

Assessing the Correlation Between Malocclusion and Lowered Psychosocial Well-Being

By

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ABSTRACT

INTRODUCTION: Orthodontic treatment can include physical and/or psychosocial elements in addition to straightening teeth.

OBJECTIVE: Of importance to this study was to explore the correlation between malocclusion and psychosocial well-being from the perspective of younger patients, their caregivers, through the inclusion of normative criteria.

MATERIALS & METHODS: A cross-sectional study design was employed. Data was collected at a single point in time from a sample of prospective patients. Eighty-six patients and their caregivers met the inclusion criteria and were asked to complete the questionnaires. The mean age of patients included in the study was 13.57 +/- 1.57 years (55 females and 31 males). Data was collected through clinical exams. Patients were assessed using the dental and aesthetic component grades of the Index of Orthodontic Treatment Need (IOTN).

RESULTS: Caregivers' satisfaction with the patient's body image correlated with the patients' satisfaction with their body image ($p < 0.05$). Caregivers' satisfaction with tooth appearance correlated with the IOTN aesthetic component grade ($p < 0.05$). As the satisfaction score increases (reflecting overall dissatisfaction with body image), the more likely that the patient actually needs treatment. There is no significant correlation between patients' satisfaction with their teeth and IOTN dental and aesthetic component grades ($p > 0.05$). Caregivers' motivation, in comparison to the patients' motivations to seek orthodontic treatment was significant ($p < 0.05$). No significant gender differences were found with regards to being bullied about dental appearance ($p > 0.05$).

CONCLUSION: Malocclusion does impact perceptions of psychosocial well-being.

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Dedication

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Contents

Contents	5
List of Tables and Figures	8
Chapter 1: Introduction	9
Chapter 2: Literature Review	11
Psychological Dynamics of Orthodontic Treatment Need.....	11
Psychosocial Dynamics of Orthodontic Treatment Need	14
Bullying.....	14
Developmental Influences and Bullying.....	16
Developed vs. Developing Countries and Bullying.	17
Caregiving.....	17
Agreement Regarding Perceived Orthodontic Need - Caregivers versus Children.	18
Caregivers and Socioeconomic Status (SES).	18
Public Perceptions.....	19
Societal Norms and Social Stereotyping	20
Social Acceptance.	20
Social Interactions.....	21
Vocational, Educational, Intelligence, Romantic and Developmental Influences.	23
Developmental Differences.	24
Normative Dynamics of Orthodontic Treatment Need	25
Indices for Assessing Perceived Need for Orthodontic Treatment.....	26
Ideal Timing of Orthodontic Treatment Results	28
Developmental Differences and Impact of Orthodontic Treatment	28
Normative versus Patient and/or Caregiver Perceived Need	30
Gaps in the Literature.....	31
Chapter 3: Purpose and Hypotheses	34
Purpose	34
Hypotheses	34
Chapter 4: Materials and Methods.....	35
Research Ethics Approval.....	35
Study Sample	35
Inclusion Criteria	35
Exclusion Criteria.....	36
Sampling Methodology	36
Methods.....	37
Informed Consent	37
Clinical examination.....	38

Patient Self-Assessment Questionnaire.....	38
Caregiver Assessment Questionnaire	41
Pilot Study	42
Coding of Data.....	43
Validity and Reliability of Clinical Exam, Patient Self-Assessment, and Caregiver Questionnaires....	43
Index of Treatment Need - IOTN	43
The Dental Health Component (DHC) of the IOTN	44
The Aesthetic Component (AC) of the IOTN	44
Validity and reliability of the IOTN.....	45
Statistical Analysis.....	45
Descriptive Analyses.....	45
Chapter 5: Results	47
Reliability Tests	47
Socio-Demographic Data and Frequencies.....	47
Patients and Caregivers	47
Clinical Examination Data	48
Association Between IOTN and Demographic Variables	53
Parents'/Caregivers' Questionnaire.....	54
Patients' Questionnaire	61
Comparative Analysis	67
Patient Versus Caregiver - Comparison	67
Male versus Female - Comparison.....	74
Patients' Teeth Bullying Reports versus IOTN (DHC and AC) - Comparison	81
Correlation Analysis	83
Chapter 6: Discussion	86
Discussion of Obtained Findings	86
Hypothesis 1: A relationship exists between malocclusion and psychosocial well-being factors.....	87
Hypothesis 2: A relationship exists	88
Hypothesis 3: Children with severe malocclusion are more likely to have academic problems at school than those with mild malocclusion.....	90
Hypothesis 4:.....	91
Hypothesis 5: Psychosocial impact of malocclusion is higher among girls than boys	93
Implications of Findings	94
Educational Implications	96
Limitations and Weaknesses.....	97
Recommendations for Further Research	98
Chapter 7: Conclusion.....	100
References	102
Appendices	115
Appendix A. Research Ethics Approval	115
Appendix B. Amendment #1 Approval	117
Appendix C. Amendment #2 Approval	119

Appendix D. Parent Information and Informed Consent	121
Appendix E. Incentive Prizes – Email Slip	125
Appendix F. Winner’s Email	126
Appendix G. Clinical Examination Form	127
Appendix H. Patient Self-Assessment Questionnaire	129
Appendix I. Caregiver Assessment Questionnaire	133
Appendix J. Index of Orthodontic Treatment Need Dental Health Component (IOTN DHC). Proffit et al., 2007.	137
Appendix K. The Aesthetic Component (AC) of the IOTN. Proffit et al., 2007.	138
Appendix L. Correlation Tables	139
Appendix M. Principal Component Analysis – patient/caregiver satisfaction indices.	181
Appendix N. Z-tests	182
Appendix O. Journal Article	185
Appendix P. Journal Article Submission Received	199

List of Tables and Figures

Table 1. Components of clinical exam (adapted from Proffit et al., 2007).	39
Table 2. Socio-demographic data of patients and caregivers.	49
Table 3. Clinical examination results summary.....	50
Figure 1. Percentage of the presence of other facial and oral features.	51
Figure 2. Percentage of respondents' lip positions.	51
Figure 3. Percentage of respondents' according to IOTN Dental Health Grade.	52
Figure 4. Percentage of respondents' according to IOTN Aesthetic Component Grade.....	53
Table 4. Caregivers' reasons for seeking orthodontic treatment.	55
Table 5. Caregivers' satisfaction with children's appearance and bullying experiences.	57
Table 6. Caregivers' responses to bullying experiences of their children as related to their teeth/jaws/lips.	58
Table 7. Caregivers' response to the psychosocial well-being associated with their children's teeth.....	60
Table 8. Caregivers' response to the academic performance of their children at school.	61
Table 9. Patients' reasons for seeking orthodontic treatment.	62
Table 10. Patients' satisfaction with appearance and bullying experiences.	63
Table 11. Patients' satisfaction with appearance and bullying experiences.	65
Table 12. Patients' response to the psychosocial well-being associated with their teeth.....	66
Table 13. Patient/caregiver satisfaction comparison.	68
Table 14. Patient/caregiver bullying reports' comparison.	69
Table 15. Patient/caregiver reports of specific bullying experiences.	71
Table 16. Patient/caregiver answers to psychosocial questions.....	72
Table 17. Patient/caregiver answers to bullying classmates about teeth.	73
Table 18. Female/male satisfaction factors comparison.	75
Table 19. Female/male assessment of teeth crowding.....	76
Table 20. Female/male bullying reports' comparison.	77
Table 21. Female/male reports of specific bullying experiences.....	79
Table 22. Female/male answers to psychosocial questions.	80
Table 23. Female/male answers to bullying classmates about teeth.....	81
Figure 5. IOTN dental health component in relation to respondents' answering "yes" to teeth bullying.	82
Figure 6. IOTN aesthetic component in relation to respondents' answering "yes" to teeth bullying.	82
Table 24. Results of all correlations.	83

Chapter 1: Introduction

The reasons for pursuing orthodontic treatment have long been debated in the dental community, making the task of defining orthodontics and malocclusion a complicated one. Orthodontic treatment is best defined as the correction of teeth irregularities, whereas malocclusion can include physical and/or psychosocial elements (Kang & Kang, 2014). From a physical perspective, malocclusion is viewed as a “broad range of frequently occurring dental-facial mal-relations, referring to physical deviations from ideal occlusal relations and functioning” (Albino, Lawrence & Tedesco, 1994, p.82). Others stress that definitions of malocclusion should include psychological characteristics (Cohen, 1970). Despite several studies (Baylon, 2014; Dimberg, Arnrup, & Bondemark, 2014; Johal, Alyaqoobi, Patel, & Cox, 2014) on the topic of malocclusion and psychological well-being, the reasons for pursuing orthodontic treatment are still being debated. Ample dedicated effort has gone towards putting these important debates into more logical and reliable conclusions in order to help answer questions such as a) do patients’¹ dental appearance help determine their overall well-being; b) do visible deformities or malocclusions have a significant and negative influence on the psychological conditions of those who suffer from them and finally; c) how do malocclusions affect the potential for healthy psychological growth? Amidst all these debates, there is one consensus: the relation between malocclusion and psychological wellbeing does exist. Hence, the need for orthodontic treatment can be determined by psychological, social and normative factors. Psychological factors include variables such as patients’ self-esteem, self-concept, and body image. Social factors include social perceptions, expectations, bullying, and caregiver perceived need. Normative factors include prevalence and severity and normative perceived need. The aim

¹ Note: the term “patient” will be referred to interchangeably with the term “children” throughout this thesis and will describe the same cohort.

of the present study was to examine the relation between the psychosocial factors and malocclusion, focusing on young patients (children or adolescents) as the more vulnerable patient category with the most potential to benefit psychologically from early detection and treatment.

Chapter 2: Literature Review

The literature on orthodontic treatment need can be divided into three categories. The first, psychological, focuses specifically on the patient and includes factors such as the patients' self-concept, self-esteem, and body image, and how each of these influence whether a patient desires orthodontic treatment. The second, psychosocial, focuses on the perceptions and a range of behaviors of others, from bullying to caregiving, which are intricately related to developmental differences, SES, vocation, and education. The third, normative, involves addressing the orthodontic treatment need based on expert opinion and examines indices that attempt to combine both normative and psychosocial factors to determine treatment need. Each of these perspectives is further discussed below.

Psychological Dynamics of Orthodontic Treatment Need

Psychological factors, which are patient specific, play a significant role in determining orthodontic treatment need. These include a patient's body image, self-esteem, self-concept and self-image. Body image is defined as a person's attitude towards his/her body. It includes how people view themselves and how others view them. The way individuals view their body is a significant factor in their feelings of safety and self-confidence (Samsonyanova, & Broukal, 2014). For example, a study by Helm et al., (1985) demonstrated that specific types of malocclusion might adversely affect an individual's body image.

Self-esteem refers to how one perceives his or her general sense of self-worth or own value. Self-esteem can involve a variability of beliefs about the self, such as the evaluation of one's personal appearance, emotions, beliefs and behaviors (Johal et al., 2014). For example, a study by Badran (2010), found that adolescents that had completed orthodontic treatment exhibited superior self esteem than those who had not.

Body image is perceived as the way in which individuals perceive their body, which plays an important role in the feeling of safety and self-confidence (Samsonyanova & Broukal, 2014). A number of studies (Amin & Hassan, 2010; Alley & Hildebrandt, 1988; Berscheid & Gangestad, 1982; Goldstein, 1993; Hatfield & Sprecher, 1986; Peck & Peck, 1970; Peck & Peck, 1993) have shown that the perception of facial appearance by an individual not only affects body image and self-perception, but also has a strong bearing on negative self-image. For instance, in a study of 366 young orthodontic patients, malocclusions were found to correlate to embarrassment and feeling self-conscious. Specifically, higher treatment need is directly linked to increased social disadvantages. Amin and Hassan (2010) found that orthodontic patients with greater clinically assessed orthodontic needs were more embarrassed and irritable with others as compared to no or marginal orthodontic treatment needs. In another study, patients' dentofacial satisfaction had a direct impact on their body image. Children who viewed themselves as having attractive as compared to unattractive teeth, believed to have higher grades, better health, slimmer bodies, more friends, and more money (Bos, Hoogstraten, & Prah-Andersen, 2008). In light of such findings, it becomes clear that dental perceived deformities and higher treatment needs have directly been linked to psychosocial related issues. In each of the above cases, a child's need for orthodontic treatment may be driven in part by his/her perceptions of body image, self-esteem, or overall self-perception.

It is not surprising that each of these psychological constructs also interact with each other to further drive the needs for orthodontic treatment. For instance, adolescents and adults tend to associate body image with a person's confidence and level of self-esteem, as well as his/her mental well-being. Negative body images have been known to be correlated with lower

self-esteem, which could lead to anxiety, depression, and even isolation (Kumpulainen & Rasanen, 2000; Vilhjalmsson, Kristjansdotti & Ward, 2012).

In addition, the severity of malocclusion has a direct impact on a child's psychological well-being. For instance, Helm, Kreiborg, and Solow (1985) demonstrated that the majority of those who suffer from malocclusions might have varying levels of negative body image and low self-esteem, depending on the type and severity of their conditions. In their study, 977 Danish young adults with malocclusions assessed their self-perception, self-image, and social well-being. In a follow-up 15 years later, the study found that, first, specific types of malocclusions, such as "conspicuous occlusal and space anomalies" (p.110), could negatively impact an individual's self-image and self-concept both in adolescence and adulthood. Second, although individuals with malocclusion tended to have a compromised body image, dissatisfaction was particularly expressed in certain types of malocclusions. These included overjets that were greater than nine millimeters, severe crowding of teeth, and/or overbites greater than seven millimeters. These malocclusions were found to be more detrimental to the sampled patients' body image and self-esteem than other types. Other studies (Paula Jr, Silva, Campos, Nunez, and Leles, 2011; Sardenberg, Martins, Bendo, Pordeus, Paiva, Auad, & Vale, 2013) found that a higher psychosocial impact was associated with gingival smile, specifically showing more than 3 mm of gingival display and excessive anterior teeth display (i.e., anterior segment spacing and anterior mandibular overjet). These findings were corroborated in a study (Martins-Júnior, Marques & Ramos-Jorge 2012) that included 102 schoolchildren ages 8-10 years. The researchers found that of those who presented with lower anterior irregularity ≥ 2 mm, 18.8% felt sad and upper anterior irregularity ≥ 2 mm was associated to difficulty paying attention in class (42.9%). However, a more recent study (Bellot-Arcis, Montiel-Company, & Almerich-

Silla, 2013) reported that the conditions associated to higher psychosocial impacts were impeded eruption, increased overjet, increased overbite and tooth displacement.

Psychosocial Dynamics of Orthodontic Treatment Need

Research demonstrating the correlation between physical attractiveness, interpersonal popularity, and social behaviors strongly indicates that malocclusion may have significant psychosocial effects (Barocas & Daroly, 1972; Giddon, 1995; Goldman & Lewis, 1977; Sardenberg, Martins, Bendo, Pordeus, Paiva, Auad, & Vale, 2013). The psychosocial dynamics of orthodontic treatment need is best defined by behaviors including bullying and caregiving and are often motivated by public perceptions, societal norms, social stereotyping, social acceptance, social interaction, and social attractiveness. Psychosocial dynamics of orthodontic treatment need are also found as a result of developmental differences, economics, education, intelligence, vocation, and romance. Each of these is further described below.

Bullying. Bullying is one of the social responses to need for orthodontic treatment. Bullying as defined by Al-Bitar et al., (2013) is an “aggressive behavior or intentional harm carried out repeatedly in a relationship characterized by an imbalance of power”. This behavior may manifest itself as physical aggression or verbal aggression such as gossip, rumors, and social exclusion. The term bullying is synonymous with teasing, the latter referred to as a milder type of aggressive behavior (Seehra, Fleming, Newton, & Dibiase 2011). In a study by Shaw, Meek, and Jones (1980), 531 school children were asked to identify the most common target of teasing. The results established that out of 14 facial features, teeth bullying was ranked as the fourth most frequent target of teasing for children aged 9 to 12. Furthermore, Shaw et al., (1980) also identified that teasing about teeth produced deeper feelings of being upset and harassment,

61% more than other types of teasing. In addition, half of the respondents who were teased about their teeth reported verbal and/or physical intimidation.

In a recent Jordanian study (Al-Bitar et al., 2013) included 960 boys and girls, 433 respondents identified general physical characteristics and dentofacial features as the reasons for being bullied. Another finding included a high prevalence of bullying reported by Jordanian students, with a considerable number being targeted for their dentofacial appearance. Furthermore, teeth were found to be the number one feature identified as the target for bullying, with 50% of the bullied victims acknowledging its importance as a target. The dentofacial features that were identified as targets for bullying included, those who had wide gaps between teeth or a missing tooth (accounting for over 20%), those who had issues with the color and shape of their teeth (20%) and those who had either prominent overbites or prominent anterior teeth (19%). Other studies (Helm et al., 1985) reported that among young school children, teasing was found seven times more often in the existence of malocclusion. Specifically, 50 percent of young school children presenting with overjet reported teasing.

Another study by Seehra, Fleming, Newton, and Dibiase (2011) reported that out of an adolescent group of 336 participants referred for orthodontic assessment, the prevalence of peer victimization in orthodontic patients with an untreated malocclusion aged between 10 and 14 years was 12.8%. In addition, being bullied was linked with Class II Division 1, increased overbite and overjet, and a higher need for orthodontic treatment. Also, those who were being bullied reported decreased levels of social competence, athletic competence, physical appearance related self-esteem and general self-esteem.

Furthermore, in a study of almost 500 orthodontic patients ages up to 16, Klages and Zentner (2002) found that 44% of parents² stated that their children had been teased due to their teeth. The existence of severe overjet amplified the probability of teasing by 5.5 times; tooth malalignment increased it by 2.4 times. In addition, DiBiase and Sandler (2001) stated that minor variations in facial form, such as “buck teeth”, that elicited teasing or bullying, were more harmful psychologically than the more significant deformities that evoked deep emotional reactions such as pity or revulsion. A recent systematic review (Dimberg, Arnrup, & Bondemark, 2014) found that perceptible malocclusions, excessive overjet accompanied by incomplete lip closure, crowded incisors, and large diastema have been associated with lowered self-esteem and bullying among adolescents. Baylon (2014) stated that strong factors that may lead to a desire to seek treatment might include social interactions such as bullying and teasing due to facial appearance.

