Self-Esteem, Self-Perception of Malocclusion, and Motivation to Seek Orthodontic Treatment

by

Erika Kendal Schroeder

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The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, a thesis entitled:

SELF ESTEEM, SELF PERCEPTION OF MALOCCLUSION AND MOTIVATION TO SEEK ORTHODONTIC TREATMENT

submitted by Erika Schroeder in partial fulfillment of the requirements for the degree of Master of Science in Craniofacial Science

Examinining Committee:

Dr. Jolanta Aleksejuniene, Associate Professor, Oral Health Sciences, UBC
Supervisor

Dr. David Kennedy, Clinical Professor, Oral Health Sciences, UBC
Supervisory Committee Member

Dr. Siddharth Vora, Assistant Professor, Oral Health Sciences, UBC
Supervisory Committee Member

Dr. Bingshuang Zou, Associate Professor, Oral Health Sciences, UBC
Supervisory Committee Member

Dr. David MacDonald, Professor, Oral Biological and Medical Sciences, UBC
Additional Examiner
Abstract

Objectives: The study examined whether a relationship exists between self-esteem, self-perception of malocclusion and motivation to seek orthodontic treatment.

Methods: 49 patients were recruited from the Graduate Orthodontics Department, Faculty of Dentistry, UBC. An online survey inquired about their self-esteem, motivation to seek orthodontic treatment, and self-perceived esthetics of their malocclusion. The objective severity of malocclusion was assessed by a single examiner. Subjectively and objectively measured malocclusion were compared and subsequently related to patient self-esteem and their motivation to seek orthodontic treatment. Self-esteem was measured by the Rosenberg Self-Esteem Scale; self-perception of malocclusion through the aesthetic component of the Index of Orthodontic Treatment need (IOTN-AC); and the objective malocclusion severity by the IOTN-AC, IOTN-DHC (Dental Health Component) and by the Index of Complexity and Orthodontic Need (ICON). Patients indicated their motivation for treatment on a scale 1-100%.

Results: Self-esteem and motivation to seek orthodontic treatment did not differ significantly with age, gender, objectively assessed severity or malocclusion, or self-perceived severity of malocclusion. Self-esteem was not significantly different among participants with different motivations to seek orthodontic treatment. Objective measures of malocclusion (IOTN-AC, ICON, IOTN-DHC) were significantly associated. Higher and lower self-esteem were not significantly related to an underestimation, or overestimation of self- perceived malocclusion severity (self-perception discrepancy). Motivation to seek treatment was significantly higher in participants with severe, as compared to mild treatment need when the severity of malocclusion was measured objectively using the ICON scale. Self-esteem was not significantly related to
motivation to seek treatment when compared among objectively assessed malocclusion groups, self-perception groups, or self-perception discrepancy groups.

**Conclusions:** Self-esteem was not related to objectively measured severity of malocclusion, self-perception of malocclusion, or the discrepancy between self-perception and objectively determined malocclusion severity. Motivation to seek treatment was not related to self-esteem or self-perception of the severity of the malocclusion but was related to the objectively measured malocclusion severity.
Lay Summary

Patients seek orthodontic treatment for a variety of reasons. Patients’ self-esteem may influence their decision to seek treatment and the way they see their own dental appearance. This may lead to a person thinking their smile looks better or worse than it is seen by others. Motivation to seek treatment may be impacted by this difference.

The purpose of the study is to understand the relationship between self-esteem, opinion of dental appearance, and motivation to seek orthodontic treatment.

Self-esteem was not found to be related to a difference between people’s idea of their dental esthetics as compared to expert evaluation. Motivation to seek treatment was not related to the self-esteem, self-perception, or a discrepancy between how they see themselves vs reality. Severity of the malocclusion may be related to motivation to seek treatment. This study did not support that self-esteem is related to self-perception or motivation to seek orthodontic treatment.
Preface

The identification and design of this research, data collection, and analyses of the data were done by the primary author Dr. Erika Schroeder. Statistical analyses were done with assistance from Dr. Jolanta Aleksejuniene. Development of the data collection tool (REDCap) and calibration for the administration of the objective assessment tool (ICON) was made possible with the support and guidance of Dr. Suliman Alsaeed.

No part of this research data has been published in articles or was a part of a collaboration. This project received approval from the Behavioural Research Ethics Board of UBC certificate number H18-02398.
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List of Abbreviations

ICON: Index of Complexity, Outcomes and Needs
IOTN: Index of Orthodontic Treatment Need
IOTN-AC: Index of Orthodontic Treatment Need- Aesthetic Component
IOTN-DHC: Index of Orthodontic Treatment Need- Dental Health Component
OHRQoL: Oral health related quality of life
RSES: Rosenberg Self-Esteem Scale
REDCap: Research Electronic Data Capture
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Chapter 1: Introduction

Self-esteem has been one of the most extensively studied topics in contemporary psychology, with over 35,000 publications in this research area. The abundance of literature may reflect its importance as a psychological concept and of the innate desire to understand and improve ourselves. As a subjective state of the mind, self-esteem is difficult to objectively define or measure. Definitions of self-esteem range from the first description by William James in 1890 as a “positive self-regard that develops when individuals consistently meet or exceed the important goals in their lives”, to an “evaluative aspect of self-knowledge that reflects the extent to which people like themselves and believe they are competent”. Endeavours to define self-esteem so that it can be measured, assessed, and studied, have produced three working definitions: 1) a person’s general success or competence, particularly in areas of life that are especially meaningful to a given individual; 2) an attitude or feeling concerning a sense of worth or one’s “worthiness” as a person; and 3) a relationship between these two aforementioned aspects. In this view, it is only an individual’s competence at dealing with the challenges of living in worthy ways that gives rise to healthy, positive, or authentic self-esteem. It will be useful to explore the concept of self-esteem to interpret the intention behind the research. In the absence of this interpretation, it would be possible to be misled by what the assessment scales truly measure, which could result in inappropriate conclusions about the reality of self-esteem. After examining the concept of self-esteem, the assessment scales will be discussed and their suitability in measuring the quintessence of self-esteem, determined.

Self-esteem is considered an enduring characteristic, with both motivational and cognitive components. Self-esteem necessarily reflects perception rather than reality. It is the lens through which people see themselves in the world and the interpretation of the results of one’s own
actions. It is also instrumental in directing future action and behaviour based on the expected outcomes, which are produced by feelings of aptitude. Those with high self-esteem are thought to be more likely to view their place within the world with positive expectation of future events, whereas those with lower self-esteem have increased focus and intention toward preventing negative consequences. High self-esteem individuals have been observed to be more likely to focus their efforts on further increasing their feelings of self-worth, whereas those with low self-esteem are primarily concerned with protecting against the loss of the limited self-esteem resources they already possess. This presents an interesting challenge for interpreting the motivation of those in high or low self-esteem groups as it relates to physical attempts to change themselves with the hope to improve their self-esteem. This may be interpreted that those with high self-esteem would seek out any number of means to further bolster their self-perception while those with low self-esteem would merely try to protect what they already possess. However, it is not clear as to whether those with higher self-esteem would not perceive attributes in themselves as requiring improvement due to their already high self-regard, whereas those with low self-esteem may be more acutely sensitive to areas in which they perceive the need for improvement. Misperception due to variation in self-esteem may be a key motivating factor toward seeking treatments intended to improve a self-perceived flaw. The difference in risk aversion between individuals of high and low self-esteem may also factor in how they answer questions regarding their own self-esteem.

Self-esteem is considered an enduring trait however; characteristic age-related changes are observed across the life span. Self-esteem is often relatively high during childhood followed by a precipitous drop at puberty. It then increases throughout adolescence, young adulthood, and middle age, reaching a peak at age 60 and then declining with advanced age. This fluctuation
in self-esteem may be attributed to external circumstances related to age-dependent factors, an internalized interpretation, or may be self-directed or intentionally changed to an extent that is argued by psychologists.

To a similar magnitude that the definition of self-esteem is debated, its purpose or value is also contested. Theories of its utility include it as a means for transferring information, or that it serves a protective function to buffer from negative experiences, or may have a direct positive affect on physical wellbeing. Self-esteem has been theorized to have status-tracking property. The feelings of self-worth of an individual depend on the comparative value that an individual believes he or she possesses within a specific group, society or community. This model suggests that it is an evolutionary adaptation that allows individuals to monitor the degree to which they believe they are valued by others. Evidence for this is demonstrated by feelings of self-worth that tend to vary in relation to the perception of social acceptance and rejections. The second possible function of self-esteem to serve as a protective mechanism has been supported with evidence that those who possess high self-esteem are more emotionally stable, less affected by a negative experience, recover from negative circumstance more quickly, and are less prone to psychological distress and psychopathology than their low self-esteem counterparts. High self-esteem may produce health benefits by mitigating the harmful effects of negative experiences in diminishing the critical self-directed interpretation of such events, through the modification of the neuroendocrine system and the autonomic nervous system.

