smile before surgery affect overall satisfaction rate?
35	Smile_T2	Q4	Does the patient's perception of his smile after surgery affect whether a patient would recommend surgery to others?
36	Smile_T2	Q5	Does the patient's perception of his smile after surgery affect overall satisfaction rate?
37	Smile_Change	Q4	Does the patient's perception of his smile change affect whether a patient would recommend surgery to others?
38	Smile_Change	Q5	Does the patient's perception of his smile change affect overall satisfaction rate?
39	Looks_T1	Q4	Does the patient's perception of his appearance before surgery affect whether a patient would recommend surgery to others?
40	Looks_T1	Q5	Does the patient's perception of his appearance before surgery affect overall satisfaction rate?
41	Looks_T2	Q4	Does the patient's perception of his appearance after surgery affect whether a patient would recommend surgery to others?
42	Looks_T2	Q5	Does the patient's perception of his appearance after surgery affect overall satisfaction rate?
43	Looks_Change	Q4	Does the patient's perception of his appearance change affect whether a patient would recommend surgery to others?
44	Looks_Change	Q5	Does the patient's perception of his appearance change affect overall satisfaction rate?
45	Function_T1	Q4	Does the patient's perception of his function before surgery affect whether a patient would recommend surgery to others?
46	Function_T1	Q5	Does the patient's perception of his function before surgery affect overall satisfaction rate?



47	Function_T2	Q4	Does the patient's perception of his function after surgery affect whether a patient would recommend surgery to others?
48	Function_T2	Q5	Does the patient's perception of his function after surgery affect overall satisfaction rate?
49	Function_Change	Q4	Does the patient's perception of his function change affect whether a patient would recommend surgery to others?
50	Function_Change	Q5	Does the patient's perception of his function change affect overall satisfaction rate?
51	TMJ_T1	Q4	Does the patient's perception of his TMJ function before surgery affect whether a patient would recommend surgery to others?
52	TMJ_T1	Q5	Does the patient's perception of his TMJ function before surgery affect overall satisfaction rate?
53	TMJ_T2	Q4	Does the patient's perception of his TMJ function after surgery affect whether a patient would recommend surgery to others?
54	TMJ_T2	Q5	Does the patient's perception of his TMJ function after surgery affect overall satisfaction rate?
55	TMJ_Change	Q4	Does the patient's perception of his TMJ function change affect whether a patient would recommend surgery to others?
56	TMJ_Change	Q5	Does the patient's perception of his TMJ function change affect overall satisfaction rate?
57	Confidence_T1	Q4	Does the patient's perception of his confidence before surgery affect whether a patient would recommend surgery to others?
58	Confidence_T1	Q5	Does the patient's perception of his confidence before surgery affect overall satisfaction rate?
59	Confidence_T2	Q4	Does the patient's perception of his confidence after surgery affect whether a patient would recommend surgery to others?
60	Confidence_T2	Q5	Does the patient's perception of his confidence after surgery affect overall satisfaction rate?
61	Confidence_Change	Q4	Does the patient's perception of his confidence change affect whether a patient would recommend surgery to others?
62	Confidence_Change	Q5	Does the patient's perception of his confidence change affect overall satisfaction rate?
63	Motivation_T1	Q4	Does the patient's perception of his motivation before surgery affect whether a patient would recommend surgery to others?
64	Motivation_T1	Q5	Does the patient's perception of his motivation before surgery affect overall satisfaction rate?
65	Motivation_T2	Q4	Does the patient's perception of his motivation after surgery affect whether a patient would recommend surgery to others?
66	Motivation_T2	Q5	Does the patient's perception of his motivation after surgery affect overall satisfaction rate?
67	Motivation_Change	Q4	Does the patient's perception of his motivation change affect whether a patient would recommend surgery to others?
68	Motivation_Change	Q5	Does the patient's perception of his motivation change affect overall satisfaction rate?
69	IP_T1	Q4	Does the patient's perception of his relationships before surgery affect whether a patient would recommend surgery to others?
70	IP_T1	Q5	Does the patient's perception of his relationships before surgery affect overall satisfaction rate?
71	IP_T2	Q4	Does the patient's perception of his relationships after surgery affect whether a patient would recommend surgery to others?
72	IP_T2	Q5	Does the patient's perception of his relationships after surgery affect overall satisfaction rate?
73	IP_Change	Q4	Does the patient's perception of his relationships change affect whether a patient would recommend surgery to others?
74	IP_Change	Q5	Does the patient's perception of his relationships change affect overall satisfaction rate?
75	Q3	Q5	Is how happy a patient is that he had the procedure directly related to the overall satisfaction rate?
76	Q4	Q5	How related is a patient's willingness to recommend the treatment to others to the overall satisfaction rate?
77	Q3	Q4	How related is how happy the patient is to have had the procedure with the willingness to recommend it to others?
78	Gender	Jaw	Does the gender of the patient have any direct relationship to the type of surgery the patient had?
79	Gender	Feedback	Does the gender of the patient have any relationship to the type of feedback the patient received after the procedure?
80	Gender	Reason	Does the gender of the patient have any direct relationship to the primary reason for surgery?
81	Q1	Paresthesia	Does the age of the patient at the time of surgery have any relation to the rate of paresthesia after the surgery?
82	Q1	Regain	Does the age of the patient at the time of surgery have any affect on whether they regained any sensation at the extent of the recovery?
83	Dentist	Paresthesia	Does whether you work in a dental occupation have any affect on your chance of getting paresthesia?
84	Paresthesia	Jaw	Is the rate of paresthesia different depending on which jaw was involved in the surgery?
85	Regain	Jaw	Is the rate of recovery from paresthesia different depending on which jaw?
86	Extent	Jaw	Does the extent that the paresthesia bothers the patient on a daily basis differ depending on which jaw was involved?
87	Reason	Looks_Change	Does the patient's primary reason for having surgery affect their perceived change in overall appearance?
88	Reason	Function_Change	Does the patient's primary reason for having surgery affect their perceived function change?
89	Reason	Confidence_Change	Does the patient's primary reason for having surgery affect their perceived change in confidence following the procedure?
90	Looks_Change	IP_Change	Does the patient's perceived change in overall appearance directly relate to their perceived change in interpersonal relationships?
91	Reason	Profile_Change	Does the patient's reason for the surgery affect how they feel about their profile change?