Developmental Influences and Bullying. A common conclusion from the literature is that the perception of facial features, including dental appearance, is a major underlying factor that influences the psychological condition and development from early childhood to adulthood (Seehra, Newton, & DiBiase, 2011; Tung & Kiyak, 1998). While both genders receive bullying indirectly, boys in general suffer more direct bullying when compared to girls. However, with both genders, bullying and victimization can create feelings such as anxiety, insecurity, and even loneliness (DiBiase & Sandler, 2001; Hawker & Boulton, 2000). Low self-esteem and depression are also common characteristics of victims of bullying; feelings of depression can persist even into adulthood. Furthermore, children victimized by bullying have a greater chance of adopting more submissive roles in their social interactions; their social skills are often more

² Note: the term “parent” will be referred to interchangeably with the term “caregiver” throughout this thesis and will describe the same cohort.

inhibited. This may cause underachievement in their learning environment further inhibiting their educational process (Kumpulainen et al, 1998; Olweus, 1978). Consequently, with dental appearance affecting those crucial social relations in a child's early developmental years, the correlation between treatment of dental malalignment and enhanced psychosocial development might be comprehended (Baylon, 2014).

Developed vs. Developing Countries and Bullying. Bullying cases have been especially common in the context of a learning environment, specifically in educational institutions. Variations in the percentage and frequency of bullying against those who suffer from certain physical conditions or deformities were found when developed and developing countries were compared in a recent analysis of a global school data health survey (Al-Bitar et al., 2013). Findings revealed that although bullying occurred frequently in developed countries in middle school stages particularly (around 5% - 50% in high income countries), the frequency and percentages was found to be quite higher in range when comparing with lower income and less developed countries (a range of 20% - 58%). Therefore, present findings indicate that in a low-income population, early treatment to merely improve the esthetics of obvious malocclusions, rather than complete correction of misalignment, does produce psychosocial benefits (Proffit et al., 2013).

Caregiving. Caregiving involves making certain decisions on the provision of dental treatment and brings with it certain behaviors by the caregiver often in response to the oral health condition of his/her child. Although studies focusing on perceived need from the standpoint of the caregiver are minimal, yet they are of vital importance as it is often the caregiver that determines treatment demand. One study (Wedrychowska-Szulc and Syrynska 2010) examined caregiver perceived need and treatment motivation, found that 77% selected irregular teeth and

54% selected wanting their child to look ‘pretty’ as motivations for pursuing orthodontic treatment. In addition, 64% of caregivers stated that they wanted treatment for their child out of fear of potential future blame from the child that their caregiver neglected their duty to provide them with orthodontic treatment. A recent study (Samsonyanova, & Broukal, 2014) reported that aesthetics, precisely irregular positioning of the teeth and anterior crowding ≥ 2 mm, was the main factor motivating caregivers to seek treatment. Caregivers consider that through orthodontic treatment, their child would look pretty and therefore enhance their self-esteem along with oral health.

Agreement Regarding Perceived Orthodontic Need - Caregivers versus Children.

Researchers have attempted to examine the perceived need of patients versus the caregivers’ perceived need. For example, a study (Bos, Hoogstraten, & Zentner 2010) assessing 182 orthodontic patients ages 8 to 15 and their parents found that parents’ reports on their children’s OHRQoL of life were in overall agreement with reports of their children. However, parents, in comparison to their children, reported a more positive outlook with regards to treatment expectations, appearance of the children’s teeth and about the general health of their children. Conversely, more recent studies (Abreu, Melgaco, Abreu, Lages, & Paiva, 2014; Hassan, Hassan, & Linjawi, 2014) reported poor agreement between young patients and their caregivers with regards to emotional and social impacts of malocclusion. These studies suggest that while the patients’ perceived need is of vital importance, it cannot be used solely; therefore, they are complementary to each other.

Caregivers and Socioeconomic Status (SES). A recent study (Piovesan, Marquezan, Kramer, Bönecker, & Ardenghi, 2011) examined how SES and clinical conditions affect caregivers’ perceptions and observations of their child’s oral health. The cross-sectional study

conducted in Brazil assessed a theoretical explanation that correlates SES and oral health based on psychosocial variables and their effect on individual lifestyle decisions. This theory argues that differences in psychological stress between socioeconomic backgrounds dictate the health inequalities; lower socioeconomic groups have shown to experience a higher number of negative life consequences, less social support and higher levels of antisocial behavior within the community. The researchers found that caregivers from minority groups and those with greater poverty levels or lower household incomes were more likely to rate their children's oral health as 'poor' than those with a higher socio-economic status. This means that caregivers with lower incomes or come from minority groups, are more likely to perceive their child's oral health as poor and therefore view a greater perceived need.

Public Perceptions. The concept of perfect teeth is firmly linked to a notion of beauty that encompasses the ideas of wealth, goodness and happiness. Social expectations play a significant role in molding cultural definitions of beauty and the literature on physical attractiveness suggests that appearance may be a dominant source of social stereotyping (Adams, 1982; Berscheid, Dion, & Walster, 1972; Snyder, Tanake, & Berscheid, 1977) as well as an important social cue used by others as a basis for social evaluation (Berscheid, 1981; Berscheid & Walster, 1974; Dion, 1972). A classic study conducted by Macgregor (1951), found that unconscious perceptions by others are key in molding an image personality. Research in social psychology demonstrates that an unappealing and unattractive physical appearance may result in unfavorable social responses as expressed through different facets of social interaction (Kenealy, Frude, & Shaw, 1989). For example, almost 200 investigations have confirmed the effect of facial attractiveness on several social settings; these include friendships, scholastic assessments, and helping behavior (Adams, 1977). Klima, Wiltemann and McIver (1979), in their assessment

of various studies regarding malocclusion and its relation to social issues, provided important and highly relevant insights on public perceptions of malocclusions. Dann and Broder (1995) stated that public perceptions could be more impactful on psychological and social well-being than a child's own self-concept.

Societal Norms and Social Stereotyping. There are several explanations as to how societal norms and stereotypes are formed. However, the most significant argument continues to be the formation of cultural definitions of beauty and ideal esthetics. Snyder et al., (1977) claimed that a smile and its quality and characteristics act as strong determinants of social acceptance and attractiveness due to the significant role of the media. For example, Kiyak (2008) stated that all TV heroes, actors and actresses, and other media and movie figures usually have good looking, clean, aligned and white teeth, while villains have crooked and discolored teeth. This observation was affirmed by Proffit et al., (2013) who found that, the typical image of an individual who is not intelligent includes protruding upper incisor and a witch has a prominent lower jaw that would produce a Class III malocclusion. Therefore, well-aligned teeth and an aesthetically agreeable smile carry a positive standing among all social levels and ages, while irregular or poorly aligned teeth carry a negative standing. Furthermore, tools of communication or media channels help reinforce this image to society. As a result, people begin to evaluate themselves and others using such standards and this is used to explain such public perceptions of malocclusions versus normal occlusions. In addition, these images all shape and influence young adolescent's satisfaction and body image (Kiyak, 2008).

Social Acceptance. Empirical evidence suggests that individuals use facial appearance as a way to infer a variety of characteristics about a person. For example, attractive facial appearance in young children was found to be the most influential of 33 different characteristics

for social acceptance and popularity among peers (Young & Cooper, 1944). In addition, people were more likely to link certain states of social well-being on the basis of facial characteristics (MacGregor, 1951). The oral-facial area is typically of considerable significance for an individual as it is the most noticeable during social interactions and is the main source of vocal, emotional and physical communication. Consequently, patients seeking orthodontic treatment are most likely concerned with enhancing their social acceptance and appearance, than they are with improving their oral function or health (Kiyak, 2008).

Social Interactions. Adolescents with severe malocclusion were more psychosocially disadvantaged and displayed more esthetic concerns than others (de Paula, Santoc, da Silva, Nunes, & Leles, 2009). A more recent finding established that severe malocclusions may likely become an impediment to social interactions (Proffit, Fields, & Sarver 2013). Therefore, social responses based on the appearance of the face and teeth can severely affect an individual's outlook on life. In their literature review, Klima, Wiltemann and McIver (1979), stated that malocclusions could give impressions of an individual's personality. If the malocclusion is highly perceptible, it can result in aversion, thereby obstructing the spontaneity of social interaction. On the other hand, it was generally found that people, whether children, adolescents or adults, tended to identify others with ideal, healthy looking teeth as more amicable than those with visible malocclusions. In a study to assess patients' main motivations for seeking orthodontic treatment, 205 patients were surveyed. Results showed that achieving better aesthetics was the main reason behind 86% of patients seeking orthodontic treatment; around 80% of the patients believed that orthodontic treatment would improve their social and mental well-being (Al Fawzan, 2012).

Social Attractiveness. Research by Secord and Jourard (1956) and Stricker (1970) noted the correlations between social attractiveness and the condition of dental health and appearance in individuals. Shaw (1981) found that both children and adults perceive faces with normal occlusions as more physically appealing, smarter, more amicable, and preferred as friends than identical faces with occlusal impairment. More than twenty years later, these results were replicated by others (Eli, Bar-Tal, & Kostovetzki, 2001; Newton, Prabhu, & Robinson 2003; Scapini, Feldens, Ardenghi, & Kramer, 2013). A more recent study by Henson et al., (2011) examined whether dental esthetics influenced the perception of adolescents when judging a peer's social, athletic, academic and leadership abilities. The study found that ideal smile esthetics was rated higher than non-ideal smile esthetics. On average, scores for the ideal smile esthetics in athletic, social, and leadership skills were 10% higher than non-ideal smiles.

Shaw (1981) stated that, “dentofacial anomalies of sufficient severity to mar a child's facial attractiveness may represent an important social disadvantage” (p.413). Several studies have linked specific types of malocclusion to social attractiveness and social disadvantages. He examined whether a child's dentofacial appearance could be linked to his or her social attractiveness by asking 42 children and 42 adult respondents to assess photographs displaying different dentofacial arrangements. The arrangements in the photographs included normal incisors, prominent incisors, a missing lateral incisor, severely crowded incisors and a unilateral cleft lip. The majority of observers had negative perceptions towards these images; however, different types of malocclusion elicited different degrees of negativity and judgments. For instance, observers showed the highest disfavor for cases of harelip when compared to other malocclusions, while those with missing incisors were linked to a more aggressive and less stable personality.

Another similar study (Shaw, Rees, Dawe, & Charles, 1985) asked 800 young adults to evaluate an individual's social characteristics based on dental alignment. The study found that faces demonstrating a normal incisor relationship acquired the most favorable ratings for eight of the ten characteristics. Four of eight characteristics that were statistically significant were social class, friendliness, intelligence and popularity. Faces displaying prominent incisors were rated highest for honesty and compliance; a unilateral cleft consistently drew low ratings. A more recent study (Samsonyanova & Broukal, 2014) reported that Class II malocclusion might lead to psychosocial problems such as mockery, negative stereotyping, and low self-confidence. Therefore, the study recommends interceptive treatment with regards to this condition in order to avoid social disadvantages.

Based on the above findings, psychosocial factors such as public perceptions, social stereotyping, social acceptance, social interaction, and social attractiveness, all either impact or are impacted by malocclusion. These factors may significantly affect patients' treatment need or help enhance patients' psychosocial condition by enhancing their social acceptance and/or attractiveness.

Vocational, Educational, Intelligence, Romantic and Developmental Influences.

Psychosocial dynamics also included perceptions related to economics, education, vocation, and romance. For instance, several contributions from literature go as far as linking actual economic prosperity and opportunities to ideal occlusions (Linn, 1966). Appearance is even known to influence teachers' expectations, student advancement in school, employment attainment and obtaining a romantic mate (Proffit et al., 2013). Studies have proved that attractive individuals are perceived as more intelligent (Landy & Sigall, 1977; Langlois, Kalakanis, Rubenstein, Larson, Hallam, & Smoot, 2000; Nordholm, 1980) and more qualified at task completion

(Dipboyle, Avery, & Terstra, 1977). In an early study that encompassed 1,862 adults, more than half rated dental appearance as having a significant role in determining how well an individual could make social connections and friendships, or run for public office or achieve employment (Linn, 1966). A more recent study aimed to conclude whether dental esthetics had an impact on finding a job by evaluating perceptions of people responsible for the human resources divisions of their companies (Pithon, Nascimento, Barbosa, Coqueiro Rda, 2014). 100 respondents were asked regarding the persons' probability of being hired, intelligence, honesty, and efficiency at the workplace by assessing pictures of smiling individuals. Results found that people with ideal dental esthetics were consistently viewed as more intelligent and had a greater probability of being hired. However, with regards to honesty and efficiency, no significant differences were found in the assessments. Finally, dental appearance was rated highly in relation to dating in young people in their relationships with the opposite sex (Linn, 1966).

Developmental Differences. Dann and Broder (1995) examined 208 patients ages 7 to 15 and established that, due to Class II malocclusion being highly perceivable, this may lead to psychosocial issues. Therefore, rationale for seeking treatment is that the enhancement of conspicuous traits of malocclusion at an early phase may inhibit the development of poor self-concept. A recent systematic review (Samsonyanova, & Broukal, 2014) reported that the main motivational factor for children to undergo orthodontic treatment was aesthetics, specifically crowding of teeth, large overbite, and missing teeth. Other factors reported by children included the belief that orthodontic treatment may improve their quality of life, make it easier to get a job and easier to find a romantic partner. In a similar study (Marques, Pordeus, Ramos-Jorge, Filogonio, Filogonio, Pereira, & Paiva, 2009), 403 subjects, aged 14-18 years old were assessed. Results indicated that, 72% believed orthodontic treatment could improve their lives, 41%

believed it made it easier to get a job, 27% believed it made it easier to find a partner, and 22% associated it with status and 12% with teasing. For the sake of the present study, the focus is only on children and adolescents and not on adults. There is a rich research field that focuses on the adult with regards to body image and orthodontic treatment.

Normative Dynamics of Orthodontic Treatment Need

Dental malocclusion is the deviation from ideal occlusion. It is often seen in adolescents showing characteristics, such as crooked, crowded or protruding teeth. Malocclusion not only affects appearance, but may also cause problems in speech and function. In some cases, malocclusion may interfere with oral hygiene leading to caries and gingivitis. Normative orthodontic criteria are the main tools for evaluating the prevalence and severity of malocclusion and are the main factors in determining orthodontic treatment need. Individuals with malocclusion may require orthodontic treatment in order to improve oral health, dental function, and aesthetics (Klages, Erbe, Sandru, Brullman & Wehrbein, 2014). Orthodontic treatment varies from most other medical interventions as it aims to correct variations from an arbitrary norm (Kang & Kang, 2014).

According to Klages et al., (2014), the average prevalence of adolescents' malocclusion in need of orthodontic treatment is estimated to between 40 and 60%. In addition, adolescents undergoing orthodontic treatment are about 60% in countries providing dental care insurances. Dimberg, Arnrup, and Bondemark (2014) reported a prevalence of malocclusions over 60% in preschool children and 43 to 78% in schoolchildren. Moreover, the most common malocclusions are anterior open bite, excessive over jet, Class II malocclusions, and posterior cross bite. Crowded teeth due to space deficiency in the dental arches are more recurrent in older rather than younger children. However, the frequency and prevalence of malocclusion may vary due to

differences in clinical indices and cutoff points. There are a number of clinical indices that are used to discern need of orthodontic treatment need.

Indices for Assessing Perceived Need for Orthodontic Treatment. In efforts to identify orthodontic treatment need, there has been considerable debate on how malocclusion should be evaluated with regards to aesthetics and psychosocial factors. Several studies recognized that any assessment of need for orthodontics should include aesthetics. For example, Hunt, Hepper, Johnston, Stevenson, and Burden (2002) stated that accurate evaluations of dental aesthetics are necessary if psychosocial implications of malocclusion are to be examined. In response, a number of indices have been developed in attempts to standardize and quantify these evaluations. These include the Eastman Esthetic Index (EEI; Howitt, Stricker, & Henderson, 1967), the dental–facial attractiveness index (DFA; Tedesco, Albino, Cunat, Green, Lewis, & Slakter, 1983a; Tedesco, Albino, Cunat, Slakter, & Waltz, 1983b), the Dental Esthetic Index (DAI; Jenny & Cons, 1996) and the Index of Orthodontic Treatment Need (IOTN; Hunt et al., 2002). Each of these is further described below.

EEI –Eastman Esthetic Index. (EEI; Howitt, Stricker, & Henderson, 1967) was developed as one of the first indices to consider the aesthetic aspects of malocclusion. However, despite its novelty in measuring the degree of aesthetic impact associated with the malocclusion, it failed to acquire widespread use as others. This was due to the fact that it lacked validity and was only used as a supplement in few cases (Bourzgui 2012).

DFA- Dental–Facial Attractiveness Index. (DFA; Tedesco et al., 1983a; Tedesco et al., 1983b). The DFA rating was innovative in that unlike other scales it didn't not rely on layperson perception, but used the child's own perception as a measure of his or her occlusion. However,

much like the EEI, the DFA also did not achieve widespread (Tedesco et al., 1983; Tedesco et al., 1983b).

DAI- Dental Esthetic Index. The DAI (Jenny & Cons, 1996) included social and psychological factors along with traditional measures of malocclusion. The DAI scale combines first the esthetic and physical aspects of occlusion into a numerical score using ten traits of occlusion. The patient's score is then placed on a scale to locate the point at which the score falls between most and least socially acceptable dental appearance. The DAI assumes that the further the score is from what is acceptable, the more likely the occlusal condition is physically and socially detrimental to the patient (Cons, Jenny, & Kohout, 1986). This index has been successfully employed in numerous studies including epidemiological studies to assess the prevalence of malocclusion and orthodontic treatment need. Studies have suggested that the DAI can be applied universally without any need for modification (Bourzgui 2012). Furthermore, the DAI was integrated into the International Collaboration Study of Oral Health Outcomes by the World Health Organization (WHO) (Scapini, Feldens, Ardenghi, & Kramer, 2013).

IOTN- Index of Orthodontic Treatment Need. The IOTN focuses on aesthetics as a factor in determining the requirements of treatment. It consists of two separate components, the aesthetic component (AC) and the dental health component (DHC) (Hunt et al., 2002). This index grades patients based on the extent to which malocclusion affects their stomatognathic system and according to their aesthetic perception of their own malocclusion, with the intent of indicating which patients would gain most from orthodontic treatment (Bourzgui 2012). The psychosocial indicator of treatment need was the major innovative aspect of the IOTN. The United Kingdom currently utilizes the IOTN to arrange public orthodontic care services. The IOTN's reliability and validity has been widely verified, it is user friendly, and it is also one of

the most-frequently cited indices in the literature (Bourzgui 2012). Yet, despite these efforts to standardize the evaluation of dental esthetics, the indices were met by disagreement among orthodontists. The majority of indices proved unreliable, others limited in their scope, and others simply met with disagreement creating a plethora of indices, yet no general consensus on a single one as an agreed upon measure or method (Baylon, 2014).