High self-esteem may be objectively beneficial to an individual who possesses it. As a desirable quality, patients may seek to improve it directly through psychological means or by correcting the negative circumstance they believe to be decreasing their self-esteem. Some orthodontic patients seek treatment with the specific intention to increase their self-esteem.
Lin et al. in 2016 found motivation to seek orthodontic treatment to be related to the perceived psychosocial impact of dental esthetics. Those patients who were unaware of the potential psychosocial impact were not motivated to seek, and would refuse orthodontic treatment, despite the objectively determined severe normative treatment need. Patients seeking esthetic procedures in medicine (e.g. plastic surgery or dermatology) are often motivated by anticipated improvement in their psychological wellbeing and to increase their confidence in social situations, and these reasons were stated by 69.3% and 56.6% of participants respectively.

The evidence regarding the relationship between orthodontic treatment and the effect on self-esteem, is inconsistent. Some studies suggest that the pre-existing condition of certain types of malocclusion may be associated with lower self-esteem. The conclusion could be drawn that the perceived negative circumstance of an unesthetic or poorly functioning occlusion is a causative factor in lower self-esteem. Araki et al 2017 found that not all types of malocclusion were related to psychological factors equally. Specific types of malocclusion, such as overjet and deep bite were associated with lower oral health related quality of life (OHR-QoL). Florian-Vargas et al 2016 found that only some types of malocclusions presented with significantly different self-esteem at the pre-treatment timepoint. Interestingly, it was observed that individuals with class II div 2 malocclusions had higher self-esteem than patients with class I, the less severe malocclusion. This provides support to the notion that patients may not be aware of their Angle classification and may find other aspects of their malocclusion to have more of an impact on their psychological wellbeing. Garvic et al 2015 observed that it was the perceived psychosocial impact of the malocclusion, and not the objective severity of the malocclusion itself that was more closely related to lower self-esteem prior to orthodontic treatment than any other characteristic measured.
Herkrath et al 2019 used the severity of malocclusion in school children to examine the buffering theory of self-esteem\textsuperscript{17}. They found that higher self-esteem reduced the negative impact of objectively measured malocclusion severity on OHRQoL in children with minor or definite malocclusion, but not among those with severe or very severe malocclusion. They concluded that self-esteem appears to buffer the impact of malocclusion on OHRQoL in children with minor orthodontic treatment need\textsuperscript{17}.

Brosens et al 2014 also studied the buffering theory of self-esteem\textsuperscript{18}. They demonstrated that during orthodontic treatment psychological wellbeing deteriorated temporarily. Children with high self-esteem prior to treatment showed significantly lower variability in OHRQoL (the scale used to measure psychological well-being) during their treatment. Self-esteem may be a protective factor for psychological wellbeing during orthodontic treatment\textsuperscript{18}. Similarly, Venete et al 2017 observed that those individuals most affected in psychological wellbeing by the severity of malocclusion were those with low self-esteem\textsuperscript{19}.

Dos Santos et al 2017 did not find lower self-esteem to be associated with an overestimation of a perceived treatment need, when compared to normative treatment needs. Low self-esteem did not cause children to view their malocclusion more negatively than reality\textsuperscript{20}. Conversely, Agou et al 2008 found that the impact of malocclusion on quality of life and psychological wellbeing was more substantial in children with lower self-esteem. They concluded that when normative measures of malocclusion are controlled for, self-esteem was a prominent factor in oral health related to quality of life in those seeking orthodontic treatment\textsuperscript{21}.

It has been proposed that malocclusion and self-esteem are not directly correlated but associated through a third variable. The most frequently considered third variable is the OHR-QoL. Clijmans et al 2015 observed a significant association between orthodontic treatment need
and OHRQoL, and between self-esteem and OHRQoL. No evidence was found that self-esteem moderates the association between OHRQoL and treatment need\textsuperscript{22}. However, despite similar results Kragt et al \textsuperscript{2018} made a different conclusion. They observed that the relationship between a subjective orthodontic need and OHRQoL was not based on the self-esteem. Self-esteem modified the relationship between a subjective orthodontic need and OHRQoL in some way that requires additional research\textsuperscript{23}.

Self-esteem and orthodontic treatment need are associated, and orthodontic patients can seek treatment with the motivation of intentionally improving their self-esteem, but impact of orthodontic treatment on increasing self-esteem, is not definitive. Adults undergoing orthodontic treatment experienced a decrease in OHR-QOL initially, which then returned to baseline toward the end of treatment\textsuperscript{24}. This was followed by a transient increase in OHR-QOL and self-esteem immediately after debonding, which again returned to baseline at the follow-up\textsuperscript{24}. In contrast to this, a study by Avontroodt et al \textsuperscript{2019} found that self-esteem was stable during orthodontic treatment\textsuperscript{25}. Some elements of self-esteem were influenced by age and gender, and in support of earlier ideas; low self-esteem and the subjective or perceived need for orthodontic treatment were associated positively\textsuperscript{25}.

Min Ho Jung \textsuperscript{2010} found that gender played a modifying role in the association between self-esteem, malocclusion, and orthodontic treatment\textsuperscript{26}. The crowding of the anterior teeth had significant effects on the self-esteem of females but not males. Females who underwent orthodontic treatment had higher self-esteem than the untreated malocclusion group, while no significant improvement was observed in males. Females who did not require orthodontic treatment who started with an ideal profile and tooth alignment, had higher self-esteem than students with crowding or protrusion. This demonstrates that malocclusion was related to self-
esteem, which can also be improved by orthodontic treatment in females. Additional evidence for the positive effects of orthodontic treatment may have on self-esteem comes from the Nascimento et al 2016 study. They observed a significant improvement in self-esteem in adult patients who underwent orthodontic treatment. The conclusion drawn was that orthodontic treatment can cause a significant increase in self-esteem and QoL, and therefore provide psychological benefits for adult patients in need of oral rehabilitation.

Evidence exists to counter the previous conclusions. In a large prospective, longitudinal cohort study, a total of 1018, 11-12-year-old children were followed for 20 years. It was found that orthodontic treatment had negligible positive impact on psychological health and quality of life in adulthood; and that lack of orthodontic treatment, where there was an objectively determined prior need, did not lead to psychological difficulties in later life. This suggests that those patients who are motivated to seek orthodontic treatment in order to improve their self-esteem, may not receive the desired treatment outcome. When treatment satisfaction is examined directly, with regard to all categories of motivation to seek treatment, the most significant predictor was dentofacial satisfaction prior to treatment. This would suggest that if patients are generally satisfied with their appearance prior to the treatment they would not have expectations to improve this, and will be more satisfied with outcome following orthodontic treatment.
Chapter 2: Body of Thesis

2.1 Methodology

2.1.1 Data Collection

The sample in this cross-sectional study included 49 subjects (21 male, 42.8%; 28 female, 57.2%) aged between 12-68 years (median, 15 years; interquartile range, 13 - 26.75 years). Participants were recruited by phone from a list of patients accepted to start orthodontic treatment in the Graduate Orthodontic Program at the University of British Columbia, Faculty of Dentistry in September 2019. Exclusion criteria included age younger than 12 years, previous orthodontic treatment, previous orthodontic treatment planning at UBC, and lack of English language proficiency to sign a consent or answer survey questions.

Self-esteem was measured using the Rosenberg Self-Esteem Scale (RSES). The RSES is a set of questions that assesses global self-worth by measuring both positive and negative feelings about the self. It is a unidimensional 10-question survey based on a 4-point Likert-type scale (1 strongly disagree to 4 strongly agree). Five items have positively, and 5 have negatively worded statements. The total scores range from 0 to 30, with a higher score indicating higher self-esteem.

Subjective perception of malocclusion severity was assessed through the aesthetic component of the Index of Orthodontic Treatment Need (IOTN-AC). The IOTN-AC uses 10 color photographs that present a decreasing degree of attractiveness. Photo 1 represents the most attractive dental arrangement and photo 10 the least attractive. The participants identified which photograph on the scale represents the degree of esthetic compromise in their own smile.
Objective malocclusion severity was determined through the use of the IOTN-AC, the IOTN-DHC (Dental Health Component), the Index of Complexity and Orthodontic Need (ICON) by a calibrated examiner.

The IOTN-DHC is a clinical index used to evaluate treatment need, based on the Swedish Medical Health Board index\textsuperscript{31}. It can be applied directly to patients, or determined through assessment of their pre-treatment study models. This assessment is classified into 5 grades, scoring only the worst feature in order to determine the grade. Grade 1 indicates that treatment is not necessary, or that there is a very minimal need for treatment, while increasing grades, indicate a greater treatment need. Grade 5 indicates the highest treatment need. The hierarchical scale allows the dentition to be assessed systematically, and if two or more occlusal anomalies are of the same DHC grade, the most severe one is scored. The scale assesses the following occlusal features: missing teeth (including aplasia, displaced and impacted teeth) overjet (including negative overjet), crossbite, displacement, overbite (including openbite)\textsuperscript{30}.