## Appendix D

### Distribution of Feedback by Gender

Label	Total	(%)	Female	(%)	Male	(%)
-	1	2.9	1	4.8	0	0
+	33	97.1	20	95.2	13	100

Insufficient data for negative feedback to perform statistical test

### Presence/Absence of Paresthesia by Use of Dentist

<u>Paresthesia</u>	Total	(%)	No	(%)	Yes	(%)	p
No	6	16.2	4	14.3	2	22.2	0.62
Yes	31	83.8	24	85.7	7	77.8	

xx

### Distribution of Reason xxx by Gender xxxx

Label	Total	(%)	Female	(%)	Male	(%)	p
Appearance	12	32.4	8	36	4	27	0.724
Function	25	67.6	14	64	11	73	

xx

### Distribution of Jaw xx by Presence/Absence of Paresthesia

Label	Total	(%)	No	(%)	Yes	(%)	p
Both jaws	19	51.4	3	50	16	51.6	1
Mandible (lower jaw)	6	16.2	1	16.7	5	16.1	
Maxilla (upper jaw)	12	32.4	2	33.3	10	32.3	

xx

Distribution of Regain xx by Jaw xx

Label	Total	(%)	Fully	(%)	Partially	(%)	p
Both jaws	16	51.6	4	50	12	52.2	0.143
Mandible (lower jaw)	5	16.1	3	37.5	2	8.7	
Maxilla (upper jaw)	10	32.3	1	12.5	9	39.1	

xx

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Distribution of Extent by Jaw Characteristic