Ideal Timing of Orthodontic Treatment Results. Before examining the impacts of orthodontic treatment, it is important to consider the literature on when orthodontic treatment might render the most impactful results, also called ‘ideal timing’. Kenealy, Kingdon, Richmond, and Shaw (2007) stated that, generally, orthodontic treatment is initiated in early teens as reasons that enhanced appearance will present long-term psychosocial benefits, and that enhanced alignment will present long-term oral health benefits. Findings from a survey assessment (Tung & Kiyak, 1998) of 75 children and their parents, revealed that the younger the patient is receiving treatment, the more impactful the treatment is in terms of psychological consequences. For example, in their study of 208 patients, ages 7 to 15, Dann and Broder (1995) highlighted that early orthodontic treatment may provide important benefits for children experiencing teasing and negative stereotyping. In addition, early orthodontic treatment to improve dentofacial attractiveness may also help improve a child’s social interactions. One randomized controlled trial (O’Brien et al., 2003), included 174 British children, aged 8-10 years old with Class II Division I malocclusion, demonstrated increased self-esteem scores in both early mixed dentition treatment and adolescent treatment groups upon completion of orthodontic care.

Developmental Differences and Impact of Orthodontic Treatment. Several studies have cited improvement in the majority of Oral Health-Related Quality of Life (OHRQoL) domains after undergoing orthodontic treatment (Agou, Malhotra, Tompson, Prakash, & Locker,

2008; Agou, Locker, Muirhead, Tompson, & Streiner, 2011; Zhang, McGrath, & Hagg, 2007). Oral Health–Related Quality of Life (OHRQoL) is defined as the assessment of how oral conditions affect a person’s overall health and well-being (Al-Omari, Al-Bitar, Sonbol, Al-Ahmad, Cunningham, & Al-Omari, 2014). It is also defined as “the absence of negative impacts of oral conditions on social life and a positive sense of dentofacial self-confidence” (Agou et al., 2011, p. 369). One study (Seehra, Newton, & DiBiase, 2012) followed the progress of 43 adolescent patients aged 11 to 14 who had suffered from bullying specifically linked to their malocclusion, to determine orthodontic treatment impact on bullying and their Oral Health–Related Quality of Life (OHRQoL). The study asserted that orthodontic treatment not only had a positive impact on those experiencing bullying, but also on their OHRQoL. Findings indicated that 78% of participants reported significantly less frequency of bullying following initiation of orthodontics. One case reported a continuation of being bullied after treatment and it was reported that the appliance itself was the focus of the harassment.

Several studies (De Oliveira & Sheiham, 2004; Scapini, Feldens, Ardenghi, & Kramer, 2013; Silvola, Varimo, Tolvanen, Rusanen, Lahti, & Pirttiniemi, 2014) revealed that both children and adults who underwent orthodontic treatment for malocclusion were more likely to account lower OHRQoL impacts than those who had not undergone any treatment. Findings show that the biggest differences concerned social and emotional factors, measures of well-being, and social interactions that involved revealing one’s teeth such as smiling or laughing.

Another study (Badran, 2010) assessing 410 students, ages 14 to 16 years found that, receiving orthodontic treatment was positively correlated with self-esteem in students. This suggests that dental appearance is a critical factor and strongly predictive of self-esteem. This study was supported in a more recent study (Johal et al., 2014) in which 61 participants reported

significant increase in self-esteem as a result of orthodontic treatment. In another study (Kang & Kang, 2014), 860 adult patients (378 men and 482 women, aged 18–39 years) were examined; found that, patients who underwent orthodontic treatment exhibited enhanced body image and self-confidence.

Another study (Jung, 2010) findings show that gender may play a slight factor in determining the possible extent of impact of orthodontic treatment on confidence levels. In one study, over 4,500 patients were clinically examined for overcrowding and/or lip protrusions and were asked to evaluate their level of self-esteem. Results revealed that post fixed orthodontic treatment, patients, and particularly female patients, showed clear improvements in their levels of confidence, self-esteem and body image. Another study (Gavric et al., 2015) found no correlation between self-esteem and gender of the patients. Accordingly, it is viable to conclude that the majority of literature on the impact of orthodontic treatment ascertains that patients who have undergone fixed orthodontic treatment are less likely to have adverse physical and psychosocial impacts related to their malocclusions (Bernabe, Sheiham, Tsakos, & de Oliveira, 2008).

Normative versus Patient and/or Caregiver Perceived Need. Normative perceived need is usually based on examination of models and the measurement of cephalometric radiographs and does not include patient perception. However, recent findings (Kang & Kang, 2014) show that while patients and orthodontists may have different observations of orthodontic treatment need, patient perceived need is vital and may help supplement normative assessments. For example, one study by Silvola et al., (2014) found that orthodontists are able to assess the type of malocclusion and esthetics that have the most significant impact on patients' psychological and social well-being, while other researchers (Klages, Erbe, Sandru, Brullman &

Wehrbein, 2014) showed that patients' perception do not always coincide with that of their orthodontist. These findings estimate that about 30% of adolescents rate their tooth alignment to be more favorable, and 20% rate it worse than their orthodontist. In addition, findings also found that one-fifth of successfully treated patients were not satisfied with their orthodontic treatment results.

Furthermore (Spalj, Slaj, Varga, Strujic, & Slaj, 2010) findings also showed a weak agreement between caregiver perceptions and clinically evaluated needs or orthodontist perceived needs. The study stated that the difference in perceptions may be due to by parents' over-scoring treatment need due to a sense of requirement to provide the best care for their children. Yet, despite parent's role in determining treatment demand, the study found that they had the lowermost predictive value regarding children's satisfaction with dental appearance; importance of teeth to facial appearance, and their malocclusion related quality of life.

Literature findings show that three main factors affect the rate at which dental professionals guide orthodontic treatment. First, Wedrychowska-Szulc and Syrynska (2010) showed that the percentage of patients guided by dental professionals decreased by 20% with increasing age. Second, other studies found that the frequency with which subjects visit their dentist influences treatment demand. This may be because regular patients are more likely to trust their dentists and to follow their professional advice. Finally, the third is socioeconomic status; this may be due to the fact that low-income families lack the financial means to afford orthodontic treatment.

Gaps in the Literature

The literature review demonstrates that many studies have focused on specific underlying factors that are linked to malocclusion. These can be labeled as influencing factors and should be

the main influencers of any further research into the impact of malocclusion on a patient's psychosocial and emotional well-being. The main factors were identified as:

- a) The link between type and severity of malocclusions and the probability of negative social and personal perceptions, especially concerning the most visible of these types;
- b) The extent to which negative perceptions can lead to higher probability of being subject to both direct and indirect forms of harassment such as teasing, verbal abuse and verbal or physical bullying;
- c) Orthodontic treatment and its expected results and impact on improving the quality of life of an individual and finally; and
- d) What is the ideal timing to seek orthodontic treatment and what are the main underlying motivations for patients who seek treatment?

In conclusion, the above literature all highlighted these factors as major dynamics of the relation between malocclusion and psychosocial well-being. These factors all interlink to create a framework for this research topic, to better formulate its design and infer its main findings.

While there are several studies that attempt to address the relation between orthodontic treatment and psychosocial well-being, there is still no consensus on the topic. This is due to the fact that while some studies reported a correlation between malocclusion and psychosocial consequences, others denied such correlation. This may be owing to varying understandings of what these impacts constitute, sample size, age, and the absence of uniform methods for assessment (Hassan, Hassan, & Linjawi, 2014). Furthermore, while studies attempt to look at different aspects of the topic, few consider the comprehensive factors as a whole. For example, studies on caregiver perceived need or caregiver versus normative or patient perceived need were minimal and lacked a dynamic approach. In addition, through literature examination, it was

found that there is a lack of theories put forth to address this topic and limited literature available on bullying and malocclusion.

Chapter 3: Purpose and Hypotheses

Purpose

In an attempt to address the gaps in research, the present study not only assessed the correlation between malocclusion and lowered psychosocial well-being from the perspective of younger patients, but also allowed for a more comprehensive approach through the examination of the caregivers' perception and through the inclusion of normative criteria. This study aimed to support and add to the current literature on the topic in an attempt to someday assist in the formation of a consensus. Furthermore, the current study hopes that findings on this topic may facilitate a better assessment of treatment needs as well as contribute towards better healthcare planning necessary for access to orthodontic treatment.

Hypotheses

1. A relationship exists between malocclusion and psychosocial well-being factors.
2. A relationship exists between malocclusion and bullying - when the severity of malocclusion increases, the more bullying experiences are anticipated and expected.
3. Children with severe malocclusion are more likely to have academic problems at school than those with mild malocclusion.
4. A child's motivation to seek orthodontic treatment is associated with the caregiver's motivation to seek treatment.
5. Psychosocial impact of malocclusion is higher among girls than boys.

Chapter 4: Materials and Methods

Research Ethics Approval

Ethical approval was attained from the University of Manitoba Health Research Ethics Board (HREB), Bannatyne Campus, on May 7, 2014 - see Appendix A. Two minor amendments were submitted. The first amendment allowed for the inclusion of screening patients in conjunction with new patients assigned to new orthodontic residents at the University of Manitoba. This amendment was approved on May 16, 2014 - see Appendix B. The second amendment was submitted to increase the age range included in this study to satisfy the needed sample size. This amendment was approved on August 21, 2014 – see Appendix C. Data collection commenced subsequent to the initial ethics approval over a period of six months.

Study Sample

The present study aimed to reach a sample size of 85 patients and their caregivers. This was based on the detection of a minimum simple correlation r ($r=0.3$) of N patients. Using a two-sided test, 5% significance level test ($\alpha=0.05$) with 80% power ($\beta=0.2$), which required a sample size of approximately 85 ($n=85$).

Inclusion Criteria: Inclusion criteria included:

1. Patients needed to be between the ages of 11-16. Caregiver age range was not specified in the study.
2. Both genders.
3. No previous orthodontic treatment.

The rationale for sample selection was based on:

1. The majority of orthodontic patients fall within this age group (11-16). A younger age group would not be as concerned nor be able to comprehend the concepts and questions included in the study. An older age group was not suitable in this study as they preclude caregivers.
2. Both genders were included to identify whether one was more concerned with psychosocial problems than the other.
3. The history effect of previous orthodontic treatment that might have changed the patient's perspective and need for orthodontic treatment.

Exclusion Criteria: The rationale for excluding the group listed below was based on the fact that they acquire their own special psychosocial problem and that there is research specifically dedicated to these specific patients. In order to emphasize the importance of the psychosocial problems for the group listed in the inclusion criteria, the exclusion criteria in the present study included:

1. Patients with special health care needs.
2. Syndromes and craniofacial anomalies (e.g., cleft lip and palate).
3. Mentally handicapped patients.
4. Chronic medical conditions.
5. Respondents with language barrier difficulties.

Sampling Methodology

Selection of participants was based on screening of new patients assigned to new orthodontic residents at the University of Manitoba in conjunction with new screening patients at the Graduate Orthodontic Clinic at the University of Manitoba. Although stratified random

sampling was initially proposed, due to the difficulty of attainment of complete list of patients, purposive sampling was employed. Purposive sampling was used whereby participants were selected based on availability.

Methods. A cross-sectional study design was employed. Data was collected at a single point in time from a sample of prospective patients.

Informed Consent - see Appendix D. Caregivers of patients eligible to participate in the study were given the Parent Information and Informed Consent form by the principal investigator. Due to the fact that study participants were under 18 years of age, in accordance with Research Ethics Board guidelines, caregivers were asked to sign the consent form to allow their child to participate in the study. The caregivers had an opportunity to read this form in the waiting room as they waited for their child to be taken in for the appointment. Upon completion of the clinical exam at the Graduate Orthodontic Clinic at the University of Manitoba, the investigator inquired if the caregivers would like to participate in the study, and if they had any questions. Upon agreement of participation in the study, the investigator then obtained the informed consent. Thereafter, patients and their respective caregivers filled the questionnaires.

Incentive prizes were offered to elicit questionnaire participation. Prizes included a PC tablet and gift cards. Questionnaire respondents were asked to provide an email address if they wished to participate in the draw - see Appendix E. Winners were selected randomly and contacted via email - see Appendix F. The ballots were locked in a black box until the draw, which was held on October 1, 2015 at the University of Manitoba. Prizes that were not claimed after seven days were given to a newly randomly selected winner. Once all prizes were claimed, the ballots were destroyed.

Clinical examination - see Appendix G. Clinical data was collected through an oral examination to assess the severity of malocclusion. Dental examination of the subjects was performed at the University of Manitoba Orthodontic Graduate Clinic (at Health Sciences Centre). The principal investigator performed the examination using a dental mirror, explorer, periodontal probe, and light. In addition, the use of dental casts and digital images for patients was also employed. The clinical exam was comprised of several components, which provided a summary of dentofacial features. Components used for the purpose of this study were extracted from the clinical examination employed at the graduate orthodontic clinic at the University of Manitoba. Components of the clinical examination are listed and described in Table 1 below.

Following the clinical examination, questionnaires were administered to the selected patients and their caregivers. Both questionnaires and clinical exam were labeled with an identification number in order to protect anonymity and to protect privacy for both, patients and their respective caregivers.

Patient Self-Assessment Questionnaire. In a recent study, Al-Bitar et al., (2013) employed a questionnaire that was modified from that of Shaw et al., (1980). For the purpose of this study, the same questionnaire used by Al-Bitar was used but modified to meet other aspects needed in the study. Upon completion of the questionnaire design by the principal investigator, the questionnaire was then provided to Dr. Dieter Schönwetter, a psychometrician, for reviewing and approval. As seen in Appendix H, a statistician also evaluated the questionnaire for its validity.

Table 1. Components of clinical exam (adapted from Proffit et al., 2007).

Component	Description
Facial type	In the profile view (anteroposterior plane), the facial pattern is described as prognathic, retorognathic or orthognathic. • An orthognathic facial type pattern denotes that the chin is normally positioned and the profile, exclusive of the nose, is straight. • In a prognathic facial type pattern, the chin is protrusive and facial concavity is evident. • A retrognathic pattern is represented by a retrusive position of the chin and facial convexity is evident.
Profile type	The relationship between two lines is examined, one dropped from the bridge of the nose to the base of the upper lip, and the second one from that point downward to the chin. As a result of these two lines, the patient is classified as convex, concave, or straight.
Facial asymmetry	Patient examined in the frontal view for bilateral symmetry in the facial fifths.
Nose size	Nasal dorsum contour and nasal tip projection is measured on the profile view of the patient. Noses are classified as normal – average, large, or small.

Upper and lower lips	Lip prominence is evaluated by relating the upper lip to a true vertical line passing through the concavity at soft tissue point A. Also, relating the lower lip to a similar true vertical line through the concavity between the lower lip and chin. If the lip is considerably forward from this line, it is judged as prominent; if the lip falls behind the line, it is judged as retrusive. If the lip lies within this line, it is considered average.
Interlabial gap	Considered present when both lips are incompetent (separated by more than 3 to 4 mm).
Upper and lower arch space analysis	Space analysis, using the dental casts to measure the size of the teeth versus the space available for them. Classification used was either presence of spaces, mild crowding (1-4 mm), moderate crowding (4-7 mm), and severe crowding (>7 mm).
Midline diastema	Measurement of the space between the mesial surfaces of upper central incisor.
Overjet	Defined as horizontal overlap of the incisors. Overjet is classified as negative or reverse, edge-edge, normal (1-2mm), mild (2-4 mm), moderate (4-6 mm), or severe (>6 mm)
Overbite	Defined as the vertical overlap of the incisors. Overbite is classified as normal (10-20%), mild (20-50%), moderate (50-80

	%), severe – impinging (100%), or openbite.
Anterior crossbite	Occurs when maxillary incisors are displaced lingually or in children developing a Class III jaw relationship. Considered present when two or more teeth are in anterior crossbite.
Posterior crossbite	Occurs when the maxillary posterior teeth are lingually positioned relative to the mandibular teeth. Considered present when two or more teeth are in posterior crossbite.
Smile line	The ideal elevation of the lip on smile for adolescents is slightly below the gingival margin, so that most of the upper incisor can be seen. Up to 4 mm display of gingiva in addition to the crown of the tooth, or up to 4 mm lip coverage of the incisor crown, is acceptable. More than 4 mm of gingival display is considered as a high/gummy smile line. Less than 4mm of gingival display is considered as a low smile line.

The first section of the questionnaire involved the reason(s) behind the patient's decision to visit an orthodontist. The second section queried patient's satisfaction regarding different body parts. The third section focused on the personal experience of teasing and bullying directed at all body parts first and then regarding dentofacial features specifically. The fourth part identified the dentofacial feature's effect on social life.

Caregiver Assessment Questionnaire. As seen in Appendix I, the caregiver assessment questionnaire mirrored the patient self-assessment questionnaire; the significant difference

between them was the perspective from which the answers were given. This means that while patients answer the questions based on how they view themselves, caregivers answered them based on how they view their child (the patient). The purpose of giving both patients and caregivers the same questions was to evaluate the similarities and differences between both groups' perception of treatment need.

Furthermore, a section regarding socio-economic status was added to the caregivers' questionnaire. Ethnicity information was attained from the caregivers, allowing each patient to be classified as Asian, Black, Caucasian, East Indian, First Nation, Hispanic, Metis, or other. Another question included caregivers' level of education (i.e., up to grade 8, up to grade 12, high school diploma, some college, college diploma, some university, undergrad degree, or graduate degree). The third question asked about their annual income (i.e., \$0-25, \$26-35, \$36-45, \$46-55, \$56-65, \$66-75, \$76-80, \$81+, or if they refuse to answer). The purpose of including these additional variables was to investigate whether ethnicity, level of education or annual income had an effect on psychosocial factors regarding dentofacial features of patients.

Pilot Study. Before starting the research, a pilot study was undertaken with caregivers of six patients from the graduate orthodontic clinic at the University of Manitoba to ensure that the questions and language used were clear and easy to comprehend. The purpose of the pilot study was to also ensure that patients' caregivers took no longer than 10-15 minutes to complete all sections of the questionnaire. After receiving satisfactory feedback from the patients, research was instigated. Upon completion of the questionnaire design by the principal investigator, the questionnaire was then provided to Dr. Dieter Schönwetter, a psychometrician, for reviewing and approval. The questionnaire as seen in Appendix I was also provided to a statistician to approve its validity.

Coding of Data. In order to ensure that all data gathered from the same patient could be tracked and linked, a unique code was given to each patient and the patient's data, including the patient's self-assessment questionnaire, his/her caregiver's questionnaire and clinical exam.

Validity and Reliability of Clinical Exam, Patient Self-Assessment, and Caregiver Questionnaires

Inter-reliability assesses the degree to which measurements taken by different researchers are similar, whilst intra-reliability assesses the degree to which measurements taken by the same researcher are consistent. A second year orthodontic resident performed the clinical exam on twelve randomly selected patients; results were compared with those found by the principal investigator. Cohen's Kappa test was used to measure inter-reliability and intra-reliability. Reliability in questionnaires is associated with the fact that no matter how many times the questionnaire is tested, it should yield the same results. Accordingly, the questionnaires were pre-tested six times to assess the inter-reliability and intra-reliability of data using Cohen's Kappa test.