ICON assesses esthetics, crowding/impacted teeth/spacing, overbite/openbite, crossbite, and buccal segment relationship, from the pretreatment models and photographs to measure the need for, expected complexity of treatment and the severity of the malocclusion. Each category is assigned a weighting, to produce a summative total score of severity (the aesthetic component of IOTN (X7), upper arch crowding/spacing (X5), crossbite (X5), overbite/Open bite (X4), buccal segment relationship (X3)). A score of more than 43 indicates a substantial need for treatment. The pre-treatment scores can be graded in different levels of complexity as follows: easy: < 29, mild 29 to 50, moderate: 51 to 63, difficult: 64 to 77 or very difficult > 77\textsuperscript{32}. Measures were taken to ensure calibration of the single examiner responsible for use of the ICON scale. The author was trained in the theory and execution of the ICON by a calibrated examiner; Dr.
Suliman Alsaeed. A subgroup of 10 patients were assessed with the ICON by Dr. Schroeder and Dr. Alsaeed individually and the results were compared. This was repeated 2 weeks later with the same group of patients to establish both interrater, and intrarater reliability. The process was repeated with a second group of 10 participants.

Motivation to seek orthodontic treatment was assessed through a continuous scale of 1-100 on which patients indicated their desire to undergo orthodontic treatment.

The study was approved by the UBC Behavioural Research Ethics Board in Vancouver British Columbia Canada. Participation was voluntary. A ten-dollar Starbucks gift card was provided to each participant after successfully completing the study survey. Following verbal consent to participate during recruitment, the participant consent form (participants 16 years and over), or parental consent form and participant assent forms (participants under 16 years) were distributed via email using Research Electronic Data Capture (REDCap). Once the consent and assent forms were digitally signed, participants were redirected to complete the digital survey. All signed consent forms and survey responses were stored using REDCap software without using patients’ personal identifiers. Study data were collected and managed using REDCap electronic data capture tools hosted at the University of British Columbia. REDCap is a secure, web-based software platform designed to support data collection for research studies, providing 1) an interface for data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for data downloads to statistical packages; and 4) data integration and interoperability with external sources.

2.1.2 Data Analysis
The Statistical Package for the Social Sciences (version 10.0; SPSS, Chicago, Ill) was used for all data analyses with the threshold for statistical significance set at $p<0.050$.

Groupings for the measurement scales were created to organize the data for statistical analysis and visualization. Groupings are an inherently qualitative assessment. The groupings in this study were made according to the distribution of the sample to allow statistical analysis, reasonable range comparisons in the measurement scale scores, and judgement of the author.
2.2 Results

2.2.1 Objective Measures of Malocclusion

Three tools were used to quantify the objective severity of malocclusion; the ICON, IOTN-DHC, and the IOTN-AC, which were all performed by the same calibrated examiner. To determine how ICON and IOTN-DHC were related, groups were created within the IOTN-DHC of mild, moderate and severe treatment needs. IOTN-DHC scores of 1 and 2 were grouped as mild need, a score of 3 indicated moderate treatment need and, scores of 4 and 5 were grouped into a severe treatment need category. These groups of treatment need severity were plotted against original ICON scores within the same participant (Figure 2.2.1.1). A one-way Anova showed that groups differed statistically significantly (p<0.001). Post-Hoc analysis with the Bonferroni adjustment test found significant differences among all groups p<0.050 (Table 2.2.1.).

Table 2.2.1 Comparison of Objective Measures of Malocclusion (Anova)

<table>
<thead>
<tr>
<th>PREDICTORS</th>
<th>Number</th>
<th>OUTCOME: ICON scores</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± sd</td>
<td></td>
</tr>
<tr>
<td>IOTN-AC (Objective)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild Need (1-2)</td>
<td>19</td>
<td>28.0 ± 12.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Moderate Need (3-5)</td>
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<td>47.7 ± 8.9</td>
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<tr>
<td>Severe Need (6-10)</td>
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<td>76.2 ± 15.7</td>
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<tr>
<td>IOTN-DHC</td>
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<tr>
<td>Mild Need (1-2)</td>
<td>12</td>
<td>26.9 ± 10.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Moderate Need (3)</td>
<td>19</td>
<td>45.0 ± 18.8</td>
<td></td>
</tr>
<tr>
<td>Severe Need (4-5)</td>
<td>18</td>
<td>65.9 ± 20.6</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2.2.1 Comparison of two measures of objective malocclusion (ICON vs IOTN-DHC).

Similarly, to determine how ICON and IOTN-AC (objective) are related, similar size groups were created based on the IOTN-AC score (objective measure) into groups of mild, moderate and severe treatment need. IOTN-AC (objective) scores of 1 and 2 were grouped as mild need, scores of 3-5 were grouped as a moderate treatment need and IOTN-AC scores 6-10 were grouped into a severe treatment need category. Distribution of original ICON scores were compared among the groups of treatment need severity (Figure 2.2.1.2). Statistical analysis was performed with a one-way Anova that showed the groups were statistically significantly different.
The Post-Hoc analysis with the Bonferroni adjustment found significant differences among all groups p<0.001.

![Box plot showing comparison of objective malocclusion measures (ICON vs IOTN-AC).](image)

**Figure 2.2.1.2 Comparison of two measures of objective malocclusion (ICON vs IOTN-AC).**

To determine how the IOTN-DHC and the IOTN-AC (objective measure) were related to the original scores of each scale without making new variables (additional groupings). The scores of the IOTN-DHC (1-5) were compared to the score (1-10) of the IOTN-AC (objective measure), (Figure 2.2.1.3). An overall difference between the groups was found to be statistically significant using a one-way Anova test (p=0.007). The post-hoc analysis with the Bonferroni test
showed statistical significance between the IOTN-AC scores (objective measure) of participants with IOTN-DHC scores of 2 and 5 (p=0.039) but no other significant differences were observed.

Figure 2.2.1.3. Comparison of two measures of objective malocclusion (IOTN-DHC vs IOTN-AC).

2.2.2 Self-Perception vs Objectively Determined Severity of Malocclusion

The self-perceived IOTN-AC was compared to the objectively measured IOTN-AC to determine whether there was a difference between self-perceived and the objectively determined
severity of malocclusion (Figure 2.2.2.1). No statistically significant difference was found between self-perceived and objectively assessed malocclusion severity (p= 0.857).

![Graph showing comparison between self-perceived and objectively determined scores](image)

**Figure 2.2.2.1 Comparison between self-perceived and objectively determined score.**

### 2.2.3 Self-Esteem: Positively vs Negatively Phrased Questions

Self-esteem was measured using the Rosenberg Self-Esteem scale RSES as described in the methodology section. The scores of positively worded questions were related to the scores of the negatively worded questions (using the converted scores that would make them relatable). Despite the difference in means not showing statistical significance, the trend observed visually in the box plot (Figure 2.2.3.1.) would suggest that the positively worded questions produce higher scores than the negatively worded questions.
Figure 2.2.3.1 Self-Esteem- comparison between positively and negatively worded RSES questions.

2.2.4 Self-Esteem as an Outcome of Age and Gender

The means of total self-esteem scores were compared between two different age groups; a younger group (12-18 years) and an older group (19-68 years) (Figure 2.2.4.1), which approximately divides the 49 participants into two equal groups. This also allows for a comparison between adolescents and adult participants. No statistically significant difference was found in means of total self-esteem scores between older and younger age groups (p=0.987).
Figure 2.2.4.1 Self-Esteem – Comparison between younger and older participants

The means of the total self-esteem score were compared between male and female participants (Figure 2.2.4.2). A statistically significant difference was not found (p=0.095).
2.2.4.2 Self-Esteem – comparison between male and female participants.

2.2.5 Self-Esteem as an Outcome of Objective Severity of Malocclusion

The three groups were created for the IOTN-DHC (measure of objective severity of malocclusion) as mild, moderate and severe treatment need groups and compared with total self-esteem (Figure 2.2.5.1). Statistically significant differences were not found using a one-way Anova analysis when comparing the means of self-esteem among the groups with mild, moderate, and severe treatment need as measured by the IOTN-DHC (p=0.501).
Figure 2.2.5.1 Self-Esteem – comparison between mild, moderate and severe treatment need (IOTN-DHC).

Three groups were created based on the objective measure of treatment need using the ICON scale. Participants were determined to have mild treatment need if they scored between 10-34 on the ICON scale, moderate scoring between 35-56, and severe need for the participants with scores 57-114. Significant differences were not found in self-esteem among groups with mild, moderate, and severe treatment need (p=0.352) using a one-way ANOVA analysis (Figure 2.2.5.2).
2.2.5.2 Self-Esteem – comparison between mild, moderate and severe treatment need (ICON).