Label	Total	(%)	Moderate	(%)	None	(%)	Slight	(%)	p
Both jaws	16	51.6	2	66.7	6	46.2	8	53.3	0.969
Mandible (lower jaw)	5	16.1	0	0	2	15.4	3	20	
Maxilla (upper jaw)	10	32.3	1	33.3	5	38.5	4	26.7	

xx

|

Distribution of Jaw xx by Gender

Label	Total	(%)	Female	(%)	Male	(%)	p
Both jaws	19	51.4	13	59.1	6	40	0.591
Mandible (lower jaw)	6	16.2	3	13.6	3	20	
Maxilla (upper jaw)	12	32.4	6	27.3	6	40	

xx

## Appendix E

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**Table xx: Distribution and Statistics for Analyses with both Categorical and Continuous Variables**

Outcome Variable	Explanatory Variable	Category	Mean(SD)	Med(Min-Max)	Min. Counts		P-Value
					Outc.	Exp.	
Q4	Gender	Female	4.3(1.4)	5(0-5)	15	1	0.033
		Male	3.7(1.6)	4(0-5)			
Q5	Gender	Female	4.2(2)	5(-4-5)	15	1	0.481
		Male	4.3(0.9)	5(3-5)			
Q4	Race	Caucasian	4(1.5)	5(0-5)	8	1	0.481
		Other	4.1(1.8)	5(0-5)			
Q5	Race	Caucasian	4.5(0.9)	5(2-5)	8	1	0.644
		Other	3.5(3.1)	5(-4-5)			
Q4	Dentist	No	4(1.5)	4.5(0-5)	9	1	0.324
		Yes	4.2(1.7)	5(0-5)			
Q5	Dentist	No	4.5(0.9)	5(2-5)	9	1	0.374
		Yes	3.6(2.9)	5(-4-5)			
Q4	Reason	Appearance	4.2(1.4)	5(0-5)	12	1	0.711
		Function	4(1.6)	5(0-5)			
Q5	Reason	Appearance	4.2(2.6)	5(-4-5)	12	1	0.218
		Function	4.3(0.9)	5(2-5)			
Q4	Jaw	Both jaws	4.2(1.5)	5(0-5)	6	1	0.333
		Mandible (lower jaw)	4.5(0.5)	4.5(4-5)			
		Maxilla (upper jaw)	3.6(1.8)	4(0-5)			
Q5	Jaw	Both jaws	4.6(0.9)	5(2-5)	6	1	0.253
		Mandible (lower jaw)	4.7(0.5)	5(4-5)			
		Maxilla (upper jaw)	3.6(2.5)	4.5(-4-5)			
Q4	Paresthesia	No	4.7(0.5)	5(4-5)	6	1	0.455
		Yes	3.9(1.6)	5(0-5)			
Q5	Paresthesia	No	4.7(0.8)	5(3-5)	6	1	0.536
		Yes	4.2(1.7)	5(-4-5)			
Q4	Extent	Moderate	3(2.6)	4(0-5)	3	1	0.060
		None	4.5(1.5)	5(0-5)			
		Slight	3.7(1.5)	4(0-5)			
Q5	Extent	Moderate	1(4.6)	2(-4-5)	3	1	0.144
		None	4.6(0.8)	5(3-5)			
		Slight	4.5(0.7)	5(3-5)			
Q4	Regain	Fully	4.4(1.1)	5(2-5)	8	1	0.486
		Partially	3.8(1.8)	5(0-5)			
Q5	Regain	Fully	4.9(0.4)	5(4-5)	8	1	0.095
		Partially	4(2)	5(-4-5)			
Q4	Coverage	No	5(0)	5(5-5)	2	1	0.244
		Yes	4(1.6)	5(0-5)			
Q5	Coverage	No	5(0)	5(5-5)	2	1	0.350
		Yes	4.2(1.7)	5(-4-5)			
Q4	Feedback	-	0(NA)	0(0-0)	1	1	0.074
		+	4.2(1.4)	5(0-5)			
Q5	Feedback	-	-4(NA)	-4(-4--4)	1	1	0.036
		+	4.5(0.8)	5(2-5)			
Looks_Ch	Reason	Appearance	4.5(3.2)	4.5(-2-9)	12		0.209
		Function	3.4(2.8)	3(0-10)			
Funct_Ch	Reason	Appearance	3.2(1.9)	4(0-6)	12		0.120
		Function	4.8(4.4)	5(-8-10)			
Conf_Ch	Reason	Appearance	4.2(2.4)	5(-1-7)	12		0.414
		Function	3.6(3.4)	3(0-10)			
Profile_Ch	Reason	Appearance	5.6(2.9)	6(-2-10)	12		0.136
		Function	4.1(3.1)	4(0-9)			
Q1	Paresthesia	No	20.2(6)	17.5(15-30)	6		0.322
		Yes	24.1(10.8)	20(13-56)			
O1	Regain	Fully	23.5(10.3)	18(17-42)	8		0.698
		Partially	24.3(11.2)	20(13-56)			