The questionnaires were designed by the principal investigator and reviewed by a statistician and a psychometrician to ensure that the results were measurable and valid. Sixty percent was the minimum rate of response that was deemed acceptable in order to be included in the study.

Index of Treatment Need - IOTN

The IOTN is a widely used index created by Brook and Shaw (1989). It was the first index that included a socio-psychological angle. It serves as a tool to determine the severity of malocclusion along with the patient's perception of his or her dental aesthetics. The IOTN comprises two separate components, the dental health component (DHC) and the aesthetic

component (AC). The components are assessed separately and cannot be combined into a single score. However, together, the components can help classify the patient's treatment need (Bellot - Arcís et al., 2012).

The Dental Health Component (DHC) of the IOTN. The DHC (Dental Health Component) is the clinical component of the IOTN. This component categorizes patients into five grades based on their occlusal features and their impact on the stomatognathic system as seen in Appendix J. This component can be obtained directly through clinical examination of the patient or through the use of models. The final score for the DHC was given to the patient given the most severe trait. The DHC has five grades, from Grade 1 (no need for treatment) to Grade 5 (extreme need for treatment) (Bellot-Arcís et al., 2012). Later on, a proposed modification of the IOTN was created. The modification comprised reducing the IOTN DHC grades to three: DHC 1-2 (little or no need for treatment); DHC 3 (moderate need for treatment); and DHC 4-5 (great need for treatment) (Bellot-Arcís et al., 2012). It is important to note that for the purpose of this study, the five grades of the IOTN DHC were employed and were not modified.

The Aesthetic Component (AC) of the IOTN. As seen in Appendix K, the aesthetic component (AC) comprises a scale showing images of ten grades of dental aesthetics. The AC was originally created to determine each patient's aesthetic perception of his or her own malocclusion. To create this component, 1000 intraoral photographs of 12-year-old children were gathered and placed in order. Six non-dental judges rated the photographs. This resulted in the scale of ten photographs showing different levels of dental esthetic (Bellot-Arcís et al., 2012). A modification was later proposed to improve the AC component's reliability and efficiency. This modification was to decrease the number of IOTN AC grades from 10 to 3: AC 1-4 (little or no need for treatment); AC 5-7 (moderate need for treatment); and AC 8-10

(definite need for treatment) (Bellot-Arcís et al., 2012). It is important to note that for the purpose of this study, the 3 IOTN AC grading system was employed and was not modified. It should also be noted that while the AC was originally created to be used by the patient to assess his or her self, several studies noted good results and reproducibility when the dentist carries out the AC (Bellot-Arcís et al., 2012). This may be due to the fact that it is considered difficult for patients to decide which of the ten photographs most resemble their own teeth. Therefore, for the purpose of this study, the principal investigator carried out the AC.

Validity and reliability of the IOTN. The IOTN is currently used in the United Kingdom for classifying public orthodontic care services. The validity, reliability, and reproducibility of the IOTN have been widely proved. It is also one of the most cited indices in the literature (Bellot-Arcís et al., 2012). An early study by Richmond et al., (1995) established the validity and reliability of the IOTN. In this study, 74 dentists and orthodontists evaluated the treatment need of 256 models of orthodontic patients displaying different types of malocclusion. Furthermore, other studies such as Alkhatib et al., (2005) and Hamdan (2004) also confirmed that the IOTN is valid and reliable and also perceptive to the needs of patients. Mandall et al., (2000) and Birkeland et al., (1996) also noted that the IOTN is a reliable and reproducible index.

Statistical Analysis

The analysis of data was conducted using SPSS. Statistical analyses included the following:

Descriptive Analyses. Simple descriptive statistics of demographic and clinical characteristics, such as means, variances and frequencies, were conducted. Contingency tables were created and methods, which describe the strength of association between binary variables (e.g., ‘yes’ and ‘no’), were used.

Inferential Analyses. Correlation and agreement tests were done to compare patients with their caregivers, males and females, and the severity of malocclusion and bullying about teeth. Statistical tests used included Pearson correlation coefficient, Pearson chi-square, Gamma correlations, and Z-tests to assess the equality between sample proportions. Cohen's kappa coefficient test was used to assess reliability tests.

Chapter 5: Results

The analyses of data focused on the dental examination and patient/caregiver questionnaires in order to determine any relationships between malocclusion and lowered psychosocial well-being of patients aged 11-16 years old. Results are presented in three sections: first section including socio-demographic data of patients; second section comprises statistical comparisons between male and female participants, as well as between patients' and their caregivers' questionnaire responses; and the third section includes correlations. The presentation of data analyses results is preceded with the reliability tests for data collection instruments.

Reliability Tests

The intra-reliability and inter-reliability coefficients verified the statistical reliability of findings. Inter-reliability coefficient was used to assess the degree to which measurements made by different orthodontic residents were similar; the Cohen's kappa coefficient for this study ranged from 0.636 to 0.739, which falls within the "substantial agreement" category (range of 0.61-0.80). Intra-reliability referred to the degree of consistency of the principal investigator's measurements. To identify that coefficient, the orthodontic resident (principal investigator) was asked to perform the examination twice on 12 patients, with a three-month gap between the two measurements. Here, the Cohen's kappa coefficient was again used in the determination of test-retest reliability, yielding the results of 0.571 to 1.000. Hence, the intra-reliability level was assessed as high as well, guaranteeing both types of reliability at sufficient degrees.

Socio-Demographic Data and Frequencies

Patients and Caregivers. The initial sample size constituted 99 patients, but only 86 of them completed the questionnaires as deemed acceptable, yielding an 86% response rate. As

seen in Table 2, the average age of participants was 13.57 +/- 1.57 years old; 55 (64%) were female and 31 (36%) were male. Ethnicity of respondents was prevalently Caucasians (50%), followed by Asians (8.6%). The composition of caregiver respondents was quite varied. Seventy-seven were parents, seven were the patient's guardians, and two more persons had other relationships to the patients. The majority of caregivers (24.4%) held a college diploma as their highest verifiable education degree, and the largest percentage (24.4%) had annual income higher than \$81,000.

Clinical Examination Data. A summary of the clinical examination findings is presented in Table 3. The most dominant facial type among patients was the retrognathic one (52.3%), followed by a mesognathic facial type (37.2%). The most dominant form of upper and lower arch crowding was a mild form (1-4mm). A mild overjet (37.2%) and moderate overbite (37.2%) were also among the most frequently diagnosed malocclusion features. Finally, the smile line was most often assessed as average (64% of respondents).

Considering other facial and oral features of malocclusion among respondents, the most frequent was facial asymmetry (36%), and interlabial gap (26.7%). As seen in Figure 1, midline diastema was diagnosed in only 18.6% of the sample, while anterior and posterior crossbites were even less frequent (7% and 9.3% of cases, respectively).

As seen in Figure 2, another aspect of examination related to the lip position of respondents. An average lip position was more frequent for upper lips, with 61.6% having it, counter 24.4% of retruded lip and only 14% of protruded lip positions. As for lower lips, overwhelming 54.7% of respondents had protruded position of their lower lip and 44.2% had an average lip position. Notably, retruded lower lip position was extremely rare, accounting for only 1.2% of cases.

Table 2. Socio-demographic data of patients and caregivers.

Demographic Data	Possible Answers	Frequency	Demographic Data	Possible Answers	Frequency
Age	11	11 (12.8%)	Caregiver's highest level of education	Up to grade 8	4 (4.7%)
	12	12 (14%)		Up to grade 12	10 (11.6%)
	13	17 (19.8%)		High school	14 (16.3%)
	14	20 (23.3%)		Some college	7 (8.1%)
	15	15 (17.4%)		College Diploma	21 (24.4%)
	16	11 (12.8%)		Some university	13 (15.1%)
Ethnicity			Caregiver's income (thousands) before taxes	Undergrad degree	8 (9.3%)
				Graduate degree	9 (10.5%)
	Asian	16 (8.6%)		0-25	5 (5.8%)
	Black	8 (9.3%)		26-35	10 (11.6%)
	Caucasian	43 (50%)		36-45	13 (15.1%)
	East Indian	6 (7%)		46-55	8 (9.3%)
	First Nation	1 (1.2%)		56-65	5 (5.8%)
	Hispanic	2 (2.3%)		66-75	5 (5.8%)
	Metis	4 (4.7%)		76-80	4 (4.7%)
	Other	6 (7%)		81+	21 (24.4%)
				I refuse to answer	14 (16.3%)

Table 3. Clinical examination results summary.

Clinical Exam	Possible Answers	Frequency	Clinical Exam	Possible Answers	Frequency
Facial type	Mesognathic	32 (37.2%)	Profile type	Straight	22 (25.6%)
	Retrognathic	45 (52.3%)		Convex	58 (67.4%)
	Prognathic	9 (10.5%)		Concave	6 (7%)
Upper arch crowding	Mild (1-4mm)	55 (64%)	Lower arch crowding	Mild (1-4mm)	45 (52.3%)
	Moderate (4-7mm)	24 (27.9%)		Moderate (4-7mm)	33 (38.4%)
	Severe (>7mm)	7 (8.1%)		Severe (>7mm)	8 (9.3%)
Overjet	Negative	3 (3.5%)	Overbite	Normal (10-20%)	17 (19.8%)
	Edge-edge	4 (4.7%)		Mild (20-50%)	19 (22.1%)
	Normal (1-2mm)	24 (27.9%)		Moderate (50-80%)	32 (37.2%)
	Mild (2-4mm)	32 (37.2%)		Severe-impinging (100%)	12 (14%)
	Moderate (4-6mm)	14 (16.3%)		Open bite	6 (7%)
	Severe (>6mm)	9 (10.5%)			
Smile line		Average			55 (64%)
		High/Gummy			10 (11.6%)
		Low			21 (24.4%)

Figure 1. Percentage of the presence of other facial and oral features.

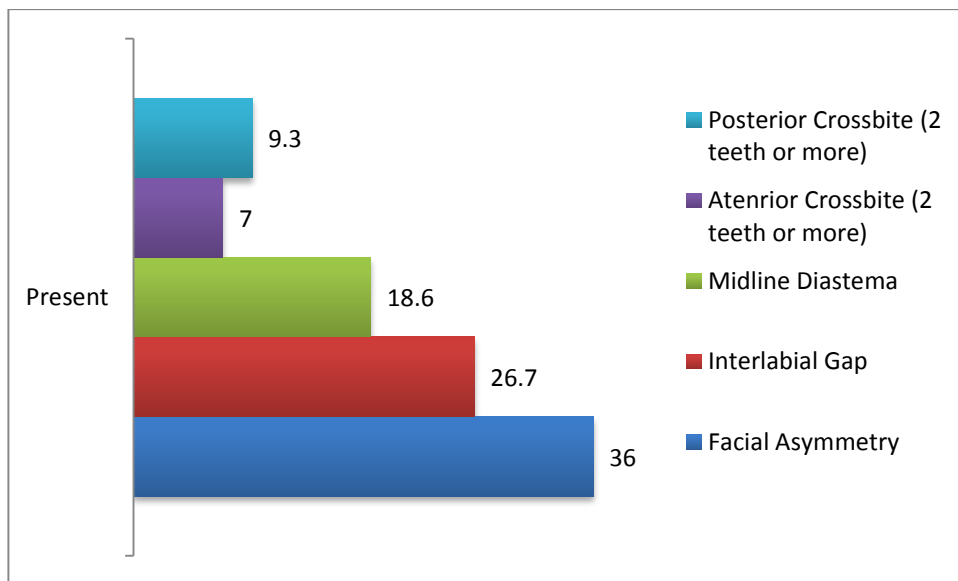
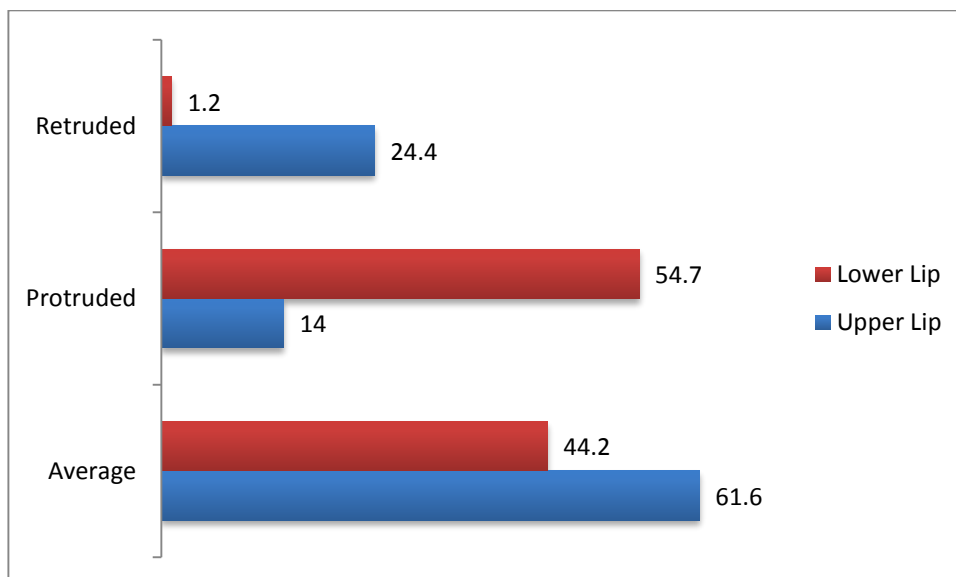


Figure 2. Percentage of respondents' lip positions.



The final physical examination of patients with malocclusion referred to diagnosing the need for orthodontic treatment in accordance with the IOTN guidelines – both in terms of dental and aesthetic health components. As seen in Figure 3, the majority of patients (41.9%) were graded as borderline need for treatment according to the IOTN dental health grade followed by severe need for treatment (22.1%), and no need for treatment (2.3%). According to the IOTN aesthetic component grading system – Figure 4, 34.9% of patients were graded as borderline need for treatment and one-third of patients (32.6%) were graded as definite need for treatment or no need for treatment (32.6%).

Figure 3. Percentage of respondents' according to IOTN Dental Health Grade.

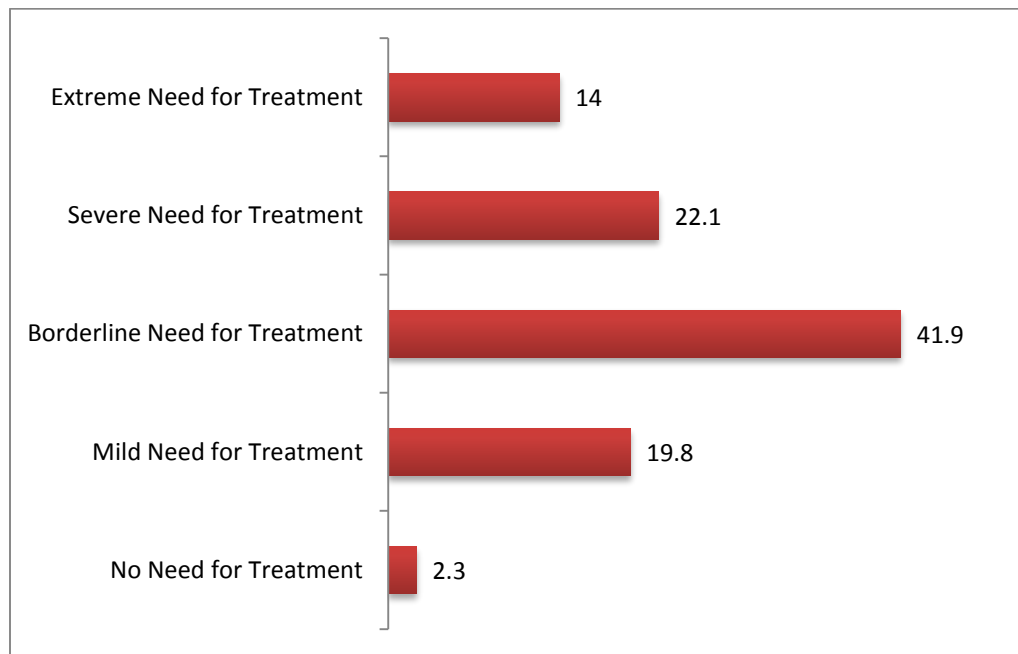
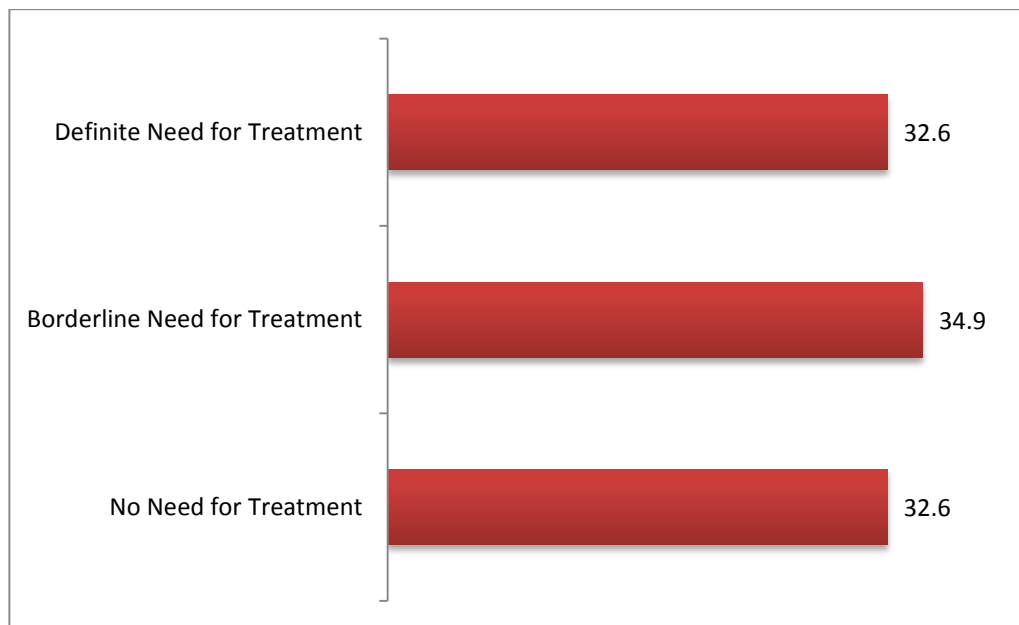


Figure 4. Percentage of respondents' according to IOTN Aesthetic Component Grade.



Association Between IOTN and Demographic Variables. The relation between IOTN dental health and aesthetic guidelines for treatment and patients' ethnicity showed that 66.7% of those requiring treatment and 36.8% of those with a severe need of treatment were both Caucasian. The second largest ethnic group severely needing treatment was Asians – 26.3%. In accordance with the IOTN aesthetic scale, the majority of those definitely needing treatment were also Caucasian, which nevertheless may be explained by the dominant majority of Caucasians constituting the overall sample of this study. In terms of gender, 45.5% of female patients and 35.5% of male patients were in moderate need of treatment, (IOTN dental health scale), while eight girls (14.5% of the female sample) and four boys (12.9% of the male sample) were in extreme need of treatment. In accordance with the IOTN aesthetic guidelines, 16 girls (29.1%) and 12 boys (38.7%) were diagnosed with a definite need for treatment.