2.2.6 Self-Esteem as an Outcome of Self-perceived Severity of Malocclusion

Groups were created from the subjectively determined IOTN-AC to compare with the outcome of self-esteem. Participants were determined to have mild self-perceived malocclusion severity if they scored between 1-2 on the IOTN-AC, moderate scoring between 3-4, and severe for the participants with scores 5-9. These groups were made to allow a similar number of participants in each group. Another comparison was done with four groups (mild, moderate, severe and very severe), in which the severe group was further divided with severe now representing a score of 5-6, and very severe indicated by scores 7-9 (Figure 2.2.6.1). Significant
differences were not found in self-esteem among the following groups: mild, moderate, and severe (or when comparing the four groups) of self-perceived malocclusion severity ($p=0.352$) using a one-way Anova analysis.

Figure 2.2.6.1 Self-Esteem- Comparison between mild IOTN-AC 1-2), moderate IOTN-AC 3-4), and severe (IOTN-AC 5-9) self-perceived severity of Malocclusion IOTN-AC.
2.2.6.2 Self-Esteem- Comparison between mild IOTN-AC 1-2), moderate (IOTN-AC 3-4), severe (IOTN-AC 5-6), and very severe (IOTN-AC 7-9) self-perceived severity of Malocclusion IOTN-AC

2.2.7 Self-Esteem as an Outcome of the Discrepancy between Self-perceived and Objectively Determined Severity of Malocclusion

Groups based on the discrepancy between the perception and objective measures of malocclusion severity were created based on whether they perceived their malocclusion to be worse than, the same as, or better than, the objectively assessed severity of their malocclusion (Figure 2.2.7.1). The self-esteem scores among these groups were compared using a one-way Anova. No statistically significant differences were found among the three discrepancy groups (p=0.585).
Figure 2.2.7.1 Self-Esteem – Comparison between participants who perceived their malocclusion (IOTN-AC self-perceived) as worse, the same as, or better than objectively assessed malocclusion (IOTN-AC objective)).

Self-esteem was not found to be statistically significantly different between any of the variables measured (age, gender, objective severity of malocclusion, self-perceived severity of malocclusion, or perception discrepancy of malocclusion severity).

2.2.8 Motivation to Seek Treatment as an Outcome Self-Esteem

Motivation to seek orthodontic treatment was measured by asking participants to indicate their level of motivation on the scale 0-100%. High and low self-esteem groups were compared based on their motivation scores (Figure 2.2.8.1). Statistical analysis using the independent
sample t-test showed no statistically significant difference in motivation to seek treatment between high and low self-esteem participants (p=0.998).

![Box plot comparing motivation scores between higher and lower self-esteem participants.](image)

**Figure 2.2.8.1 Motivation – comparison between higher and lower self-esteem participants.**

### 2.2.9 Motivation to Seek Treatment as an Outcome of Age and Gender

Participants previously divided into older and younger age groups (adolescent and adult groups) (Figure 2.2.9.1), and two gender groups (males and females) were compared based on their motivation scores (Figure 2.2.9.2). Independent sample t test found no statistically
significant differences between high and low self-esteem participants, or male and female participants, in their motivation to seek treatment (p=0.853, and p= 0.099, respectively).

Figure 2.2.9.1 Motivation – comparison between younger and older participants.
Figure 2.2.9.2 Motivation – comparison between males and females.

Although, not statistically significant, the trend observed visually was that females tended to be more motivated to seek treatment than males. The non-significant gender-related difference we found (p=0.099), could be significant in a larger sample size.

2.2.10 Motivation to Seek Treatment as an Outcome of Objective Severity of Malocclusion

Motivation to seek treatment was compared among groups of mild, moderate, and severe treatment need as measured by IOTN-DHC and ICON (Figure 2.2.10.1 and Figure 2.2.10.2).
Through one-way Anova analysis no statistical significance was found between motivation to seek treatment and objective severity of malocclusion as measured by the IOTN-DHC (p=0.269). However, a statistically significant difference was found when ICON was used to measure objectively the severity of malocclusion (p=0.040). The Post hoc analysis with the Bonferroni test revealed statistically significant differences between mild and severe ICON groups (p=0.003), but not between mild and moderate groups (p=0.573), or between moderate and severe ICON groups, p=0.136).

![Motivation comparison between mild, moderate and severe treatment need (IOTN-DHC).](image)

Figure 2.2.10.1 Motivation – comparison between mild, moderate and severe treatment need (IOTN-DHC).
2.10.2 Motivation – Comparison between mild, moderate and severe treatment need (ICON).

2.11 Motivation to Seek treatment as an Outcome of Objective Severity of Malocclusion: Comparison between Higher and Lower Self-Esteem groups within the same Severity Group

The groups were then subdivided into groups of high and low self-esteem within each mild, moderate, and severe treatment need groups (objective severity of malocclusion) as measured by ICON and IOTN-DHC (Figure 2.11.1 and Figure 2.11.2). No clear pattern was found in either higher and lower self-esteem groups. There were no differences between high and low
self-esteem groups within each of objectively measured malocclusion groups, in relation to motivation to seek treatment.

Figure 2.2.11.1 Motivation – comparison between mild, moderate and severe treatment need participants (IOTN-DHC), divided into high and low self-esteem groups.

2.2.12 Motivation to Seek treatment as an Outcome of Self-Perceived Severity of Malocclusion

Self-perceived severity of malocclusion was compared to motivation to seek treatment by determining if the motivation to seek treatment scores differed between the mild, moderate and
severe self-perceived IOTN-AC groups (Figure 2.2.12.1). One-way Anova analysis showed no statistically significant difference in the motivation among different groups of self-perceived severity of malocclusion (p=0.088).

![Motivation - Comparison between self-perceived severity of malocclusion](image)

**Figure 2.2.12.1 Motivation – Comparison between self-perceived severity of malocclusion (IOTN-AC Self-perceived: high, moderate, and mild severity).**

The groups of mild, moderate, and severe self-perceived malocclusion were then divided into groups of high and low self-esteem and again their motivation to seek treatment was compared (Figure 2.2.12.2). No significant differences were observed when self-esteem was used as a modifying variable in the motivation to seek treatment groups.
2.2.12 Motivation

Figure 2.2.12.2 Motivation—comparison between self-perceived severity of malocclusion (IOTN-AC Self-perceived: high, moderate, and mild severity), divided into high and low self-esteem groups.

2.2.13 Motivation to Seek treatment as an Outcome of Groups of Positive, Neutral, and Negative Discrepancy Groups of Self-perceived vs. Objectively Determined Severity of Malocclusion

Motivation to seek treatment was compared between the discrepancy of subjective vs. objective severity of malocclusion groups (subjective IOTN-AC vs objective IOTN-AC). The groups perceiving their malocclusion as worse than, the same as, or better than, the objectively
assessed malocclusion, were compared in their motivation to seek treatment (Figure 2.2.13.1).

Using the one-way Anova analysis, no statistically significant differences were found in
motivation to seek treatment based on the perception discrepancy of the severity of malocclusion
(p= 0.414).

![Figure 2.2.13.1 Motivation– comparison participants that perceived their malocclusion (IOTN-AC self-perceived) as worse, the same as, or better than objectively assessed malocclusion (IOTN-AC objectively determined).]

Despite not achieving statistical significance, there did appear to be trend observed visually in
the box plot; those who perceived their malocclusion as worse than perceived their malocclusion
severity as the same as objectively determined, which again had lower motivation to seek

33
treatment than those who saw their malocclusion severity as better than objectively determined.

The discrepancy groups were subdivided into higher and lower self-esteem groups and again compared with motivation to seek treatment (Figure 2.2.13.2).

**Figure 2.2.13.2 Motivation—comparison participants that perceived their malocclusion (IOTN-AC self-perceived) as worse, the same as, or better than objectively assessed malocclusion (IOTN-AC objectively determined), divided into high and low self-esteem groups.**

In the negative discrepancy group (those that perceived their malocclusion severity as worse than objectively determined), it was observed that the subgroup of higher self-esteem participants had higher motivation to seek treatment. In both other perception discrepancy groups, the higher self-
esteem participants had a lower motivation to seek treatment. The neutral and positive discrepancy groups (perceiving their malocclusion as the same as, or better than that which was objectively determined), were combined into one group for further statistical analysis (Figure 2.2.13.3). Using the chi-square test no statistical significance was found \((p=0.980)\), however it does appear visually that those in the positive discrepancy group (perceiving their malocclusion as the same or better than objectively determined), had higher motivation to seek treatment than those who saw their malocclusion as worse than objectively assessed.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{motivation.png}
\caption{Motivation– Comparison participants that perceived their malocclusion (IOTN-AC self-perceived) as worse, and the same as, or better than objectively assessed malocclusion (IOTN-AC objectively determined)}
\end{figure}
The two new perception discrepancy groups were subdivided into higher and lower self-esteem groups for further analysis (Figure 2.2.13.4). Those that have a negative perception of discrepancy and higher self-esteem have a large variation in their motivation to seek treatment. Those with a positive perception discrepancy or no perception error and high self-esteem tend to have a lower motivation to seek treatment than those with the same perception discrepancy and lower self-esteem.