Min. Counts - Minimum Counts - refer to the minimum counts for a variable at a specific level. This can be a numeric or a categorical level. P-value- Wilcoxon Rank Sum Exact Test for variables with two categories. Kruskal-Wallis test for more than two categories. Outc. - Outcome Variable. Exp. - Explanatory Variable. Looks\_Ch- Looks Change, Funct\_Ch - Function Change; Conf\_Ch - Confidence Change; Mandible-lower jaw, Maxilla-upper jaw.

## Appendix F

Table xx: Distribution and Statistics for Analyses Involving Only

Numeric Variables								
Outcome Variable	Explanatory Variable	Correlation		95% CI		P-Values		
		Spearman	Pearson	Lo	Hi	Spearman	Pearson	fdr
Age	Q4	0.07	0.11	-0.22	0.42	0.693	0.508	0.759
Age	Q5	-0.09	-0.18	-0.48	0.15	0.592	0.287	0.715
Q1	Q4	-0.11	0.03	-0.29	0.35	0.494	0.843	0.623
Q1	Q5	-0.05	-0.17	-0.47	0.16	0.783	0.306	0.839
Q2	Q4	0.27	0.24	-0.10	0.52	0.111	0.160	0.202
Q2	Q5	0.03	0.00	-0.32	0.33	0.877	0.982	0.877
Prof._T1	Q4	-0.12	-0.08	-0.39	0.25	0.468	0.647	0.623
Prof._T1	Q5	-0.28	-0.15	-0.45	0.18	0.089	0.377	0.172
Prof._T2	Q4	0.32	0.43	0.13	0.66	0.055	0.008	0.122
Prof._T2	Q5	0.52	0.68	0.45	0.82	0.002	0.000	0.009
Prof._Ch.	Q4	0.31	0.35	0.03	0.61	0.065	0.032	0.140
Prof._Ch.	Q5	0.60	0.57	0.30	0.76	0.000	0.000	0.003
Smile_T1	Q4	-0.07	-0.11	-0.42	0.22	0.676	0.522	0.759
Smile_T1	Q5	-0.24	-0.21	-0.50	0.12	0.145	0.216	0.233
Smile_T2	Q4	0.35	0.38	0.06	0.62	0.037	0.022	0.094
Smile_T2	Q5	0.40	0.55	0.27	0.74	0.018	0.000	0.052
Smile_Ch.	Q4	0.28	0.29	-0.04	0.56	0.093	0.082	0.174
Smile_Ch.	Q5	0.45	0.46	0.16	0.68	0.008	0.004	0.029
Looks_T1	Q4	0.07	0.03	-0.30	0.35	0.684	0.851	0.759
Looks_T1	Q5	-0.12	-0.08	-0.40	0.25	0.484	0.624	0.623
Looks_T2	Q4	0.39	0.48	0.18	0.69	0.019	0.003	0.052
Looks_T2	Q5	0.49	0.68	0.45	0.82	0.003	0.000	0.013
Looks_Ch.	Q4	0.25	0.28	-0.05	0.56	0.128	0.090	0.224