The findings of IOTN guidelines and the age of respondents showed that the group of patients with an extreme need of treatment was most numerous among 12- and 13-year-olds, while severe need for treatment was most common for 13- and 14-year-olds according to IOTN dental health component. In accordance with the IOTN aesthetic component guide, the most numerous category of patients with a definite need of treatment was 13-14 years old, while at the same time the largest category of patients not requiring treatment also belonged to 14-year-old patients.

Parents'/Caregivers' Questionnaire. Caregivers were asked about their reasons for seeking orthodontic treatment for their children. As seen in Table 4, the main reasons are either because of self-diagnosis of their child having crooked teeth (75.6%), or according to dentist's recommendations (55.8%). The reason of correcting appearance is also quite frequent (38.4%); caregivers acted as initiators of orthodontic treatment (20.9%). Notably, very few noted that their children have difficulties speaking, eating, or problems with classmates harassing them because of unattractive appearance (only 7% and 3.5% accordingly).

The next section focuses on caregivers' satisfaction with their children's appearance. As seen in Table 5, caregivers expressed the highest degree of satisfaction with their children's height, eyes, nose, ears, and lips, as well as chins. The lowest level of satisfaction was expressed regarding jaws and teeth, which is natural because of the questionnaire's completion at the orthodontist's office, which supposes that patients are children with certain dental or dentofacial problems. Z-test was implied to assess the agreement with caregivers regarding teeth satisfaction. The result was statistically significant ($p < 0.05$) meaning that there is more agreement with caregivers being dissatisfied about their children's teeth – see Appendix N.

Table 4. Caregivers' reasons for seeking orthodontic treatment.

Reasons	Yes	No	Reasons	Yes	No
Crooked teeth	65 (75.6%)	21 (24.4%)	Classmates laugh at crooked teeth	3 (3.5%)	83 (96.5%)
To correct appearance	33 (38.4%)	53 (61.6%)	Referred by the dentist	48 (55.8%)	38 (44.2%)
Difficulties speaking/eating	6 (7%)	80 (93%)	Caregiver wanted the child to visit an orthodontist	18 (20.9%)	68 (79.1%)

As seen in Table 5, the results were further correlated with instances of bullying based on a certain aspect of appearance experienced by patients. Interestingly, very few cases of bullying were reported by caregivers regarding children's jaws or chins; the largest number of bullying experiences related to children's teeth (22.1%), followed by weight (16.3%) and height (12.8%).

As seen in Table 6, specific teeth-related bullying problems were further clarified with caregivers. Only 19 respondents who indicated the existence of certain bullying problems in previous questions were further surveyed regarding the presence of these specific bullying experiences. These 19 caregivers reported that their children have been victims of bullying as a result of the appearance of their teeth, jaws, and lips. The most frequent subject of bullying includes front teeth sticking out (16.3%) and crooked teeth (16.3%). Five caregivers stated that their children experienced bullying regarding the shape and color of their teeth. None experienced bullying regarding their children's chin's far back position or insufficient covering of bottom teeth by top teeth.

Table 5. Caregivers' satisfaction with children's appearance and bullying experiences.

Satisfaction Factors	Degree of Satisfaction					Bullying	
	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied	I don't care	Yes	No
Height	59 (68.6%)	23 (26.7%)	3 (3.5%)	---	---	11 (12.8%)	75 (87.2%)
Weight	54 (62.8%)	26 (30.2%)	5 (5.8%)	---	---	14 (16.3%)	72 (83.7%)
Strength	51 (59.3%)	31 (36%)	2 (2.3%)	---	1 (1.2%)	6 (7%)	80 (93%)
Hair	58 (67.4%)	25 (29.1%)	1 (1.2%)	---	1 (1.2%)	5 (5.8%)	81 (94.2%)
Eyes	61 (70.9%)	23 (26.7%)	1 (1.2%)	---	1 (1.2%)	5 (5.8%)	81 (94.2%)
Nose	62 (72.1%)	21 (24.4%)	1 (1.2%)	---	1 (1.2%)	3 (3.5%)	83 (96.5%)
Ears	65 (75.6%)	19 (22.1%)	---	---	---	4 (4.7%)	82 (95.3%)
Lips	62 (72.1%)	21 (24.4%)	2 (2.3%)	---	---	2 (2.3%)	84 (97.7%)
Jaws	53 (61.6%)	23 (26.7%)	7 (8.1%)	1 (1.2%)	1 (1.2%)	3 (3.5%)	83 (96.5%)
Chin	59 (68.6%)	22 (25.6%)	2 (2.3%)	2 (2.3%)	---	3 (3.5%)	83 (96.5%)
Teeth	8 (9.3%)	23 (26.7%)	48 (55.8%)	7 (8.1%)	---	19 (22.1%)	67 (78%)

Table 6. Caregivers' responses to bullying experiences of their children as related to their teeth/jaws/lips.

Bullying experiences	Yes	No	Bullying experiences	Yes	No
Bullied about top front teeth sticking out	14 (16.3%)	5 (5.8%)	Bullied about bottom front teeth sticking out	2 (2.3%)	17 (19.8%)
Bullied about chin sticking out	2 (2.3%)	17 (19.8%)	Bullied about chin is far back	---	19 (22.1%)
Bullied about having a gap between front teeth	3 (3.5%)	16 (18.6%)	Bullied about shape or color of teeth	5 (5.8%)	14 (16.3%)
Bullied about being unable to close lips comfortably	3 (3.5%)	16 (18.6%)	Bullied about top teeth not covering bottom teeth	---	19 (22.1%)
Bullied about showing too much gum	3 (3.5%)	16 (18.6%)	Bullied about crooked teeth	14 (16.3%)	5 (5.8%)

Caregivers were also referred to the psychosocial aspect of their children's malocclusion and dental problems. They were asked about problems that teeth created for their children, and whether correction of occlusion could result into better academic performance, self-esteem, and other positive psychosocial changes. As the findings in Table 7 suggest, caregivers denied that their children have nicknames at school that were related directly to the appearance of their teeth; 15% of caregivers reported that their children had been physically bullied before. A number of caregivers (39.5%) believed that straight teeth are associated with improved school performance and many more (75.6%) associated improved appearance of teeth with life success, self-esteem in public (87.2%), and personal self-confidence (86%). Z-tests were implied to assess the agreement between the caregivers' sample regarding straight teeth improving the children's feeling in public, boosting confidence and increasing chances of success in life. Results of the Z-tests were all statistically significant ($p < 0.05$) demonstrating that the majority of caregivers agree on the implication of their children having straight teeth on their psychosocial well-being. Z-test was also implied to assess the agreement on if straight teeth will improve school performance; the result of this test was also statistically significant ($p < 0.05$) with the majority of the caregivers agreeing that straight teeth has no influence on their children's academic performance – see Appendix N.

Table 7. Caregivers' response to the psychosocial well-being associated with their children's teeth.

Psychosocial Questions	Yes	No	Psychosocial Questions	Yes	No
Has a nickname in school because of being bullied or teased about teeth	0 (0%)	86 (100%)	Straight teeth will improve how you feel about yourself in public	75 (87.2%)	11 (12.8%)
Physically bullied	13 (15.1%)	73 (84.9%)	Straight teeth will improve school performance	34 (39.5%)	52 (60.5%)
Caregivers said something about teeth	48 (55.8%)	38 (44.2%)	Having straight teeth will boost confidence	74 (86%)	12 (14%)
Hide teeth when smiling	31 (36%)	55 (64%)	Straight teeth will increase chances of success in life	65 (75.6%)	21 (24.4%)

Finally, caregivers were asked to rate their children's academic performance. As seen in Table 8, the overall accounts of academic performance were positive.

Table 8. Caregivers' response to the academic performance of their children at school.

Grade	Academic Performance
Poor	1 (1.2%)
Fair	2 (2.3%)
Good	23 (26.7%)
Very good	39 (45.3%)
Excellent	21 (24.4%)

Patients' Questionnaire. Patients were also asked about their needed for orthodontic treatment. As seen in Table 9, the most frequently reported reasons were having crooked teeth (73.3% of patients), caregivers' initiative (58.1%), and dentist's referral (47.7%). Among other frequently cited reasons, patients named their wish to correct appearance (40.7% of cases).

As seen in Table 10, patients were asked about their degree of satisfaction regarding different physical aspects and whether they were bullied about any of them. The highest degree of satisfaction was reported by patients in relation to their eyes, hair, ears, and lips, whereas the lowest satisfaction was noted regarding weight, strength, nose, jaws, chin, and teeth. Z-test was statistically significant ($p < 0.05$), demonstrating that the majority of patients agree on dissatisfaction regarding their teeth – see Appendix N. As for bullying, 20 patients stated they were bullied about their teeth and 19 reported being bullied about weight.

Table 9. Patients' reasons for seeking orthodontic treatment.

Reasons	Yes	No	Reasons	Yes	No
Crooked teeth	63 (73.3%)	23 (26.7%)	Classmates laugh at crooked teeth	4 (4.7%)	82 (95.3%)
To correct appearance	35 (40.7%)	51 (59.3%)	Referred by the dentist	41 (47.7%)	45 (52.3%)
Difficulties speaking/eating	7 (8.1%)	79 (91.9%)	Caregiver wanted the child to visit an orthodontist	36 (41.9%)	50 (58.1%)

Table 10. Patients' satisfaction with appearance and bullying experiences.

Satisfaction Factors	Degree of Satisfaction					Bullying	
	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied	I don't care	Yes	No
Height	20 (23.3%)	49 (57%)	10 (11.6%)	---	7 (8.1%)	11 (12.8%)	75 (87.2%)
Weight	14 (16.3%)	52 (60.5%)	11 (12.8%)	5 (5.8%)	4 (4.7%)	19 (22.1%)	67 (77.9%)
Strength	14 (16.3%)	49 (57%)	15 (17.4%)	1 (1.2%)	7 (8.1%)	10 (11.6%)	76 (88.4%)
Hair	26 (30.2%)	49 (57%)	9 (10.5%)	---	2 (2.3%)	4 (4.7%)	82 (95.3%)
Eyes	31 (36%)	46 (53.5%)	5 (5.8%)	---	4 (4.7%)	3 (3.5%)	83 (96.5%)
Nose	21 (24.4%)	46 (53.5%)	8 (9.3%)	2 (2.3%)	9 (10.5%)	3 (3.5%)	83 (96.5%)
Ears	24 (27.9%)	47 (54.7%)	4 (4.7%)	---	11 (12.8%)	4 (4.7%)	82 (95.3%)
Lips	24 (27.9%)	48 (55.8%)	8 (9.3%)	---	6 (7%)	3 (3.5%)	83 (96.5%)
Jaws	20 (23.3%)	46 (53.5%)	8 (9.3%)	4 (4.7%)	8 (9.3%)	2 (2.3%)	84 (97.7%)
Chin	22 (25.6%)	47 (54.7%)	6 (7%)	2 (2.3%)	9 (10.5%)	4 (4.7%)	82 (95.3%)
Teeth	4 (4.7%)	14 (16.3%)	45 (52.3%)	19 (22.1%)	4 (4.7%)	20 (23.3%)	66 (76.4%)

Table 11 displays questions related to specific bullying experiences patients had in relation to the state of their teeth, jaws, and lips. The only aspect of bullying that was not reported by any child was bullying about bottom teeth sticking out. All other bullying types such as that about top teeth sticking out, having crooked teeth, showing too much gum when smiling, etc. were all reported by several respondents. The most frequent bullying types were having crooked teeth – 18.6% of patients, and shape and color of teeth – 10.5%. Front teeth sticking out was also a common form of bullying for 9.3% of the sample.

Table 12 refers to various aspects of well-being related to patients' appearance and teeth. More than a half of the sample indicated that they heard some unpleasant comments about their teeth from their parents/caregivers, and half of the respondents reported hiding teeth when smiling. Interestingly, only three respondents (which constitutes 3.5% of the sample) claimed that they had a nickname at school due to their dental problems. Z-test was statistically significant ($p < 0.05$) meaning that the majority of the patients did not relate academic performance to malocclusion. The overwhelming majority of patients associated straight teeth with improved public image, school performance, stronger self-confidence, and success in life. Z-tests were statistically significant ($p < 0.05$) regarding straight teeth improving patient's feeling about themselves in public, and boosting their confidence – see Appendix N.

Table 11. Patients' satisfaction with appearance and bullying experiences.

Bullying Experiences	Yes	No	Bullying Experiences	Yes	No
Bullied about top front teeth sticking out	8 (9.3%)	12 (14%)	Bullied about bottom front teeth sticking out	---	20 (23.3%%)
Bullied about chin sticking out	3 (3.5%)	17 (19.8%)	Bullied about chin is far back	2 (2.3%)	18 (20.9%)
Bullied about having a gap between front teeth	6 (7%)	14 (16.3%)	Bullied about shape or color of teeth	9 (10.5%)	11 (12.8%)
Bullied about being unable to close lips comfortably	2 (2.3%)	18 (21%)	Bullied about top teeth not covering bottom teeth	4 (4.7%)	16 (18.6%)
Bullied about showing too much gum	1 (1.2%)	19 (22.1%)	Bullied about crooked teeth	16 (18.6%)	4 (4.7%)

Table 12. Patients' response to the psychosocial well-being associated with their teeth

Psychosocial Questions	Yes	No	Psychosocial Questions	Yes	No
Has a nickname in school because of being bullied or teased about teeth	3 (3.5%)	83 (96.5%)	Straight teeth will improve how you feel about yourself in public	56 (65.1%)	29 (33.7%)
Physically bullied	13 (15.1%)	73 (84.9%)	Straight teeth will improve school performance	27 (31.4%)	59 (68.6%)
Caregivers said something about teeth	44 (51.2%)	42 (48.8%)	Having straight teeth will boost confidence	66 (76.7%)	20 (23.3%)
Hide teeth when smiling	43 (50%)	43 (50%)	Straight teeth will increase chances of success in life	39 (45.3%)	47 (54.7%)

Comparative Analysis

The present section compares research findings on the basis of three comparative dimensions – patient versus caregiver opinions, female versus male gender of participants, and patients' teeth bullying reports versus IOTN (DHC and AC).³

Patient Versus Caregiver - Comparison. As seen in Table 13, the first comparative analysis was conducted on the basis of satisfaction degrees of children and caregivers with various aspects of children's appearance, and the extent to which the opinions of caregivers and patients coincide. The highest level of satisfaction is recorded for children's hair, eyes, ears, and lips, while the lowest level of shared satisfaction (7%) is for the children's teeth. Moreover, counter to very low percentages of dissatisfaction of both children and caregivers with various aspects of appearance (3.5% maximum), the shared dissatisfaction for the condition of children's teeth appeared 46.6%.

The next comparison focused on the frequency of reported bullying by children versus their caregivers. As seen in Table 14, the degree of caregivers' and children's responses regarding bullying was quite high, with the most pronounced discrepancies in questions regarding weight, height, strength, and teeth – the most frequent aspects of appearance facing bullying. Unfortunately, 11.6% of children reported bullying about which their caregivers did not know, while interestingly, 10.5% of caregivers reported their children's bullying experiences that children, in their turn, denied.

³ Note: very dissatisfied and dissatisfied were combined in one group as well as very satisfied and satisfied

Table 13. Patient/caregiver satisfaction comparison.

Satisfaction Factors	Patient - Satisfied Caregiver – Satisfied	Patient – Dissatisfied Caregiver – Satisfied	Patient – Satisfied Caregiver – Dissatisfied	Patient – Dissatisfied Caregiver – Dissatisfied	Don't Care	Missing
Height	67 (77.8%)	9(10.5%)	1 (1.2%)	1 (1.2%)	7 (8.2%)	1 (1.2%)
Weight	63 (73.2%)	15 (17.5%)	2 (2.4%)	1 (1.2%)	4 (4.7%)	1 (1.2%)
Strength	60 (69.8%)	15 (17.5%)	1 (1.2%)	1 (1.2%)	8 (9.4%)	1 (1.2%)
Hair	72 (83.7%)	9 (10.4%)	1 (1.2%)	---	3 (3.5%)	1 (1.2%)
Eyes	75 (87.3%)	5 (5.9%)	1 (1.2%)	---	4 (4.7%)	1 (1.2%)
Nose	65 (75.6%)	10 (11.7%)	1 (1.2%)	---	9 (10.5%)	1 (1.2%)
Ears	69 (80.2%)	4 (4.7%)	---	---	11 (12.8%)	2 (2.3%)
Lips	70 (81.5%)	7 (8.1%)	2 (2.3%)	---	6 (7 %)	1 (1.2%)
Jaws	60 (69.7%)	8 (9.4%)	5 (5.9%)	3 (3.5%)	9 (10.5%)	1 (1.2%)
Chin	65 (75.6%)	7 (8.1%)	3 (3.5%)	1 (1.2%)	9 (10.5%)	1 (1.2%)
Teeth	6 (7%)	24 (27.9%)	12 (14%)	40 (46.6%)	4 (4.7%)	---

Table 14. Patient/caregiver bullying reports' comparison.

Bullying Experiences	Patient – Yes	Patient - No	Patient - Yes	Patient – No
	Caregiver - Yes	Caregiver – Yes	Caregiver – No	Caregiver – No
Bullied about height	6 (7%)	5 (5.8%)	5 (5.8%)	70 (81.4%)
Bullied about weight	11 (12.8%)	3 (3.5%)	8 (9.3%)	64 (74.4%)
Bullied about strength	3 (3.5%)	3 (3.5%)	7 (8.1%)	73 (84.9%)
Bullied about hair	3 (3.5%)	2 (2.3%)	1 (1.2%)	80 (93%)
Bullied about eyes	1 (1.2%)	4 (4.7%)	2 (2.3%)	79 (91.9%)
Bullied about nose	1 (1.2%)	2 (2.3%)	2 (2.3%)	81 (94.2%)
Bullied about ears	2 (2.3%)	2 (2.3%)	2 (2.3%)	80 (93%)
Bullied about lips	---	2 (2.3%)	3 (3.5%)	81 (94.2%)
Bullied about jaws	---	3 (3.5%)	2 (2.3%)	81 (94.2%)
Bullied about chin	---	3 (3.5%)	4 (4.7%)	79 (91.9%)
Bullied about teeth	10 (11.6%)	9 (10.5%)	10 (11.6%)	57 (66.3%)

Next, comparisons of patients and their caregivers regarding specific bullying experiences they had regarding children's teeth, jaws, or chins were conducted. As seen in Table 15, answers of only ten pairs were compared given the provision of affirmative answers to questions about overall bullying. What stands out is that three patients denied being bullied because of their front teeth sticking out, while their caregivers considered that their children were bullied for that reason. At the same time, seven children reported being bullied because of their crooked teeth, which was supported by their caregivers.