Figure 2.2.13.4 Motivation– Comparison participants that perceived their malocclusion (IOTN-AC self-perceived) as worse, and the same as, or better than objectively assessed malocclusion (IOTN-AC objectively determined), divided into high and low self-esteem groups.
Table 2.2.2 Predictors of Self-Esteem and Motivation to Seek Orthodontic Treatment

(Independent sample t-test)

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<thead>
<tr>
<th>PREDICTORS</th>
<th>Number</th>
<th>OUTCOMES</th>
<th>Significance</th>
<th>OUTCOMES</th>
<th>Significance</th>
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<td>Significance</td>
<td>Motivation</td>
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<td>N/A</td>
<td>79.4 ± 27.0</td>
<td>0.508</td>
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Table 2.2.3. Predictors of Self-Esteem and Motivation to Seek Orthodontic Treatment (Anova)

<table>
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<tr>
<th>PREDICTORS</th>
<th>Number</th>
<th>OUTCOMES</th>
<th>Significance</th>
<th>OUTCOMES</th>
<th>Significance</th>
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<td>Self-Esteem</td>
<td>Mean ± sd</td>
<td>Significance</td>
<td>Motivation</td>
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<tr>
<td>Positive</td>
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<td>18.5 ± 5.0</td>
<td>0.561</td>
<td>77.8 ± 32.1</td>
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</table>
2.3 Discussion

2.3.1 Objective Measures of Malocclusion

It was expected that a relationship would exist between the ICON and IOTN-DHC, as these scales intend to measure the same construct. If both scales represent objective severity of malocclusion, their findings should be associated i.e. subjects with higher ICON scores should also have higher treatment need according to the IOTN-DHC. Fox et. al. in 2002 reported a significant relationship between the ICON and IOTN-DHC scores, concluding that ICON could be substituted for IOTN for assessing clinical treatment need. Our study supported this, as significant differences were found between the mild, moderate and severe treatment need groups of IOTN-DHC in their ICON scores. More severe ICON scores were found in those of the severe treatment need group according to the IOTN-DHC, than moderate, and again significantly higher ICON scores in the moderate than in the mild group. It is interesting however, that this is not a perfect relationship. There was variability in the ICON scores within each treatment need group of the IOTN-DHC. This indicates some differences must exist between these two measurement scales. Our study does not argue which of the two scales is a more accurate representation of the malocclusion’s severity. Due to the variation observed, and the lack of consensus in the literature, both scales were used. If either scale demonstrated a relationship with self-esteem, self-perception of malocclusion, and motivation to seek treatment, it would be interesting for future research to examine which aspects of the scales are more closely related with these aforementioned outcomes; and which elements of these objective measures of malocclusion are the most important and why.

The IOTN-AC is the first component of the ICON scale so these two scales will invariably be related. Cases in the severe esthetic malocclusion will consistently have higher ICON scores.
Similar to the relationship of ICON with IOTN-DHC, it is interesting to note the observed variability within each IOTN-AC severity group in the ICON score. The differences between the groups were statistically significant, but not perfectly related. This means that there are some aspects of the functional malocclusion assessment (i.e. crowding, overbite, buccal segment relationship) measured in the ICON scale that is either over or under valued in the IOTN-AC scale. The elements creating this discrepancy are not clear but possibly could relate to aspects of posterior occlusion (interdigitation, crossbites etc.) that are not as visible on a frontal smiling photograph as they are when models are assessed in three dimensions. This aspect is worth considering in regard to patient perception of malocclusion, as patients’ opinions about their malocclusion are not considered outside the context of what they can see or experience.

The disconnection between a visual interpretation of malocclusion severity with more traditional measures of malocclusion severity, is more clearly represented in the comparison between the IOTN-DHC and the objectively assessed IOTN-AC. Both scales measure treatment-need and it would be reasonable to expect that with higher treatment need as measured by dental health, there would be higher treatment need as measured by the esthetic assessment. This was not reflected in our comparison between IOTN-DHC and objectively assessed IOTN-AC scores. Only the participants with IOTN-DHC scores of 2 and 5 were found to be significantly different in objectively assessed IOTN-AC scores. It is possible with a larger sample size that the variability within each group would have less impact on this relationship. There was a weak trend observed visually with cases in more severe treatment need groups based on the IOTN-DHC having higher objectively assessed IOTN-AC scores. However, we expected this relationship would be stronger than was observed in the present study.
2.3.2 Self-Perception vs Objectively Determined Severity of Malocclusion

The self-perceived IOTN-AC scores were compared to the objectively assessed IOTN-AC scores to determine whether these two scales are related. No significant association was found between the self-perceived and objectively assessed IOTN-AC scores. This means that participants were neither consistently more or consistently less critical of their malocclusion than the calibrated examiner. The participants did not perceive themselves with more or less severe malocclusions, as a group, than was objectively measured. This does not mean that each individual was accurately assessing their own malocclusion severity, as was demonstrated in the malocclusion severity discrepancy comparisons to be discussed later. In a study of self-perception, Gallerin et. al 2016 supported previous research to conclude that people have particular blind-spots in self-perception with respect to alternative views, or perspectives that others may be able to provide 33. Duncan et. al. 2011 conducted a study in which self-perception discrepancy of normal, overweight, and obese individuals was consistently different 34. They concluded that not only was more severe obesity related to a discrepancy between self-perception and objective assessment of obesity, but those discrepancies were related to lower interest and attempts made toward weight loss 34. Our results would suggest that the severity of malocclusion may not represent one of these blind-spots, or that there is a third variable that would lead to these blind-spots being expressed, possibly self-esteem or objective severity of malocclusion, which will be discussed later.
2.3.3 Self-Esteem: Positively vs Negatively Phrased Questions

As described earlier, the RSES is composed of 10 questions, with five questions worded in a positive manner (e.g. question 7: “On the whole, I am satisfied with myself”) and five negatively worded questions (e.g. question 9: “I certainly feel useless at times”). There has been debate on whether the wording of the question in a positive or negative direction would influence the answer provided. In this study, when the answers of positively vs. negatively worded questions were compared within the same individual, a small difference was observed visually. The difference was not statistically significant, possibly due to a large variation and a small sample size, but the trend was that the positively worded questions tended to score more highly, or to more of an extreme, than the negatively worded questions. The comparison was made after converting the positive and negative questions to allow their direct comparison. For example, in questions 7 and 9 stated above, the question 9 is more likely to be answered with “strongly agree” than the question 7 is to be answered with a “strongly disagree”, despite the assumption within the scoring system that this would produce similar responses. It has been suggested that this discrepancy is further exaggerated with variations in self-esteem. Zeigler-Hill et. al. 2013 assert that individuals with higher self-esteem tend to seek out and reinforce positive statements and effects, while low self-esteem individuals are more risk averse. This could result in high self-esteem individuals scoring positively worded questions to more of an extreme (strongly agreeing with the positively framed questions), while the low-self-esteem individuals would avoid strongly disagreeing with the negatively worded questions, despite such responses being representative of their thoughts. In our study, the positive and negative RSES scores were compared between high and low self-esteem individuals. The results of this comparison were that the positively worded questions tended to be scored higher than the negatively worded
questions. In other words, individuals were willing to answer positive questions more positively than they were to answer negatively worded questions more negatively. This could reflect the risk aversion Zeigler-Hill 2013 was referring to, more commonly seen in lower self-esteem individuals. It is possible that risk aversion, to answer negative statements less extremely than positive statements, is common in both high and low self-esteem groups. It may also be related to the discrepancy between self-perception and objective assessment, which will be discussed in later sections. The wording effect is reviewed and examined in detail in the 2017 paper by Gu et al. They conclude that ignoring the wording effect may result in an overestimation of the homogeneity within the sample and underestimate the effect size or “criterion-related validity”.

Further recommendations are made for controlling the wording effect. Future studies related to self-perception of malocclusion and self-esteem could consider using a measure of self-esteem that is not potentially confounded by the wording effect.