Looks_Ch.	Q5	0.52	0.49	0.20	0.70	0.002	0.002	0.009
Funct._T1	Q4	-0.12	-0.11	-0.42	0.22	0.477	0.516	0.623
Funct._T1	Q5	-0.23	-0.23	-0.52	0.10	0.169	0.163	0.265
Funct._T2	Q4	0.53	0.45	0.14	0.67	0.001	0.005	0.009
Funct._T2	Q5	0.54	0.56	0.29	0.75	0.001	0.000	0.009
Funct._Ch.	Q4	0.33	0.30	-0.02	0.57	0.049	0.069	0.114
Funct._Ch.	Q5	0.42	0.44	0.13	0.67	0.011	0.007	0.039
TMJ_T1	Q4	-0.10	-0.12	-0.42	0.22	0.559	0.490	0.690
TMJ_T1	Q5	-0.14	-0.32	-0.59	0.00	0.414	0.051	0.616
TMJ_T2	Q4	0.15	-0.03	-0.35	0.30	0.375	0.875	0.572
TMJ_T2	Q5	0.04	-0.13	-0.43	0.21	0.831	0.457	0.846
TMJ_Ch.	Q4	0.13	0.07	-0.26	0.39	0.426	0.672	0.617
TMJ_Ch.	Q5	0.08	0.16	-0.17	0.46	0.621	0.330	0.735
Conf._T1	Q4	0.04	0.03	-0.29	0.35	0.806	0.845	0.839
Conf._T1	Q5	-0.04	-0.04	-0.36	0.29	0.810	0.804	0.839
Conf._T2	Q4	0.52	0.45	0.15	0.68	0.002	0.005	0.009
Conf._T2	Q5	0.57	0.56	0.28	0.75	0.001	0.000	0.005
Conf._Ch.	Q4	0.29	0.23	-0.10	0.51	0.081	0.172	0.162
Conf._Ch.	Q5	0.34	0.35	0.03	0.60	0.041	0.035	0.098
Motiv._T1	Q4	0.13	0.00	-0.32	0.33	0.440	0.982	0.622
Motiv._T1	Q5	-0.13	0.02	-0.31	0.34	0.453	0.914	0.623
Motiv._T2	Q4	0.43	0.34	0.02	0.60	0.010	0.040	0.038
Motiv._T2	Q5	0.25	0.29	-0.04	0.56	0.137	0.082	0.233
Motiv._Ch.	Q4	0.24	0.24	-0.09	0.52	0.143	0.151	0.233
Motiv._Ch.	Q5	0.39	0.19	-0.14	0.48	0.018	0.258	0.052
IP_T1	Q4	-0.07	-0.10	-0.41	0.23	0.691	0.549	0.759
IP_T1	Q5	-0.29	-0.16	-0.46	0.18	0.079	0.355	0.162
IP_T2	Q4	0.49	0.43	0.12	0.66	0.003	0.008	0.013
IP_T2	Q5	0.39	0.41	0.10	0.65	0.020	0.011	0.053

IP_Ch.	Q4	0.42	0.36	0.05	0.62	0.012	0.027	0.040
IP_Ch.	Q5	0.62	0.40	0.08	0.64	0.000	0.015	0.003
Q3	Q5	0.78	0.80	0.64	0.89	0.000	0.000	0.000
Q4	Q5	0.61	0.60	0.34	0.77	0.000	0.000	0.003
Q3	Q4	0.77	0.83	0.69	0.91	0.000	0.000	0.000
Looks_Ch.	IP_Ch.	0.66	0.56	0.29	0.75	0.000	0.000	0.001