As seen in Table 16, comparisons of patients' and their caregivers' responses to psychosocial questions related to their psychological discomfort, problems with academic performance, and psychosocial gains associated with improved appearance of their teeth were also tested. Only 3.5% of the sample (3 respondents) reported having a nickname at school, which is a small percentage. 22.1% of children and caregivers reported that children try to hide teeth when smiling, while 27.9% more children confided to doing that while their caregivers either denied it, or did not notice that. More than 65% of children and caregivers agreed that straight teeth are likely to boost a child's confidence and 34.9% - it would increase chances of success in life. Notably, a weaker association was found between straight teeth and school performance, with only 17.4% children and caregivers agreeing on that point.

Table 15. Patient/caregiver reports of specific bullying experiences.

Bullying Experiences	Patient - Yes	Patient - No	Patient - Yes	Patient – No
	Caregiver – Yes	Caregiver – Yes	Caregiver – No	Caregiver – No
Bullied about top teeth sticking out	3 (30%)	3 (30%)	1 (10%)	3 (30%)
Bullied about bottom teeth sticking out	---	1 (10%)	---	9 (90%)
Bullied about chin sticking out	1 (10%)	1 (10%)	1 (10%)	7 (70%)
Bullied about chin being far back	---	---	---	10 (100%)
Bullied about crooked teeth	7 (70%)	2 (10%)	---	1 (10%)
Bullied about shape and color of teeth	3 (30%)	2 (10%)	1 (10%)	5 (50%)
Bullied about having a gap between front teeth	1 (10%)	1 (10%)	1 (10%)	7 (70%)
Bullied about top teeth not covering bottom teeth	---	---	2 (20%)	8 (80%)
Bullied about showing too much gum when smiling	---	1 (10%)	---	9 (90%)
Bullied about being unable to close lips comfortably	1 (10%)	1 (10%)	1 (10%)	7 (70%)

Table 16. Patient/caregiver answers to psychosocial questions.

Psychosocial Questions	Patient - Yes	Patient - No	Patient - Yes	Patient – No	Missing
	Caregiver – Yes	Caregiver – Yes	Caregiver – No	Caregiver – No	
Have a nickname at school being of being bullied or teased about teeth	---	---	3 (3.5%)	83 (96.5%)	---
Physically bullied	8 (9.3%)	5 (5.8%)	5 (5.8%)	68 (79.1%)	---
Parents ever commented about appearance of teeth	26 (30.2%)	22 (25.6%)	18 (20.9%)	20 (23.3%)	---
Hide teeth when smiling	19 (22.1%)	12 (14%)	24 (27.9%)	31 (36%)	---
Having straight teeth will boost confidence	56 (65.1%)	18 (20.9%)	10 (11.6%)	2 (2.3%)	---
Having straight teeth will improve how you feel about yourself in public	49 (57%)	25 (29.1%)	7 (8.1%)	4 (4.7%)	1 (1.2%)
Straight teeth will improve school performance	15 (17.4%)	19 (22.1%)	12 (14%)	40 (46.5%)	---
Straight teeth will increase chances of success in life	30 (34.9%)	35 (40.7%)	9 (10.5%)	12 (14%)	---

The next portion of comparison was undertaken between patients' and caregivers' responses regarding whether the respondents ever bullied their classmates about teeth. Notably, despite having dental problems and suffering a variety of psychosocial problems about it, 11.7% of respondents denied bullying other people, while their caregivers stated otherwise – see Table 17.

Table 17. Patient/caregiver answers to bullying classmates about teeth.

Question	Patient - Yes	Patient - No	Patient - Yes	Patient – No
	Caregiver – Yes	Caregiver – Yes	Caregiver – No	Caregiver – No
Have you ever bullied your classmates about teeth?	1 (1.2%)	10 (11.7%)	1 (1.2%)	74 (84.9%)

Only one respondent confided to bully another classmate about teeth, which was not known to his/her caregiver, and one child reported bullying another person, which was known by his/her caregiver. Ten caregivers stated that their children bullied their classmates about their teeth while their children denied. The rest of the sample agreed on non-involvement in bullying – see Table 17.

The final portion of comparison was to relate the association between caregivers' and patients' satisfaction index related to body image conducted with the help of Principal Component Analysis – see Appendix M. The findings showed that both children and their caregivers tend to give much importance to each of the named aspects of appearance in the formation of self-image and self-esteem. Importantly, for children, their perceptions about lips (0.842), chin (0.793) and jaws (0.771) were among the most important aspects contributing to

their satisfaction with appearance, while for caregivers, these aspects were also among the most important contributors to the child's self-image. Satisfaction index for teeth was the lowest – 0.374 for children, and 0.086 for caregivers – which suggests a considerably low satisfaction level regarding teeth in children's appearance, according to both caregivers' and patients' assessments – see Appendix M.

Male versus Female - Comparison. The comparison of patient's answers based on the male versus female criterion was also conducted in accordance with the same structure, starting with the extent of boys' and girls' satisfaction with certain aspects of their appearance. Findings from Table 18 suggest that 80% of females (44 persons, 51.5% of the total sample, and 80% of the female sample), in contrast to 64.52% of males (20 persons, 23.3% of the total sample, and 64.52% of the male sample), were dissatisfied with the appearance of their teeth - see in Table 18. Z-test showed statistically significant results indicating that females are much more preoccupied with their appearance and are much more skeptical about their physical attractiveness – see Appendix N.

Table 18. Female/male satisfaction factors comparison.

Satisfaction Factors	Satisfied		Dissatisfied		Don't Care
	Female	Male	Female	Male	
Height	45 (52.4%)	24 (27.9%)	5 (5.8%)	5 (5.8%)	7 (8.1%)
Weight	39 (45.4%)	27 (31.4%)	13 (15.2%)	3 (3.5%)	4 (4.7%)
Strength	39 (45.4%)	24 (27.9%)	11 (12.8%)	5 (5.9%)	7 (8.1%)
Hair	47 (54.6%)	28 (32.6%)	6 (7%)	3 (3.5%)	2 (2.3%)
Eyes	48 (55.7%)	29 (33.7%)	4 (4.7%)	1 (1.2%)	4 (4.7%)
Nose	41 (47.7%)	26 (30.3%)	7 (8.1%)	3 (3.5%)	9 (10.5%)
Ears	43 (50%)	28 (32.6%)	3 (3.5%)	1 (1.2%)	11 (12.8%)
Lips	46 (53.5%)	26 (30.2%)	4 (4.7%)	4 (4.7%)	6 (7%)
Jaws	39 (42.3%)	27 (31.4%)	9 (10.5%)	3 (3.5%)	8 (9.3%)
Chin	42 (48.8%)	27 (31.4%)	5 (5.8%)	3 (3.5%)	9 (10.5%)
Teeth	8 (9.3%)	10 (11.6%)	44 (51.2%)	20 (23.3%)	4 (4.7%)

Next, comparison of the degree of teeth crowding was conducted to see how subjective males and females were regarding their teeth. The findings seen in Table 19 suggest that males seem to treat the crowding of their teeth less than females do; none of the male respondents characterized his crowding as severe, in contrast to two female respondents. Moreover, when respondents were asked to compare the appearance of their teeth to their face, 69% of females stated that their teeth were less attractive than their face, while 58% of males stated the same.

Table 19. Female/male assessment of teeth crowding.

Gender	Minimal crowding	+	++	+++	Severe Crowding	Missing
Female	7 (8.1%)	11 (12.8%)	23 (26.7%)	10 (11.6%)	2 (2.3%)	2 (2.3%)
Male	4 (4.7%)	3 (3.5%)	15 (17.4%)	8 (9.3%)	----	1 (1.2%)

As seen in Table 20, bullying experiences were also compared. Males are less frequently bullied on a variety of appearance traits in comparison to females whose bullying on the subject of weight, strength, eyes, nose, ears, etc. is more common. Nevertheless, bullying on the subject of teeth is quite widespread both for male and female respondents, with 14 females and six male patients reporting being bullied about their teeth.

Table 20. Female/male bullying reports' comparison.

Bullying Factors	Female		Male	
	Yes	No	Yes	No
Bullied about height	5 (5.8%)	50 (58.1%)	6 (7%)	25 (29.1%)
Bullied about weight	14 (16.3%)	41 (47.7%)	5 (5.8%)	26 (30.2%)
Bullied about strength	6 (7%)	49 (57%)	4 (4.7%)	27 (31.4%)
Bullied about hair	2 (2.3%)	53 (61.6%)	2 (2.3%)	29 (33.7%)
Bullied about eyes	3 (3.5%)	52 (60.5%)	----	31 (36%)
Bullied about nose	2 (2.3%)	53 (61.6%)	1 (1.2%)	30 (34.9%)
Bullied about ears	4 (4.7%)	51 (59.3%)	---	31 (36%)
Bullied about lips	3 (3.5%)	52 (60.5%)	---	31 (36%)
Bullied about jaws	2 (2.3%)	53 (61.6%)	---	31 (36%)
Bullied about chin	4 (4.7%)	51 (59.3%)	---	31 (36%)
Bullied about teeth	14 (16.3%)	41 (47.7%)	6 (7%)	25 (29.1%)

Twenty patients who reported being bullied were further asked specific questions about bullying experiences specifically related to teeth, jaws, or chins. Their responses reveal that 83% of males and 79% of females from the targeted sample were bullied because of their crooked teeth. Though other types of bullying were less frequent, they were still present, more for female respondents, which is also important to note when assessing the psychosocial impact of malocclusion of patient's well-being – see Table 21.

As seen in Table 22, a comparison between psychosocial well-being and association of psychosocial problems with crooked teeth has been conducted. Findings indicate that 82% female and 68% male respondents associated having straight teeth with better self-confidence, while 69% of female respondents and 58% male respondents stated that straight teeth would assist them in feeling better in public. Z-tests were statistically significant ($p < 0.05$) with regards to females agreeing more on straight teeth providing them with improvement on how they feel about themselves in public and that it will boost their confidence. No statistical significance ($p > 0.05$) were found with regards straight teeth having an effect on increasing chances of success in life between male and female patients – see Appendix N.

Table 21. Female/male reports of specific bullying experiences.

Bullying Experiences	Female		Male	
	Yes	No	Yes	No
Bullied about top teeth sticking out	5 (25%)	9 (45%)	3 (15%)	3 (15%)
Bullied about bottom teeth sticking out	---	14 (70%)	---	6 (30%)
Bullied about chin sticking out	3 (153%)	11 (55%)	---	6 (30%)
Bullied about chin being far back	2 (10%)	12 (60%)	---	6 (30%)
Bullied about crooked teeth	11 (55%)	3 (15%)	5 (25%)	1 (5%)
Bullied about shape and color of teeth	6 (30%)	8 (40%)	3 (15%)	3 (15%)
Bullied about having a gap between front teeth	6 (30%)	8 (40%)	---	6 (30%)
Bullied about top teeth not covering bottom teeth	4 (20%)	10 (50%)	1 (5%)	5 (25%)
Bullied about showing too much gum when smiling	1 (5%)	13 (65%)	---	6 (30%)
Bullied about being unable to close lips comfortably	1 (5%)	13 (65%)	1 (5%)	5 (25%)

Table 22. Female/male answers to psychosocial questions.

Psychosocial Questions	Female		Male	
	Yes	No	Yes	No
Have a nickname at school being of being bullied or teased about teeth	1 (1.2%)	54 (62.8%)	2 (2.3%)	29 (33.7%)
Physically bullied	5 (5.8%)	50 (58.1%)	8 (9.3%)	23 (26.7%)
Parents ever commented about appearance of teeth	28 (32.6%)	27 (31.4%)	16 (18.6%)	15 (17.4%)
Hide teeth when smiling	28 (32.6%)	27 (31.4%)	15 (17.4%)	16 (18.6%)
Having straight teeth will boost confidence	45 (52.3%)	10 (11.6%)	21 (24.4%)	10 (11.6%)
Having straight teeth will improve how you feel about yourself in public	38 (44.2%)	17 (19.8%)	18 (20.9%)	12 (14%)
Straight teeth will improve school performance	18 (20.9%)	37 (43%)	9 (10.5%)	22 (25.6%)
Straight teeth will increase chances of success in life	23 (26.7%)	32 (37.2%)	16 (18.6%)	15 (17.4%)

As seen in Table 23, the overwhelming majority of respondents never bully their classmates about teeth. Nevertheless, one male and one female respondent still confided to involving in classmates' bullying on the subject of crooked teeth.

Table 23. Female/male answers to bullying classmates about teeth.

Question	Female - Yes	Female - No	Male - Yes	Male - No
Have you ever bullied your classmates about teeth?	1 (1.2%)	54 (62.8%)	1 (1.2%)	30 (34.9%)

Patients' Teeth Bullying Reports versus IOTN (DHC and AC) - Comparison. Another essential aspect of interest in comparative analysis was the relationship between an objective IOTN assessment of the need of orthodontic treatment and reports about patient's bullying experiences. Interestingly, out of 20 patients bullied about teeth, 40% had a moderate need for treatment, 25% were diagnosed with severe need for treatment, 10% had an extreme need for treatment, and only 5% did not need treatment at all – in accordance with the IOTN dental health scale – Figure 5. As for the IOTN aesthetic scale, out of the sample of 20 patients, six patients who reported being bullied about teeth appeared not to need treatment (30%). 35% of the bullied patients were diagnosed with either a definite need or a borderline need for treatment for aesthetic purposes – Figure 6.

Figure 5. IOTN dental health component in relation to respondents' answering "yes" to teeth bullying.

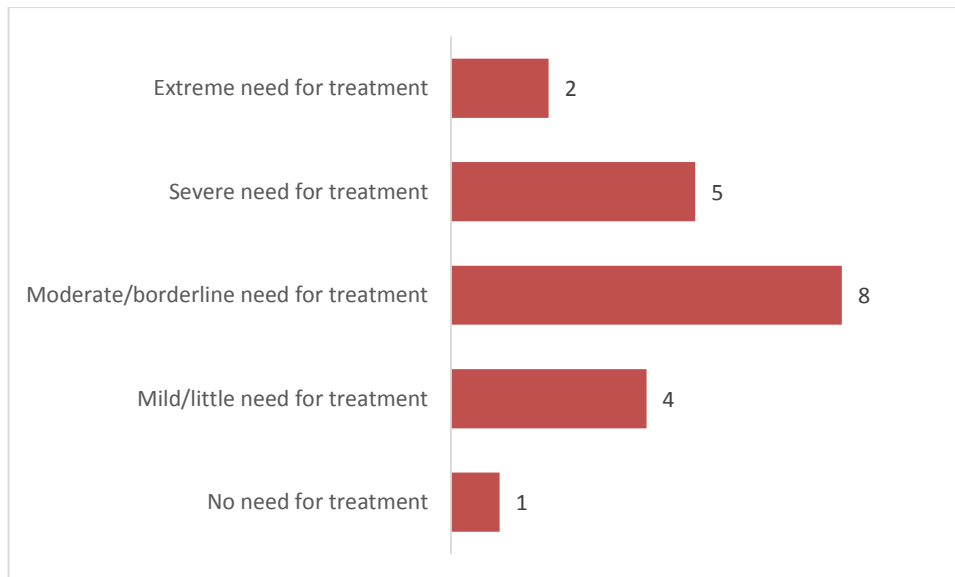
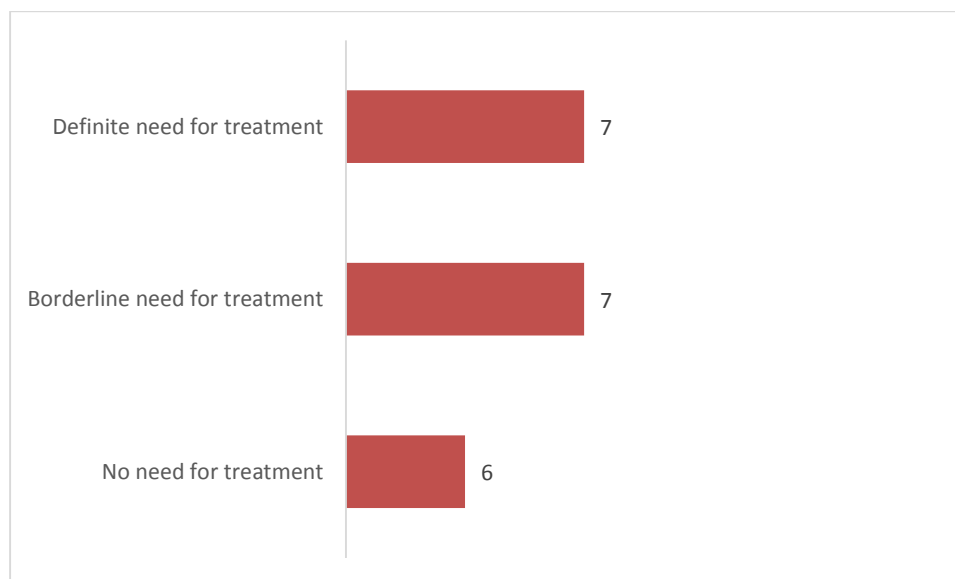


Figure 6. IOTN aesthetic component in relation to respondents' answering "yes" to teeth bullying.



Correlation Analysis

Correlation analysis was further conducted to determine the relationships between various aspects of clinical conditions and psychosocial experiences of patients and their caregivers. Table 24 provides a summary of the correlational findings. A full list of correlation tables is found in Appendix L. First, a statistically significant correlation was found between caregivers' satisfaction with the child's teeth and the IOTN aesthetic guidelines. The higher the dissatisfaction of caregivers with the child's teeth, the higher is the actual need for treatment.

Table 24. Results of all correlations.

Correlated Variables	Test Used	Results
IOTN dental health grade + IOTN aesthetic component grade.	Pearson Correlation	Significant correlation ($P < 0.05$).
Child satisfaction index + caregiver Satisfaction Index.	Pearson Correlation	Significant correlation ($P < 0.05$).
Child's satisfaction with teeth + IOTN dental health grade.	Pearson Correlation	No significant correlation.
Child's satisfaction with teeth + IOTN aesthetic component grade	Pearson Correlation	No significant correlation.
Caregiver's Satisfaction with teeth + IOTN dental health grade.	Pearson Correlation	No significant correlation.
Caregiver's satisfaction with teeth + IOTN aesthetic component grade.	Pearson Correlation	Significant correlation ($P < 0.05$).
Caregiver's satisfaction with teeth/chin/jaws/lips + income	Spearman's rho	No significant correlation.
Caregivers' motivation to seek orthodontic treatment + income.	Pearson Correlation	No significant correlation.
Caregiver's motivation to	Gamma	Significant correlation

seek orthodontic treatment+ child's motivation to seek orthodontic treatment.		(P<0.05) between caregivers and their children in regards to their motivation to seek orthodontic treatment with respect to crooked teeth and referral by the dentist. No significant correlation with respect to other motivation factors.
Patient/caregiver satisfaction comparison.	Gamma	No significant correlations between patients and caregivers with respect to satisfaction factors.
Patient/caregiver bullying reports' comparison.	Gamma	Significant correlation (P<0.05) with respect to height, weight, and teeth. No significant correlation with respect to other physical factors.
Male/female assessment of teeth crowding.	Pearson's chi-square	No significant correlation.
Gender + being bullied about teeth.	Pearson Correlation	No significant correlation.
Male/female satisfaction factors comparison.	Pearson's chi-square	No significant correlations between males and females with respect to satisfaction factors except for teeth (P<0.05).
Male/female bullying reports' comparison.	Pearson's chi-square	No significant correlation.
Severity of malocclusion (IOTN dental health grade) + being bullied about teeth.	Pearson Correlation	No significant correlation.
Severity of malocclusion (IOTN aesthetic component grade) + being bullied about teeth	Pearson Correlation	No significant correlation.