2.3.4 Self-Esteem as an Outcome of Age and Gender

Self-esteem scores were compared between groups of males and females and age groups. The age groups were separated between adults (over 18 years) and adolescents (12-18 years). This also represented splitting the sample into approximately equal groups of older and younger patients. No significant differences were found in self-esteem scores based on gender, or age group. This was an interesting finding as the expectation was that teenagers, and particularly females would have lower self-esteem scores. The meta-analysis on self-esteem done by Zuckerman et. al. in 2016 reviewed and analyzed these differences further. They found that recent studies showed a small but significant gender-related difference in self-esteem in men and women, which showed men having higher self-esteem than women. This gender difference was
largest through adolescence and declined afterward with increased age. In certain ethnic groups a gender difference was found in self-esteem but not in other ethnic groups. The gender difference in self-esteem was found to be the largest in liberal developed countries. It is possible that the population in our study did not represent the population in Canada, as a liberal developed country. It is not possible to analyze this as demographic variables were not included in the present study. In our study, the female group had a larger variation in self-esteem scores than males but these differences were not significant. The older and younger age groups were comparable in regard to self-esteem scores and their intra-group variabilities were similar too. It is also possible that with larger sample size, the effect of this variation would be statistically significant.

2.3.5 Self-Esteem as an Outcome of Objective Severity of Malocclusion

Self-esteem scores were compared between groups of mild, moderate and severe treatment need using the objective measures of malocclusion (IOTN-DHC and ICON). Previous studies supported an association between malocclusion and self-esteem. The expectation based on the literature was therefore, that the current study would find significant differences in self-esteem scores among the mild, moderate, and severe malocclusion groups. It would be expected that if objectively more severe malocclusion had a negative impact on self-esteem that the severe groups as determined by both ICON or IOTN-DHC would have lower self-esteem scores than the moderate, which would have significantly lower scores than the mild treatment need groups. This was not found. Significant differences were not observed between any of the malocclusion severity groups as measured by ICON or IOTN-DHC in self-esteem scores. There was also the absence of any trend that would suggest that with larger sample size or less variability, a
significant difference could be found. In both comparisons, the self-esteem of participants with mild or severe treatment need were similar, while the self-esteem of those with moderate treatment need was slightly higher. This does not suggest a trend. High variability in self-esteem scores was observed in all groups. Our findings were in contrast to the findings of Sharma et. al. 2017 who found that the IOTN-DHC was a strong predictor of self-esteem in adolescence followed closely by the IOTN-AC\textsuperscript{37}. Gavric et al. in 2015 found that self-esteem was more related to the psychosocial impacts of dental esthetics than to the objectively determined severity of malocclusion\textsuperscript{16}. Some studies found that the severity of malocclusion as a whole is not related to self-esteem or quality of life, but that these psychosocial factors are related only to specific aspects of malocclusion\textsuperscript{14,15}. It is possible that the objective measures of malocclusion severity are too general and are not measuring the specific aspects of malocclusion that may be related to self-esteem. This might explain the lack of association between self-esteem and severity of malocclusion measured with ICON and IOTN-DHC.

2.3.6 Self-Esteem as an Outcome of Self-perceived Severity of Malocclusion

If objectively measured severity of malocclusion is not directly related to self-esteem, it is possible that only the self-perception of the malocclusion`s severity is important. Only once the malocclusion is perceived will it be experienced by the patient, and therefore be able to affect their self-esteem. This is supported by research done by Silva et. al. 2016, which concluded that the self-perception of the malocclusion`s severity is a more important determinant of treatment need than the Angle classification\textsuperscript{38}. Avondtroodt et. al. 2019 found that self-esteem and self-perceived severity of malocclusion were negatively correlated\textsuperscript{25}. Neither Clijmans et. al. in 2015 nor Kragt et. al in 2017 found an association or moderating effect of self-esteem or other
personality traits on the perception of treatment need\textsuperscript{22,23}. The objectively assessed severity of the malocclusion may not be an important factor in determining patients’ self-esteem as the thoughts that individuals have about their own malocclusion. To determine whether this was true, the self-perceived IOTN-AC scores were compared between the higher and lower self-esteem groups. It would be expected that if self-perceived severity of malocclusion did impact self-esteem that those perceiving themselves as having worse malocclusions would also have lower self-esteem. This was not observed. No statistically significant difference was found between the higher and lower self-esteem groups in their perception of the severity of their malocclusion. A slight trend could be argued with the higher self-esteem group that may have had lower scoring of self-perceived severity of malocclusion and if the sample size was larger a significant difference would be found. The variability in both high and low self-esteem groups was large in their self-perceived IOTN-AC scores. It is unlikely that by increasing the sample size we could find a significant result. It is also unlikely, from the observations in this study that self-perceived severity of malocclusion plays a significant role in self-esteem.

2.3.7 Self-Esteem as an Outcome of the Discrepancy between Self-perceived and Objectively Determined Severity of Malocclusion

It was then examined whether self-esteem would be significantly different between those participants who saw their malocclusion as worse than it actually was, or whether it was an accurate reflection of the true severity of malocclusion, or whether their perception was better than objective severity (the self-perception discrepancy of malocclusion severity). Comparing the self-esteem scores among these three groups sought to determine whether self-esteem would be associated with a discrepancy in how participants viewed themselves. It has been suggested
Zeigler et. al. 2013 and Kwan et. al. 2008 that those with higher self-esteem tend to see themselves as better or the same as objective assessment would suggest, while those with low self-esteem would tend to perceive themselves as worse than objectively assessed1,39. In the current study, self-esteem scores did not differ significantly among the three groups, however there was a small trend to suggest that those who perceived their malocclusion as less severe than objectively assessed would have higher self-esteem. It is possible with a larger sample size that statistical significance in self-esteem among these groups would be observed. There was high intra-group variability of self-esteem scores in all groups of self-perception discrepancy in the assessment of malocclusion severity.

2.3.8 Motivation to Seek Treatment as an Outcome Self-Esteem

Motivation to seek treatment has been shown to be important in orthodontic treatment11,40. In order to understand factors affecting motivation to seek treatment, participants with higher and lower self-esteem were compared. It could be expected that those with higher self-esteem would be more likely to seek treatment if it is true than higher self-esteem influences positive action. If higher self-esteem is more likely to drive action based on participants believing they are in control of their environment and existence, those in the higher self-esteem group would have higher motivation toward treatment. However, if those with lower self-esteem believe their malocclusion to be the cause of their lower self-esteem and are seeking orthodontic treatment in order to improve their self-esteem, it is conceivable that the ones with lower self-esteem may be more motivated to seek treatment. Our study found no significant differences between high and low self-esteem groups in their motivation to seek treatment. It is possible that the two competing theories of motivation and self-esteem may have influenced the results in opposing
directions, thereby cancelling any difference in motivation between those with high compared to low self-esteem. Level of self-esteem did not influence motivation to seek treatment. Higher and lower self-esteem groups both had high motivation to seek treatment, with only a few participants in the higher self-esteem group that scored low in their motivation to seek treatment. It is possible that all individuals in this study present with high motivation to get treatment because they were already accepted to the Graduate Orthodontics program at UBC. Conceivably, those with lower motivation to seek treatment were excluded because they would not have sought treatment. A more complete representation of all motivation levels would include a cross-section of the population that may or may not be seeking orthodontic treatment. However, this may then tend to skew the results toward a low motivation to seek treatment. An interesting question for future studies would be to determine why motivation would be high or low. This may be able to determine why both high and low self-esteem groups were almost identical in their motivation to seek treatment. It is also possible that motivation to seek treatment is unrelated to self-esteem but there may be additional confounding factors that would be interesting to elucidate.

2.3.9 Motivation to Seek Treatment as an Outcome of Age and Gender

Motivation to seek treatment was compared between males and females, as well as between older and younger participants. Neither age nor gender related significantly in regard to motivation to seek treatment. However, a trend was observed that the older group and females were more motivated for treatment than the younger participants and males. The difference in motivation between males and females approached significance with $p=0.099$. With a larger sample size, it could be expected that females would show a significantly higher motivation for
treatment than males. This is supported by Zuckerman et. al. 2013, who delve deeper into how self-esteem varies by demographics of age and gender. Higher motivation for adult patients than for adolescents to seek treatment could be related to the fact that adults have autonomy to make treatment decisions while adolescents may be pushed to treatment by their parents. If adolescents who reported their decision to seek treatment was primarily due to their parent’s desires were eliminated, the difference in motivation may be more similar to that seen in adults. It may also reveal a relationship to other variables like self-perception of malocclusion and self-esteem. In future research, it may be useful to ask the question of where the primary motivation to seek treatment originates, either within a patient or from an external source. It may be less common but the same question in adult patients could also reveal an external source for motivation to seek treatment, for example a spouse, family member, or other medical professionals. Participants with external sources of motivation to seek treatment may not necessarily need to be eliminated but it would be another interesting variable to consider.