Abbreviations: Prof.- Profile; Ch. - Change; Funct. - Functional; Conf. - Confidence; Motiv. - Motivation; fdr -False Discover Rate

## Appendix G

Overall Distribution of Numeric Variables

Name	Mean	SD	Median	Minimum	Maximum
Q4	4.1	1.5	5	0	5
Q5	4.3	1.6	5	-4	5
<u>IP_Change</u>	2.1	2.9	1	-2	10
Age	26.2	9.8	22	18	56
Q1	23.5	10.2	19	13	56
Q2	2.7	3.2	2	0	16
Profile_T1	-1.6	2.1	-2	-5	5
Profile_T2	3	2.1	4	-4	5
<u>Profile_Change</u>	4.6	3.1	5	-2	10
Smile_T1	-1.7	2.4	-2	-5	3
Smile_T2	3.5	1.7	4	-1	5
<u>Smile_Change</u>	5.3	3.2	5	-1	10
Looks_T1	-0.9	2.1	-1	-5	5
Looks_T2	2.9	1.9	3	-3	5
<u>Looks_Change</u>	3.7	2.9	4	-2	10
Function_T1	-1.2	2.4	-1	-5	4
Function_T2	3.1	2	4	-4	5
<u>Function_Change</u>	4.3	3.8	4	-8	10
TMJ_T1	-0.5	2.9	0	-5	5
TMJ_T2	1.4	2.5	0	-4	5
<u>TMJ_Change</u>	1.9	3.8	0	-6	10
Confidence_T1	-0.8	2.5	0	-5	4
Confidence_T2	3.1	1.8	3	-1	5
<u>Confidence_Change</u>	3.8	3.1	4	-1	10
Motivation_T1	0.7	2.5	0	-5	5
Motivation_T2	2.5	1.8	3	0	5
<u>Motivation_Change</u>	1.8	2.5	1	0	10
IP_T1	0.8	2.4	1	-5	5
IP_T2	2.9	1.9	3	0	5
Q3	4.1	2	5	-4	5