Second, a significant correlation was identified between the caregiver and child's motivation to seek orthodontic treatment. Third, a significant correlation was identified between caregivers' and child's satisfaction with body image. Finally, the researcher found no correlation

between the respondents' gender bullying factor, which shows that gender is an insignificant factor in terms of having bullying experiences.

Chapter 6: Discussion

The first section of this chapter reviews the findings according to each primary hypothesis, and relates them to reviewed research. The second section presents implications of the obtained findings, followed by an overview of study limitations and weaknesses. The chapter concludes with recommendations for further research that address this study's limitations and expand the body of existing knowledge on the subject of relationship between malocclusion and psychosocial well-being of children and adolescents.

Discussion of Obtained Findings

The present study was based on the initial premise that malocclusion affects a person's self-esteem and body image negatively (DeBiase & Sandler, 2001; Pithon et al., 2014), which causes a variety of psychosocial problems and degrades the person's well-being (Helm et al., 1985; Sardenber et al., 2013). To verify that relationship, the researcher formulated five hypotheses:

1. A relationship exists between malocclusion and psychosocial well-being factors.
2. A relationship exists between malocclusion and bullying - when the severity of malocclusion increases, the more bullying experiences are anticipated and expected.
3. Children with severe malocclusion are more likely to have academic problems at school than those with mild malocclusion.
4. A child's motivation to seek orthodontic treatment is associated with the caregiver's motivation to seek treatment.
5. Psychosocial impact of malocclusion is higher among girls than boys.

Hypothesis 1: A relationship exists between malocclusion and psychosocial well-being factors. Malocclusion has been strongly associated with various aspects of psychosocial well-being of respondents, which the findings of this study verify. The psychosocial well-being of a child with dental problems is negatively affected in a variety of ways: experiences of bullying at school, caregivers' negative remarks, as well as personal low self-evaluation and complexes. This study showed that respondents often associate their malocclusion with serious flaws in their appearance and many of them find support for their psychological fears in the negative attitude of people surrounding them. The study's findings indicate that most of the surveyed patients are dissatisfied with the appearance of their teeth. The majority of both caregivers and patients agree on dissatisfaction of teeth. Patients reported being bullied because of various dental problems such as crooked teeth, shape and color of their teeth, teeth sticking out, etc. Very few caregivers and patients indicated that classmates laugh at the child because of problems with teeth, while a third of parents and a little more than a third of the patients came to the orthodontist to correct the patient's appearance. Moreover, the majority of patients and caregivers agree that straight teeth do improve psychosocial factors. These findings are consistent with claims of Alley and Hildebrandt (1988), Berscheid and Gangestad (1982), Peck and Peck (1993), and a more recent study of Amin and Hassan (2010) about facial appearance being a very influential component of the overall self-image determining self-esteem. They also support the findings of Baylon (2014) about children's close psychological association of self-perception with dental appearance.

It is evident that malocclusion and other dental problems are related to psychosocial well-being and self-esteem; few respondents (patients and caregivers) requested orthodontic treatment because of objective problems with eating and/or speaking, while one third of the surveyed

patients were diagnosed with an objective need for treatment according to the IOTN dental health guidelines. Counter to the IOTN aesthetic guidelines for treatment stating that one third of the sample do not need treatment at all, the overwhelming majority of the study sample's caregivers and patients claimed that the teeth of the patients were crooked and require treatment. Here, it is evident that perception is more powerful than objective medical criteria. These findings are consistent with Helm et al., (1985) and Sardenberg et al., (2013) about a strong association of malocclusion with a negative body image that may be subjectively worse than the real state of affairs is.

Moreover, a notable effect of malocclusion on respondents' psychosocial well-being may be seen in their association of straight teeth with better self-confidence in public, life success, and overall attractiveness of their appearance. Moreover, the satisfaction index for teeth was the lowest for both patients and their caregivers, which suggests a considerably low satisfaction level regarding teeth in patient's appearance, according to both caregivers' and patients' assessments. As for public presence and life success, most patients and their caregivers agreed with the statement that straight teeth will increase the patient's confidence, that it will improve the patient's self-perception in public, and less so, that it will increase chances for success in life. Such observations support previously made claims about public self-confidence and association of dental health with life success of Badran (2010), Kang and Kang (2014), and Johal et al., (2014).

Hypothesis 2: A relationship exists between malocclusion and bullying - when the severity of malocclusion increases, the more bullying experiences are anticipated and expected. A vital aspect of poor psychosocial well-being is a concept of bullying; patients with problems with appearance are likely to experience bullying, which also contributes to their

psychosocial problems, shyness, and poor self-esteem. Based on this study, having a malocclusion was identified as being related to bullying, with more than one fifth of patients confessing to being bullied about dental appearance followed by bullied about weight. Out of the overall sample, some patients reported being physically bullied, which is obviously ruinous for the child's self-image and self-esteem.

In addition, it is essential to note more than half of the bullied sample either needed no treatment, or little treatment or moderate/borderline treatment according to the IOTN dental health guidelines. These milder forms of malocclusion are still powerful enough to attract bullying regarding patients' teeth which may be due to having less than ideal physical (dental) characteristics. In terms of the IOTN aesthetic guidelines, one third of the bullied sample did not need treatment and just more than third of the sample needed definite treatment. The present evidence suggests that not only children with a severe need for treatment, visible, and easily detectable dental problems suffer from bullying, but also children who have milder forms of malocclusion and even those who do not meet the objective treatment need criteria. Those findings were further correlated and showed no statistical significance between the severity of malocclusion according to IOTN dental and aesthetic guidelines and patients experiencing bullying related to teeth. Such findings indicate the need for considering even mild forms of malocclusion as possible sources of negative psychosocial experiences and problems for children, which increases the need to consider orthodontic treatment for a child to improve their quality of his/her school life and peer interactions.

The present research findings support or align with prior findings of Shaw et al., (1980) about teeth-related bullying being much more abusive than other forms of bullying about height, weight, hair, and other elements of appearance. Al-Bitar et al., (2013) also found out that

bullying about teeth is a quite common, and even a dominant, form of bullying at school because of the visible imperfections of children's facial appearance. Such bullying experiences intensify anxiety, depression, and poor self-image among children, causing lower self-esteem, loneliness, and insecurity feelings further deteriorating the psychosocial well-being and emotional health of children (DiBiase & Sandler, 2001; Hawker & Boulton, 2000).

Hypothesis 3: Children with severe malocclusion are more likely to have academic problems at school than those with mild malocclusion. The majority of patients were ranked as performing excellently or very good at school according to their caregiver's evaluation. Thus, children with malocclusion may not experience a negative impact of their unattractive oral appearance, low self-esteem, and bullying experiences on their academic progress. Due to the insufficient sample size of patients experiencing serious problems with academic performance, it is not possible to validate the presence of a correlation between severity of malocclusion and academic performances. On the other hand, Z-test negates this hypothesis and showed that there is no relation between malocclusion and academic performance. The majority of patients' and caregivers' perceptions of malocclusion had no effect on academic performance. Therefore, the findings do not validate a hypothesis about academic performance's dependence on having straight teeth. Moreover, these findings do not support prior research indicating that attractive appearance and straight teeth help individuals to succeed. However, one should keep in mind that all those issues are also of psychological nature, and there is no direct biological association between straight teeth and better academic performance. On the other hand, studies of Kumpulainen et al. (1998) and Olweus (1978) suggested that students with malocclusion may have under-achievements in academic performance because of their psychosocial problems

distracting them from studies and reducing their self-esteem, overall well-being, and causing depression and isolation.

Moreover, it is possible to identify the potential impact of straight teeth on school performance that caregivers and patients see. Very few of the caregivers and patients agreed that straight teeth may improve school performance. Moreover, few children considered straight teeth able to help them improve their school performance, while their caregivers responded otherwise. Almost half of the total respondents (caregivers and their children), denied any association between straight teeth and improved school performance, which suggests that self-esteem and psychological aspects such as self-confidence, positive self-image, confidence in social interactions, etc. are much more closely associated with straight teeth, while their connection with academic success is recognized by much fewer persons. Thus, a considerable portion of the sample associating straight teeth with academic success are compliant with the suggestions of Landy and Sigall (1977), Langlois et al. (2000), and Pithon et al. (2014). These studies proved that people associate physical attractiveness, including straight teeth, with higher levels of intelligence and better aptitude to task completion, which would infer improved school performance.

Hypothesis 4: A child's motivation to seek orthodontic treatment is associated with the caregiver's motivation to seek treatment. Alignment of caregivers' motivation to seek orthodontic treatment for their children was validated with respect to crooked teeth and referral by the dentist. This was also supported with numerous data about child's self-reported dental health problems and recognition of those problems by caregivers. Having crooked teeth was recognized by most of the patients and their caregivers, which suggests that caregivers are quite realistic, and even critical, about their children's dental appearance. Dentist referral motivated

over half of the caregivers and almost half of the patients to seek treatment. Although fewer caregivers viewed themselves as being the motivators of visiting an orthodontist, more of the patients stated that they came to seek orthodontic treatment upon their caregivers' wish. These findings support prior research of Wedrychowska-Szulc and Syrynska (2010) and Samsonyanova and Broukal (2014) who found that caregivers' wish for their children to look attractive as motivating them to seek orthodontic treatment, and determining their children's need for treatment on their own.

Interestingly, caregivers often become negative contributors to children's poor psychosocial well-being in case they have serious orthodontic problems. In many cases, caregivers appear to comment on their children's appearance negatively, and they often become the primary initiators of visits to a dentist for correction of children's appearance. In this study, more than half of patients and caregivers reported commenting about their children's crooked teeth, which may exert a strong psychological pressure on children. A significant correlation between the patients' satisfaction with their body image and their caregivers' satisfaction validates this claim. Children who feel the discontent of caregivers about their teeth may experience much worse levels of dissatisfaction with their self-image, which leads to aggravation of their psychosocial problems. Is it possible that caregivers' negative comments about their children's dental appearance may predispose the child to bullying experiences?

These observations substantiate the claims of Abreu et al. (2014), Hassan et al. (2014), and Piovesan et al. (2011) about a frequent disagreement of patients and their caregivers about the objective need for treatment. Spalj et al. (2010) associated such a disagreement with parents' subjective perceptions of their responsibility to provide their children with the best possible care, while this study did not find any plausible evidence for such claims. In some cases, caregivers'

assessment of children's dental health was more critical than children's self-assessment, but these findings are insufficient to make conclusions about caregivers' subjectively higher assessment of treatment need.

Despite the increasing body of literature regarding the connection of caregivers' socio-economic status and their subjective perceptions of children's need for dental treatment, the present study did not support these aspects. Hence, the claims of Piovesan et al. (2011) in this regard were not supported.

Hypothesis 5: Psychosocial impact of malocclusion is higher among girls than boys.

Preoccupation with physical appearance and gravity of psychosocial problems associated with malocclusion was found to be higher for girls, which validates the present hypothesis. The majority of female patients agreed that straight teeth would improve how they would feel in public and would boost their confidence. The most general assessment showed that female sample in contrast to male sample were more dissatisfied with the condition and appearance of their teeth. Moreover, female respondents tended to evaluate their teeth crowding and teeth problems more critically; more females characterized their crowding as severe. These findings support the claims of Jung (2010) who also observed females to be much more preoccupied with their malocclusion and other dental problems.

In the present study, no significant correlation was found between bullying, self-esteem and gender which was supported by the claims of Gavric et al., (2015). Females turned out to be bullied because of poor dental appearance much more frequently in this study. Females also reported specific bullying experiences related to teeth more frequently with regards to teeth sticking out, chin sticking out or being too far back, shape and color of teeth, showing too much gum and having crooked teeth as well. Hence, it is true that females were bullied much more

frequently in this study but such values were insufficient to conclude that females are more bullied regarding their teeth when compared to males.

Implications of Findings

The present study indicated that children experience a variety of psychosocial problems associated with unappealing appearance because of dental problems. Very few respondents from the surveyed sample sought orthodontic treatment because of medical problems such as hardship eating or speaking, while the overwhelming majority of patients reported their wish to correct appearance and to get rid of crooked teeth as the primary reason for their visit to an orthodontist. Therefore, it is possible to conclude that malocclusion sometimes presents more of a psychological problem rather than a purely medical problem. That is why its treatment has to be approached from a variety of aspects, not only dental treatment but also active psychological work with the patient to restore his or her self-esteem, self-confidence, and a positive self-image.

The findings of this research also suggest that the instances of bullying and harassment regarding a variety of dental problems are very frequent. While both caregivers and patients acknowledged a wish to improve appearance with the help of orthodontic correction of occlusion, the core reason for a wish to improve appearance may be seen in the problems with classmates, bullying, and overall poor social functioning because of poor self-image, isolation, and anxiety. Moreover, which is distressing, caregivers often aggravate the situation by also acting as bullies. More than a half of the caregivers' and patients' sample agreed that caregivers commented about appearance of patients, which may act as an additional negative contributor to children's worsening quality of life, impaired self-perception, depression, and other psychological challenges.

Together with caregivers' direct contribution to the child's negative self-image, and the direct association of caregivers' dissatisfaction with the child's appearance and the child's dissatisfaction with his or her appearance, caregivers' motivation for treatment is usually subjectively higher than that of children. On the one hand, it may be assessed as a positive phenomenon because children do not have funds and independence for making autonomous decisions regarding pursuit of orthodontic treatment. On the other hand, caregivers' higher preoccupation with the child's malocclusion and other dental problems may often serve as a strong negative contributor to child's poor self-image.

Hearing comments from caregivers about his or her crooked teeth, the child's dissatisfaction with personal appearance may get exacerbated, which is not as easily corrected as malocclusion is in some instances. Acquiring deeply rooted and long-lasting psychological problems related to caregivers' dissatisfaction with the child's appearance might become a dangerous trend towards low self-esteem, absence of self-confidence, impaired social activities, and other interpersonal and internal problems in the child's adulthood. Hence, it is recommended that caregivers, in line with adequate assessment of their children's necessity for orthodontic treatment, refrain from thoughtless comments about the child's appearance to avoid exacerbation of psychological traumas.

Another important implication of this study is that both caregivers of patients with malocclusion, and patients with malocclusion have very strong expectations regarding orthodontic treatment, considering that straight teeth may help children resolve the entire complex of their psychosocial problems. This way, all respondents assessed the potential of straight teeth to boost the child's confidence, increase chances for life success, and add confidence in public very highly, which suggests that people with malocclusion develop a variety

of problems with social interactions and interpersonal relationships. In addition, being bullied because of teeth is also a very strong factor affecting children's social confidence and self-image; therefore, eliminating the physical object of teasing is considered to help children regain a confident place in their social environment and receive better competitive chances in life. These associations have been most often supported by empirical evidence examining unconscious association of positive personal characteristics such as intellect, intelligence, and ability to perform tasks with more pleasing physical appearance. Therefore, it seems reasonable that children experiencing bullying and a variety of other problems related to their poor dental health naturally expect to get rid of those problems once their malocclusion is corrected.

Finally, it is vital to point out the gender-related implication of this study. In support of prior research findings recognizing females as more preoccupied with their dental appearance, this study also showed that females tended to assess their dental problems more critically, and were more critical about their need for orthodontic treatment. An interesting observation made within this study is that females reported being bullied about teeth more often than males did, which suggests that higher expectations about attractiveness of female appearance make females a readier target for bullying in case they do not comply with the beauty ideal. However, the current study showed no significant statistical correlation when correlating gender and teeth bullying. This indicates that there are no differences in gender with regards to teeth bullying. Therefore, the study findings do not support previous research findings which revealed the females are more targeted for teeth bullying when compared to males.

Educational Implications. In this study, some patients with no/little need of treatment did experience bullying regarding teeth. Therefore, caregiver and patient education should be implied in an attempt to avoid any further teeth bullying experiences. Both caregivers and

patients would be recommended therapy about self-image and self-esteem to help them deal with distorted dental perceptions in order to align it with the standard of orthodontic treatment. Caregivers' awareness of the effects of their negative remarks regarding their children's teeth must be employed to avoid aggravating the already existing psychosocial experiences. Educating caregivers and patients will negate the distorted perceptions of body image and dental appearance attained from the media and Hollywood.

Limitations and Weaknesses

The present study has several limitations and weaknesses that need to be taken into account when evaluating the validity, reliability, and overall academic value of obtained findings. First, the purposive sampling method is a limitation of this study because it is the most convenient sampling technique but it reduces the credibility of findings. The researcher decides whom to include in the sample, and determines the setting for sampling, which weakens the study's generalizability. Using a random sampling technique would guarantee a much higher level of study's credibility, but taking into account that patients with specific dental problems had to be included into the sample; using a purpose sampling method may be justified. In case a variety of settings are included, the variability of the sample size may be guaranteed, and the findings obtain higher credibility, universality, and generalizability. This weakness may be addressed through further replicated studies in a variety of settings with the use of the same data collection instrument to compare findings and produce more generalizable findings.

Another limitation of this study was the low sample size of bullied patients. The decreased sample size prevented the researcher from achieving the necessary statistical power to conduct meaningful correlation tests. Further research with a larger sample of bullied patients is needed to validate further correlations.

Finally, it is essential to note that the cross-sectional nature of this study may also serve as a limitation. Such a study provides only a snapshot of the current situation and psychosocial well-being of patients with malocclusion and their parents. However, longitudinal approach to observing patients undergoing orthodontic treatment might yield a much richer dataset for analyzing the dynamics of patients' changing psychosocial well-being, and the extent to which their expectations regarding orthodontic treatment came true in the progress of treatment. Therefore, further research is required to assess this dimension of orthodontic treatment's association with psychosocial health and well-being of patients.