2.3.10 Motivation to Seek Treatment as an Outcome of Objective Severity of Malocclusion

The motivation to seek treatment was compared to the objective severity of malocclusion by determining if there was a significant difference in motivation scores among groups of mild, moderate, and severe treatment need, as measured by the IOTN-DHC and ICON. Objective severity of malocclusion, when measured with the IOTN-DHC, was not related to motivation to seek treatment. The moderate treatment need group had high variability in motivation ranging from the lowest to the highest possible scores in motivation (0-100%). This could mean that those with treatment needs could fall anywhere on the motivation scale but still allow the mild, and severe treatment need groups to vary. However, this was not observed. There was no
significant difference in motivation to seek treatment even between the mild and severe
treatment need groups when the IOTN-DHC was used. This could indicate that the objective
severity of malocclusion does not impact motivation to seek treatment. However, both a trend
and significance were found in motivation to seek treatment, when the ICON scale was used to
measure the objective severity of the malocclusion. The trend was observed that with more
severe treatment need (severity of malocclusion), the motivation to seek treatment increased. The
motivation to seek treatment was significantly higher in the severe treatment need group than in
the mild treatment need group. The moderate treatment need group did not differ motivation
from the mild or severe treatment need group. As observed with the IOTN-DHC scale findings,
the moderate treatment-need group based on the ICON had high variability in their motivation to
seek treatment. This likely accounts for why specify did not differ significantly from the other
treatment need groups. It is unlikely that statistical significance would be reached by increasing
the sample size, motivations to seek treatment in the moderate treatment need group was
represented by a full range (0-100%). This would suggest that only the highest levels of
treatment need may increase motivation. The severity of malocclusion should not be assumed to
be the primary motivating factor for patients to seek treatment based on our results. Feiou et. al.
2016 concluded that it was the psychosocial impact of malocclusion that influenced motivation
to seek orthodontic treatment and not necessarily the severity of the malocclusion. If the
malocclusion is not perceived by a patient, or that severity is not interpreted to have a
psychosocial impact, it may not produce increased motivation to seek treatment.
2.3.11 Motivation to Seek treatment as an Outcome of Objective Severity of Malocclusion: Comparison between Higher and Lower Self-Esteem groups within Severity Groups

In order to determine if self-esteem influences the motivation to seek treatment within the objectively determined severity of malocclusion groups, motivation to seek treatment was compared in higher and lower self-esteem groups, within severity groups of the ICON and IOTN-DHC scores. No differences within the severity groups were found in motivation to seek treatment when self-esteem was considered as a potential modifying variable. Higher and lower self-esteem groups within mild, moderate and severe treatment need groups, were found to have similar levels of motivation to seek treatment. Self-esteem of the participants with different malocclusion severity does not seem to explain their motivation to seek treatment. It was expected that subjects having mild treatment need and lower self-esteem may have a higher motivation to seek treatment. They may see their malocclusion as worse than it is, or have a higher desire to change it in order to improve their self-esteem. Similarly, it may be expected that those with higher self-esteem group and severe treatment need, would also have a higher motivation to seek treatment, because they are more willing to change than those with lower self-esteem.

2.3.12 Motivation to Seek treatment as an Outcome of Self-Perceived Severity of Malocclusion

The self-perception of the severity of malocclusion was compared to motivation to seek treatment. Wedrychowska-Szulc et. al. 2010 suggested that the main reason for motivation to seek treatment was the improvement of dental esthetics. The self-perceived severity of
malocclusion may be an important factor affecting motivation to seek treatment. Feiou et. al, 2016, as mentioned earlier, concluded that the perceived psychosocial impact of the malocclusion would influence motivation to seek orthodontic treatment. Therefore, if there was a weak relationship, but the difference in motivation to seek treatment could not be entirely explained by objective malocclusion severity, it is possible that the self-perceived malocclusion severity, would impact motivation. This however, was not observed in our study. Significant differences were not found in the motivation to seek treatment among the mild, moderate, and severe self-perceived malocclusion groups. Similar to the results observed in the comparison of motivation with objective severity of the malocclusion (ICON) the moderate self-perceived severity of malocclusion group varied substantially in motivation to seek treatment. The mild and severe self-perceived malocclusion groups do appear to have a trend of increased motivation in the severe group. It is possible that with an increased sample size the mild and severe self-perceived malocclusion groups would be significantly different in their motivation to seek treatment, as this was observed with the objective severity of the malocclusion. This again would not represent the complete explanation of the variation of motivation to seek treatment, so the mild, moderate and severe self-perceived malocclusion groups were separated into high and lower self-esteem groups and then compared based on their motivation to seek treatment scores. Again, self-esteem did not reveal any clear patterns of motivation. There were no significant differences in any self-perceived severity of malocclusion groups in motivation to seek treatment based on higher or lower self-esteem. It is possible that individuals with low self-awareness toward themselves globally, not specifically related to their malocclusion, may not internalize the effects of a severe malocclusion to cause an impact on their self-esteem. Lin et. al. 2016 found that the psychosocial impact of dental esthetics was an important factor influencing motivation to
seek treatment, however participants with low self-awareness were not motivated to seek
treatment despite the severity of malocclusion that would indicate higher treatment need. Self-
awareness was not included as a variable in this study but it would be interesting in future studies
to determine if this has an impact on motivation to seek treatment.

2.3.13 Motivation to Seek treatment as an Outcome of Groups of Positive, Neutral, and
Negative Discrepancy Groups of Self-perceived vs. Objectively Determined Severity
of Malocclusion

The discrepancy of self-perception compared with objectively measured severity of
malocclusion was compared to the motivation to seek treatment. A trend suggested that
participants seeing their malocclusion worse than reality (a negative perception discrepancy),
resulted in their lower motivation to seek treatment than for those who saw their malocclusion
severity the same way (no perception discrepancy) or better than reality (a positive perception
discrepancy). The error groups were then separated based on higher and lower self-esteem. No
statistically significant difference was found in motivation between the groups of higher and
lower self-esteem within the bias groups. The lower self-esteem groups did show some trend of
increased motivation to seek treatment in the different bias groups. Lower self-esteem
individuals appear to have a lower motivation to seek treatment when they perceive their
malocclusion as worse than it is objectively determined to be. This could represent a further
subdivision of self-esteem. It is possible that within the variation of high and low self-esteem
there are subgroups of individuals that express that in varied ways. It is possible that the lower
self-esteem individuals sometimes perceive their malocclusion as better than reality and this
would allow them to have a higher motivation to seek treatment, whereas if they have low self-esteem and low motivation, it may also be related to seeing themselves as worse than reality. The concept of self-esteem may be far more nuanced than simply a scale from low to high.

The discrepancy groups were further combined into two groups; one with those having a negative perception discrepancy, and the second with those with either no discrepancy of a positive perception discrepancy. The motivation to seek treatment was again compared between the new groups of perception discrepancy. Those with a negative discrepancy of self-perception tended to have lower motivation to seek treatment than those with a neutral or positive perception discrepancy. The opposite would be expected if there were not some other factors influencing motivation. It would be logical to expect that if individuals thought their malocclusion was worse, they would be more motivated to seek treatment to correct it, however the opposite response was observed. It was postulated that perhaps self-esteem would be an additional variable to explain the unexpected result. Both discrepancy groups were again separated into groups of higher and lower self-esteem and then the motivation to seek treatment scores were compared. Those with higher self-esteem have the most varied motivation to seek treatment in the negative discrepancy group. The range of motivation to seek treatment spanned across the entire range of the scale. Those with lower self-esteem and a negative discrepancy of self-perception were less motivated to seek treatment than those with lower self-esteem but with a neutral or positive self-perception discrepancy. There appears to be another variable associated with the self-esteem concept, related to the self-perception discrepancy.

The topic of self-esteem, although intensively studied, does not have a consensus with regard to its definition, or measurement tool. The RSES has been suggested as useful for scientific purposes because it has shown a high internal consistency, with a Cronbach alpha factor of 0.77
The Cronbach alpha factor, a reliability coefficient, indicates the amount of measurement error in the data, and denotes the reproducibility of the measurements. The test-retest reliability of the original RSES ranges from 0.82 to 0.85. It is also easily administered, as it brief and uncomplicated for the participant. It is possible that despite the RSES utility in reproducible results in what is agreed to be self-esteem, this may not reflect the intended true nature of what self-esteem embodies. It is possible that another measurement tool in existence, or yet to be created would more accurately reflect self-esteem and therefore, may produce different results. Other ideas in the field of self-esteem include self-efficacy, self-compassion, these slight alterations in the definition of self-esteem may relate more strongly with the concept of the self and, if measured accurately may produce different results as related to self-perception of malocclusion. Self-esteem may be defined correctly in reflecting the true nature of self-concept but the RSES may not measure it accurately.