# CURRICULUM VITAE

## Jessica Tunstall Crews, DMD

2124 Longest Avenue, Louisville, KY 40204 • jessica.t.crews@gmail.com • (904) 477-0823

<b>Education</b>		
July 2009 - Present	<b>UNIVERSITY OF LOUISVILLE ORTHODONTIC RESIDENCY</b> <i>Candidate for MS/Orthodontic Certificate, Anticipated Completion September 2011</i> <ul style="list-style-type: none"> <li>• Training with both 018 and 022 bracket slots and various bracket systems including MBT, Damon, Clarity &amp; Wick</li> <li>• Proficient using laser and experienced in TAD placement</li> </ul>	LOUISVILLE, KY
August 2005 - May 2009	<b>UNIVERSITY OF FLORIDA DENTAL SCHOOL</b> <i>DMD: GP-4: 3.93, NBDE Part 1-90, Rank: 8 of 82, D.A.T- 23</i> <ul style="list-style-type: none"> <li>• ASDA: 2005 – 2009</li> <li>• March of Dimes: 2007, 2008</li> <li>• Intamural Volleyball, Indoor and Outdoor, Women and Coed, Captain: 2005 – 2008</li> <li>• Advanced Honors Program in Orthodontics: 2008, Deans List: Summer 2007, Fall 2007, Interdisciplinary Family Health Program Award: 2005 - 2006</li> <li>• AAWD: 2005 - 2009</li> <li>• Give Kids a Smile: 2006, 2007</li> </ul>	GAINESVILLE, FL
Sept. 2001 - Dec. 2004	<b>UNIVERSITY OF PENNSYLVANIA</b> <i>Bachelor of Arts: Major - Biological Basis of Behavior, Minor - Psychology, GP-4: 3.29</i> <ul style="list-style-type: none"> <li>• Club Volleyball: Treasurer 2004, Secretary 2003</li> <li>• John Hopkins Pre-Health Society: 2001-2004</li> <li>• Racklin Scholarship Award: 2003, MVP League Tournament: 2003 and 2004, Varsity Volleyball Ivy League Championship: 2001</li> <li>• Rush Leader, Rho-Chi: 2004</li> <li>• Treasurer, Delta Delta Delta: 2003-2004</li> </ul>	PHILADELPHIA, PA
<b>Experience</b>		
June 2008	<b>VCU ORTHODONTIC EXTERNSHIP</b> <i>One Week Rotation</i> <ul style="list-style-type: none"> <li>• Assisted residents in various tasks and attended treatment planning seminars and discussions</li> </ul>	RICHMOND, VA
2008	<b>ELECTIVES</b> <i>Orthodontic Elective</i> <ul style="list-style-type: none"> <li>• Certified for Invisalign procedures and treated patients with Invisalign appliances</li> </ul> <i>Legislative Elective</i> <ul style="list-style-type: none"> <li>• Debated upcoming legislature that would directly impact the dental profession</li> <li>• Attended Dentist Day on the Hill and discussed pertinent issues with House Representatives and Senators</li> </ul>	GAINESVILLE, FL
Spring 2008	<b>PERIODONTAL RESEARCH</b> <i>Independent Research Project</i> <ul style="list-style-type: none"> <li>• Took samples from patients before and after SRP treatment and recorded biofilm growth over a 10-day period</li> <li>• Exposed biofilms to antibiotics and used data to determine optimal day to administer post SRP treatment</li> </ul>	GAINESVILLE, FL
2007 - 2008	<b>PRE-DOCTORAL MENTOR PROGRAM</b> <i>Volunteer</i> <ul style="list-style-type: none"> <li>• Mentored pre-dental students in patient visits to provide clinical exposure</li> </ul>	GAINESVILLE, FL
2005	<b>THE SCHOOL DISTRICT OF PHILADELPHIA</b> <i>Graduate Fellow at West Philadelphia High School</i> <ul style="list-style-type: none"> <li>• Served as a college advisor, arranged college fairs and organized/presented college - prep lectures</li> <li>• Taught an SAT prep course, tutored students and assisted in the college application/FAFSA process</li> </ul>	PHILADELPHIA, PA
2003 - 2005	<b>CHILDREN'S HOSPITAL OF PHILADELPHIA</b> <i>Pediatric Intensive Care Unit Volunteer</i> <ul style="list-style-type: none"> <li>• Worked with patients and their family members in recreational activities for 5 hours each week</li> </ul>	PHILADELPHIA, PA
Spring 2004	<b>EDUCATIONAL PIPELINE PROGRAM</b> <i>Volunteer Teaching Assistant</i> <ul style="list-style-type: none"> <li>• Mentored inner-city high school students in introductory neuroscience course taught by first year medical students</li> <li>• Graded assignments, created exam questions and communicated feedback to medical student instructors</li> </ul>	PHILADELPHIA, PA
Summer 2003	<b>RACKLIN INTERNSHIP PROGRAM</b> <i>Independent Research Project</i> <ul style="list-style-type: none"> <li>• Studied effects of nicotine on <math>\mu</math>-opioid concentration in brain regions of both wild-type and high fat diet mice</li> <li>• Related <math>\mu</math>-opioid concentration to possible reward pathways causing addiction by experimental conditioned placed preference with both nicotine and saline injections and presented results at Research Symposium</li> </ul>	PHILADELPHIA, PA
<b>Personal</b>		
<ul style="list-style-type: none"> <li>• Interests include: Open Water Diving (PADI Certified since 1998), flute, volleyball and sculpting</li> </ul>		