The IOTN-AC may not accurately represent the self-perception of malocclusion. Subjects may look for specific traits of their malocclusion, seen or not seen in the photographs, and not assess severity as a whole. Identification of these traits may skew the perception toward a more or less severe perception of malocclusion independently of feelings toward themselves. This presents a confounding factor in the relationship between self-perception and self-esteem. The comparison between objective and subjective malocclusion using the trained examiner vs. the self-assessment therefore, does not only differ on the presence or absence of influence of self-esteem. The objective measure also introduces training and specialty knowledge of malocclusions. It would be interesting in a future study, to have a lay population perform the IOTN-AC for the subjects. This may provide and unbiased assessment of malocclusion without the added confounding factor of increased knowledge of malocclusion.
There are also challenges in using the IOTN-AC, ICON and IOTN-DHC as measures of objectively determined malocclusion. The inherently subjective nature of the IOTN-AC, even when used by a trained examiner, makes it challenging to justify as a truly objective measure of malocclusion. The inter-examiner reliability is relatively low. It was useful in this study as it provided a direct comparison, using the same scale as the self-perception of malocclusion assessment.

Self-esteem attenuates the impact of malocclusion on oral health related quality of life. It is possible that high self-esteem protects the individual from attributing objectively determined or subjectively perceived severe malocclusions to aspects of themselves. Patients can recognize the malocclusion as it is in reality and not attach that to their conception of themselves. A low self-esteem individual on the other hand, may also see their malocclusion severity as it exists in reality but then incorporate this into a negative scheme about oneself, and assign that to his/her identity. Self-esteem may interact in a complicated way with other psychological variables to influence self-perception of malocclusion and other traits. Romero-Morato et.al. 2015 found anxiety to have an effect on self-esteem in adult patients undergoing orthodontic treatment, suggesting a role for cognitive behavioural consideration as a part of orthodontic treatment.
Chapter 3: Conclusion

The results found in this study were surprising for the lack of effect observed when compared to the previous research in this field. It was expected that self-esteem would be different for those with different levels of objectively determined severity of malocclusion, self-perception of malocclusion, perception discrepancy, and motivation to seek treatment. This was not observed. No significant differences in self-esteem were found in any other of the variables measured. Motivation to seek treatment was seen to be significantly higher in those with objective severe malocclusions than those with mild malocclusions.

Consequently, this study did not allow for the null hypothesis to be rejected. It is not possible to say that a relationship exists between self-esteem and self-perception of malocclusion error, or between that error and motivation to seek treatment. This study found no clear relationship between any of the variables observed within self-esteem, self-perception of malocclusion, and motivation to seek treatment.

The strength of this research was the simplicity of design and applicability to clinical settings. Had a relationship been found, it would be easy to apply this to clinical use through the diagnostic variables already collected during a routine orthodontic consultation and treatment planning, and implementing a simple ten-question survey. This research also suggests clinicians to exercise caution in making assumptions regarding a clear relationship between psychosocial factors and clinically relevant issues of perception discrepancies and motivation to seek treatment. The weakness in this research is the relatively small sample size, consequently the study potentially lacked statistical power to identify true differences if small. It is possible that with a larger sample size, some of the trends that we observed, would have reached statistical significance. It is clear that the concept of self-esteem is far more complex than can or should be
assessed through a simple survey. Future research should focus on increasing sample size to determine whether the trends we observed could achieve statistical significance, and narrowing the focus of the broad concept of self-esteem to more clinically relative variables.
References


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34. Duncan DT, Wolin KY, Scharoun-Lee M, Ding EL, Warner ET, Bennett GG. Does perception equal reality? Weight misperception in relation to weight-related attitudes and behaviors


Appendix A Scoring Systems and Surveys

Appendix A.1 IOTN-AC

Appendix A.2 IOTN-DHC

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (Very great)</td>
<td>5.1 Impeded eruption of teeth (with the exception of third molars) owing to crowding, displacement, the presence of supernumerary teeth, retained primary teeth and any pathological cause</td>
</tr>
<tr>
<td></td>
<td>5.2 Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring restorative orthodontics</td>
</tr>
<tr>
<td></td>
<td>5.3 Reverse overjet &gt; 9 mm</td>
</tr>
<tr>
<td></td>
<td>5.4 Reverse overjet &gt; 3.5 mm with reported masticatory and speech difficulties</td>
</tr>
<tr>
<td></td>
<td>5.5 Defects of cleft lip and palate</td>
</tr>
<tr>
<td></td>
<td>5.6 Submerged primary teeth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (Great)</td>
<td>4.1 Less extensive hypodontia, requiring restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis</td>
</tr>
<tr>
<td></td>
<td>4.2 Increased overjet &gt; 6 mm but ≤ 9 mm</td>
</tr>
<tr>
<td></td>
<td>4.3 Reverse overjet &gt; 3.5 mm with no masticatory or speech difficulties</td>
</tr>
<tr>
<td></td>
<td>4.4 Reverse overjet &gt; 1 mm but &lt; 3.5 mm, with recorded masticatory and speech difficulties</td>
</tr>
<tr>
<td></td>
<td>4.5 Anterior or posterior crossbites with &gt; 2 mm discrepancy between retruded contact position and intercuspal position</td>
</tr>
<tr>
<td></td>
<td>4.6 Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments</td>
</tr>
<tr>
<td></td>
<td>4.7 Severe displacements of teeth &gt; 4 mm</td>
</tr>
<tr>
<td></td>
<td>4.8 Extreme lateral or anterior open bite &gt; 4 mm</td>
</tr>
<tr>
<td></td>
<td>4.9 Increased and complete overbite without gingival or palatal trauma</td>
</tr>
<tr>
<td></td>
<td>4.10 Partially erupted teeth, tipped and impacted against adjacent teeth</td>
</tr>
<tr>
<td></td>
<td>4.11 Supplemental teeth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (Moderate)</td>
<td>3.1 Increased overjet &gt; 3.5 mm but ≤ 6 mm with incompetent lips</td>
</tr>
<tr>
<td></td>
<td>3.2 Reverse overjet &gt; 1 mm but ≤ 3.5 mm</td>
</tr>
<tr>
<td></td>
<td>3.3 Anterior or posterior crossbites with &gt; 1 mm but ≤ 2 mm discrepancy between retruded contact position and intercuspal position</td>
</tr>
<tr>
<td></td>
<td>3.4 Displacement of teeth &gt; 2 mm but ≤ 4 mm</td>
</tr>
<tr>
<td></td>
<td>3.5 Lateral or anterior open bite &gt; 2 mm but ≤ 4 mm</td>
</tr>
<tr>
<td></td>
<td>3.6 Increased and complete overbite with gingival or palatal trauma</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (Little)</td>
<td>2.1 Increased overjet &gt; 3.5 mm but ≤ 6 mm with competent lips</td>
</tr>
<tr>
<td></td>
<td>2.2 Reverse overjet &gt; 0 mm but ≤ 1 mm</td>
</tr>
<tr>
<td></td>
<td>2.3 Anterior or posterior crossbite with ≤ 1 mm discrepancy between retruded contact position and intercuspal position</td>
</tr>
<tr>
<td></td>
<td>2.4 Displacement of teeth &gt; 1 mm but ≤ 2 mm</td>
</tr>
<tr>
<td></td>
<td>2.5 Anterior or posterior open bite &gt; 1 mm but ≤ 2 mm</td>
</tr>
<tr>
<td></td>
<td>2.6 Increased overbite ≥ 3.5 mm without gingival contact</td>
</tr>
<tr>
<td></td>
<td>2.7 Premolar or postmolar occlusions with no other anomalies; includes up to half a unit discrepancy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (None)</td>
<td>Extremely minor malocclusions including displacements ≤ 1 mm</td>
</tr>
</tbody>
</table>
Appendix A.3 ICON

<table>
<thead>
<tr>
<th>Component</th>
<th>Score</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic assessment</td>
<td>Score 1 to 10</td>
<td>7</td>
</tr>
<tr>
<td>Upper arch crowding</td>
<td>&lt;2 mm</td>
<td>2.1 to 5 mm</td>
</tr>
<tr>
<td>Upper spacing</td>
<td>&lt;2 mm</td>
<td>2.1 to 5 mm</td>
</tr>
<tr>
<td>Crossbite</td>
<td>No crossbite</td>
<td>crossbite present</td>
</tr>
<tr>
<td>Incisor open bite</td>
<td>Edge to edge</td>
<td>&lt;1 mm</td>
</tr>
<tr>
<td>Incisor overlap</td>
<td>&lt;1/3 lower incisor coverage</td>
<td>1/3 to 2/3 coverage</td>
</tr>
<tr>
<td>Bucal segment antero-posterior</td>
<td>Cusp to embrasure only Class I. 1 or III</td>
<td>Any cusp relation up but not including cusp to cusp</td>
</tr>
</tbody>
</table>

Appendix A.4 RSES

Rosenberg Self Esteem Scale

Scoring: Items 2, 5, 6, 8, 9 are reverse scored. Give “Strongly Disagree” 1 point, “Disagree” 2 points, “Agree” 3 points, and “Strongly Agree” 4 points. Sum scores for all ten items. Keep scores on a continuous scale. Higher scores indicate higher self-esteem.