Recommendations for Further Research

Given the findings of this study and its methodological strength, some recommendations for further research are formulated to inform this field of research interest, and to clarify some observations made in this study. The first most notable finding was about the disagreement of patients and their caregivers regarding the gravity of dental health problems. Caregivers tended to be more skeptical about their children's dental health, and their perceptions about the need for treatment were objectively higher than those of patients and the IOTN dental health and aesthetic guidelines. The present fact requires further analysis to clarify the reasons for which caregivers are so skeptical about their children's dental health, and to determine the psychological impact of such assessment of patients' appearance on the patients' self-esteem and perception of their condition.

Second, a larger sample size of bullied patients is needed to test further correlations and indicate which bullying factors are of great importance to the patients and their caregivers. An overall larger sample would further detect the presence of a correlation between a specific gender and teeth bullying in order to support previous research regarding females being more targeted

for teeth bullying than males. Therefore, it is vital to conduct further studies to identify the rationale behind females' higher concerns about their dental health, be it an objective concern about female appearance or an effort to counter frequent bullying experiences. Standards of beauty and expectations regarding appearance are much more stringent for females, so it is vital to develop a clear and comprehensive understanding of female motives for seeking orthodontic treatment and female exposure to bullying as a key determinant of psychosocial problems.

The final observation that requires further research is that of high and diverse expectations that both caregivers and their parents have for orthodontic treatment. This study, as well as many others, identified the aspects of improvement of social, psychological, and physical functioning and relationships that patients and their caregivers expect after treatment. There are also many studies revealing significant improvements in the overall psychosocial functioning and self-perception among patients who have already undergone orthodontic treatment and improved the physical appearance of their teeth. However, there is still not enough data on whether the initial expectations are met with the help of orthodontic treatment, or children require additional psychological assistance to get rid of their complexes, anxieties, and fears associated with the well-established low self-esteem and bullying experiences. These psychological problems may remain after the physical signs of malocclusion disappear. Therefore, there is a need to study these issues to determine the entire complex of assistance that patients may require alongside with orthodontic treatment.

Chapter 7: Conclusion

Physical appearance has always been an important aspect of any individual's self-image, and it has a profound impact on the way in which this individual is perceived by surrounding people. Hence, since times immemorial, people have been trying to enhance their appearance and achieve better attractiveness to achieve their life goals such as having friends and active social life, finding a mate, and making a good career. Obviously, physical, especially facial, appearance is not everything that a person needs to succeed in life, and personal qualities of character as well as professional skills are also highly valued in various domains of human activity. Nevertheless, research has shown that attractive people tend to be perceived much more favorably than those with visible defects of physical appearance.

Because of such intense attention of the media and the society to physical attractiveness, the human self-image may be seriously damaged in case an individual has certain inborn or acquired flaws in appearance. Malocclusion is one of such aspects; there are many cases in which people are born with certain dental defects, and until recently, they have been analyzed and perceived only from a medical standpoint. That is, whether the degree of malocclusion presents any specific challenges for a person in eating, speaking, etc. Only recently, the in-depth and profound psychosocial impact of dental problems has come to be better understood. Unfortunately, people even with mild forms of malocclusion start experiencing serious psychological complexes about the defects of their appearance in childhood, which may be deepened and fuelled by negative peer comments, bullying, and parents' dissatisfaction with the child's appearance. Such experiences definitely result in the eroded self-image, low self-esteem, anxiety, depression, and social isolation, which exacerbate some other age-specific problems such as social performance of children.

Despite the common opinion about the degree of malocclusion having an effect on incidence of bullying, this study has shown that children with even the mildest forms of dental problems may experience bullying at school because of certain defects in their dental appearance. This research revealed that severity of malocclusion is not correlated with teeth bullying. Both peers and caregivers of a child with dental problems may become the source of stress and depression for a child who has not received any orthodontic treatment. Girls' experience an even greater pressure because of traditionally higher beauty demands for them posed both by parents and by the community. Furthermore, children may not be sincere with their parents about being bullied at school for their crooked teeth, so caregivers should carefully consider the indirect indicators of their children's psychosocial problems such as low self-esteem, low confidence, social isolation, problems with academic performance, having few friends, and others to initiate treatment and help their children restore normal social functioning.

In connection with these findings, the community should consider the psychosocial dimension of having aesthetic dental problems such as malocclusion more seriously, since such problems (no matter how insignificant they seem from a medical viewpoint) may produce a strong destructive impact on the child's well-being, thus affecting his or her quality of life in adulthood. It is vital to keep in mind that the ideal timing for orthodontic treatment is in the child's middle age from 11 to 15 years old, while treatment of malocclusion problems of adults is a much lengthier and more complicated task. Hence, it is the primary task of caregivers to consider the need for treatment objectively, not only through the prism of dental health but also from the viewpoint of aesthetic attractiveness of the child's appearance, and the child's subjective perceived need for orthodontic treatment.

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Appendices

Appendix A. Research Ethics Approval



UNIVERSITY
OF MANITOBA

BANNATYNE CAMPUS
Research Ethics Board

P126 - 770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Telephone 204-789-3255
Fax 204-789-3414

HEALTH RESEARCH ETHICS BOARD (HREB) CERTIFICATE OF FINAL APPROVAL FOR NEW STUDIES Delegated Review

PRINCIPAL INVESTIGATOR: Dr. O. Khatib	INSTITUTION/DEPARTMENT: UofM / Preventive Dental Science	ETHICS #: H2014:147
APPROVAL DATE: May 7, 2014	EXPIRY DATE: May 7, 2015	
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable): Dr. W. Wiltshire		

PROTOCOL NUMBER: NA	PROJECT OR PROTOCOL TITLE: Assessing the correlation between malocclusion and lowered psycho-social well-being
SPONSORING AGENCIES AND/OR COORDINATING GROUPS: NA	

Submission Date of Investigator Documents: April 7 and May 2, 2014	HREB Receipt Date of Documents: April 7 and May 2, 2014
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THE FOLLOWING ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
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Protocol:

Revised Proposal received May 2, 2014

Consent and Assent Form(s):

Parent/Guardian Information and Consent Form

May 2, 2014

Other:

Data Collection Sheet received May 2, 2014
Revised Parent/Caregiver Questionnaire received May 2, 2014
Patient Questionnaire received April 7, 2014
Clinical Exam Form received April 7, 2014
Winner congratulation email for incentive draws received April 7, 2014
Draw slip for ballot box received April 7, 2014

CERTIFICATION

The above named research study/project has been reviewed in a **delegated manner** by the University of Manitoba (UM) Health Research Board (HREB) and was found to be acceptable on ethical grounds for research involving human participants. The study/project and documents listed above was granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION

The University of Manitoba (UM) Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulations of Manitoba. In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

QUALITY ASSURANCE

The University of Manitoba Research Quality Management Office may request to review research documentation from this research study/project to demonstrate compliance with this approved protocol and the University of Manitoba Policy on the Ethics of Research Involving Humans.

CONDITIONS OF APPROVAL:

1. The study is acceptable on scientific and ethical grounds for the ethics of human use only. ***For logistics of performing the study, approval must be sought from the relevant institution(s).***
2. This research study/project is to be conducted by the local principal investigator listed on this certificate of approval.
3. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to the research study/project, and for ensuring that the authorized research is carried out according to governing law.
4. **This approval is valid until the expiry date noted on this certificate of approval. A Bannatyne Campus Annual Study Status Report** must be submitted to the HREB within 15-30 days of this expiry date.
5. Any changes of the protocol (including recruitment procedures, etc.), informed consent form(s) or documents must be reported to the HREB for consideration in advance of implementation of such changes on the **Bannatyne Campus Research Amendment Form**.
6. Adverse events and unanticipated problems must be reported to the HREB as per Bannatyne Campus Research Boards Standard Operating procedures.
7. The UM HREB must be notified regarding discontinuation or study/project closure on the **Bannatyne Campus Final Study Status Report**.

Sincerely,



- 2 -

Please quote the above Human Ethics Number on all correspondence.

Inquiries should be directed to the REB Secretary Telephone: (204) 789-3255/ Fax: (204) 789-3414

Appendix B. Amendment #1 Approval



UNIVERSITY
OF MANITOBA

BANNATYNE CAMPUS
Research Ethics Board

P126 - 770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Telephone 204-789-3255
Fax 204-789-3414

HEALTH RESEARCH ETHICS BOARD (HREB)

CERTIFICATE OF FINAL APPROVAL FOR AMENDMENTS AND ADDENDUMS

PRINCIPAL INVESTIGATOR: Dr. O. Khatib	INSTITUTION/DEPARTMENT: U of M/College of Dentistry/Preventive Dental Science	ETHICS #: H2014:147
HREB MEETING DATE (If applicable):		APPROVAL DATE: May 16, 2014
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable): Dr. W. Wiltshire		
PROTOCOL NUMBER: N/A	PROJECT OR PROTOCOL TITLE: Assessing the correlation between malocclusion and lowered psycho-social well-being	
SPONSORING AGENCIES AND/OR COORDINATING GROUPS: N/A		

REMINDER: THE CURRENT HREB APPROVAL FOR THIS STUDY EXPIRES:

REVIEW CATEGORY OF AMENDMENT:	Full Board Review ☐	Delegated Review ☒
Submission Date of Investigator Documents: May 2, 2014	HREB receipt date of Documents: May 15, 2014	

THE FOLLOWING AMENDMENT(S) and DOCUMENTS ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
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Protocol:

Amendment per report

May 13, 2014

Consent and Assent Form(s):

Other:

CERTIFICATION

The University of Manitoba (UM) Health Research Board (HREB) has reviewed the amendment to the research study/project named on this **Certificate of Approval** as per the category of review listed above and was found to be acceptable on ethical grounds for research involving human participants. The amendment and documents listed above were granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION

The University of Manitoba (UM) Health Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulation of Manitoba. In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

QUALITY ASSURANCE

The University of Manitoba Research Quality Management Office may request to review research documentation from this research study/project to demonstrate compliance with this approved protocol and the University of Manitoba Policy on the Ethics of Research Involving Humans.

CONDITIONS OF APPROVAL:

1. This amendment is acceptable on scientific and ethical grounds for the ethics of human use only. ***For logistics of performing the study, approval must be sought from the relevant institution(s).***
2. This research study/project is to be conducted by the local principal investigator listed on this certificate of approval.
3. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to the research study/project, and for ensuring that the authorized research is carried out according to governing law.
4. **This approval is valid until the expiry date noted on this certificate of approval. A Bannatyne Campus Annual Study Status Report** must be submitted to the HREB within 15-30 days of this expiry date.
5. Any changes of the protocol (including recruitment procedures, etc.), informed consent form(s) or documents must be reported to the HREB for consideration in advance of implementation of such changes on the **Bannatyne Campus Research Amendment Form**.
6. Adverse events and unanticipated problems must be reported to the HREB as per Bannatyne Campus Research Boards Standard Operating procedures.
7. The UM HREB must be notified regarding discontinuation or study/project closure on the **Bannatyne Campus Final Study Status Report**.

Sincerely,



Please quote the above Human Ethics Number on all correspondence.

Inquiries should be directed to the REB Secretary Telephone: (204) 789-3255/ Fax: (204) 789-3414

Appendix C. Amendment #2 Approval



UNIVERSITY
OF MANITOBA

BANNATYNE CAMPUS
Research Ethics Board

P126 - 770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Telephone 204-789-3255
Fax 204-789-3414

HEALTH RESEARCH ETHICS BOARD (HREB)

CERTIFICATE OF FINAL APPROVAL FOR AMENDMENTS AND ADDENDUMS

PRINCIPAL INVESTIGATOR: Dr. O. Khatib	INSTITUTION/DEPARTMENT: UofM/Preventive Dental Science	ETHICS #: H2014:147
HREB MEETING DATE (If applicable):		APPROVAL DATE: August 21, 2014
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable): Dr. W. Wiltshire		
PROTOCOL NUMBER: NA	PROJECT OR PROTOCOL TITLE: Assessing the correlation between malocclusion and lowered psycho-social well-being	
SPONSORING AGENCIES AND/OR COORDINATING GROUPS: NA		

REMINDER: THE CURRENT HREB APPROVAL FOR THIS STUDY EXPIRES: May 7, 2015

REVIEW CATEGORY OF AMENDMENT:	Full Board Review ☐	Delegated Review ☒
Submission Date of Investigator Documents: August 19, 2014	HREB receipt date of Documents: August 19, 2014	

THE FOLLOWING AMENDMENT(S) and DOCUMENTS ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
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Protocol:

Change in Age Group per Amendment Report

08/19/2014

Consent and Assent Form(s):

Other:

CERTIFICATION

The University of Manitoba (UM) Health Research Board (HREB) has reviewed the amendment to the research study/project named on this **Certificate of Approval** as per the category of review listed above and was found to be acceptable on ethical grounds for research involving human participants. The amendment and documents listed above were granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION

The University of Manitoba (UM) Health Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulation of Manitoba. In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

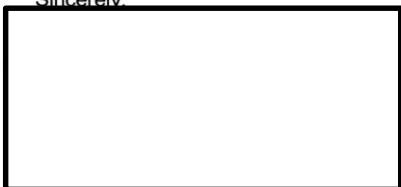
QUALITY ASSURANCE

The University of Manitoba Research Quality Management Office may request to review research documentation from this research study/project to demonstrate compliance with this approved protocol and the University of Manitoba Policy on the Ethics of Research Involving Humans.

CONDITIONS OF APPROVAL:

1. This amendment is acceptable on scientific and ethical grounds for the ethics of human use only. ***For logistics of performing the study, approval must be sought from the relevant institution(s).***
2. This research study/project is to be conducted by the local principal investigator listed on this certificate of approval.
3. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to the research study/project, and for ensuring that the authorized research is carried out according to governing law.
4. **This approval is valid until the expiry date noted on this certificate of approval. A Bannatyne Campus Annual Study Status Report** must be submitted to the HREB within 15-30 days of this expiry date.
5. Any changes of the protocol (including recruitment procedures, etc.), informed consent form(s) or documents must be reported to the HREB for consideration in advance of implementation of such changes on the **Bannatyne Campus Research Amendment Form**.
6. Adverse events and unanticipated problems must be reported to the HREB as per Bannatyne Campus Research Boards Standard Operating procedures.
7. The UM HREB must be notified regarding discontinuation or study/project closure on the **Bannatyne Campus Final Study Status Report**.

Sincerely,



Please quote the above Human Ethics Number on all correspondence.

Inquiries should be directed to the REB Secretary Telephone: (204) 789-3255/ Fax: (204) 789-3414

Appendix D. Parent Information and Informed Consent

DR. OMAR KHATIB

PARENT/GUARDIAN INFORMATION AND CONSENT
FORM

Title of Study: "Assessing the correlation between malocclusion and lowered psycho-social well-being"

Principal Investigator: Dr. Omar Khatib
Faculty of Dentistry, 780 Bannatyne Avenue,
Winnipeg, Manitoba, R3E 0W2. Telephone: (204) 557-3312.

Co-Investigator: Dr. William Wiltshire
Faculty of Dentistry, 780 Bannatyne Avenue,
Winnipeg, Manitoba, R3E 0W2. Telephone: (204) 789-3865.

Dear Parent or Guardian,

We kindly ask that you and your child participate in a study regarding the development of a questionnaire to assess the psycho-social factors that influence a patient's desire to seek orthodontic treatment. Please take your time to review this information form, and feel free to consult with or discuss this study with your dentist, colleagues, family, friends, and/or physician before deciding whether or not to participate. If you have any questions regarding the study or any related issues we encourage you to ask the principal investigator or co-investigator, as listed above. This consent form may contain words that you do not understand. Please ask the research staff to explain any words or information you do not clearly understand.

Purpose of the study

This study is being conducted at the University of Manitoba, Graduate orthodontic clinic, to understand better the psycho-social factors that influence a patient's desire to seek orthodontic treatment. The goal is to develop a simple questionnaire for parents and their children to answer, then determine if there is a correlation between each individual question and the questionnaire as a whole, and if the questionnaire correlates with the child's present malocclusion, as determined by the severity of crowding of teeth and other facial characteristics. A total of approximately 85 participants will participate in this study.

Study procedures

If you choose to take part in this study, the following procedures will happen: during your child's screening examination appointment, you will be asked to fill in the questionnaire if you agree and sign this consent. After your child has finished his/her screening appointment, he/she will be asked also to fill out the questionnaire. The clinical data collected for the purpose of this study will be based on the data collected during your child's screening examination appointment. The screening examination appointment will resemble the University of Manitoba's routine screening examination. Subsequently,

TELEPHONE: (204) 557-3312 EMAIL: khatiboo@myumanitoba.ca

ADDRESS: Faculty of Dentistry, 780 Bannatyne Avenue, Winnipeg, Manitoba, R3E 0W2.

"Assessing the correlation between malocclusion and lowered psycho-social well-being"
- Consent Form

results will then be linked to the individual questionnaire responses via codes given specifically to each participant. Although the results of the questionnaire will be linked to the clinical data collected, the assignment of the codes and the exclusion of personal information will protect the anonymity of the participant. In addition, this will NOT affect the other procedures that may or may not be performed during your child's routine examination, which may include oral hygiene instructions.

You will be asked to fill out a 26-question survey and your child will also be asked to fill out a 23-question survey. The answers are kept anonymous as each form is identified with a number instead of your name.

No treatment will be provided to, or denied from, your child as a result of your participation in this study. You may stop participating in this study at any time. However, if you decide to stop participating, we encourage you to talk to the research staff first.

Participation in the study is anonymous and voluntary. Results will be used to improve our understanding of children's desire to seek orthodontic treatment.

Risks and discomforts

There are no recognized physical risks or discomforts that may be caused to you or your child by participation in the study. However, there may be some emotional discomfort related to answering questions about g and self-esteem.

Benefits

There may or may not be a direct benefit to you and your child from participating in this study. We hope the information we learn from conducting this study will help orthodontists better understand the psycho-social factors that influence a patient's desire to seek orthodontic treatment, and that this will consequently help our profession aid parents in providing the best possible treatment for your children.

Cost

There is no cost to you for participating in the study.

Payment for participation

Incentives prizes will be offered to elicit survey participation. Prizes will include a PC tablet and gift cards. Responders of the questionnaires will be asked to provide an email address if they wish to participate in the draws. A random selection of the winners will be conducted and winners will be contacted via email. Participants will be asked to fill out a ballot to provide contact information after completion if they wish to participate in the draws. The ballots will be locked in a black box until the draw, which will be held on June 1st 2015 in Winnipeg, Manitoba. . If the prizes are not claimed within 7 days, a substitute winner will be selected; once all prizes are claimed, the ballot will be destroyed.

Alternatives

You should feel no obligation to participate in the study.

Confidentiality

All information obtained from this study is confidential and will remain so. It will not be distributed in any way. Information gathered in this study may be published or presented in public forums, however your name and other identifying information will not be used or revealed. In any published data, your identity (and your child's) will be protected and treated as confidential according to the Personal Health Information Act of Manitoba. To protect your identity, every participant will be given a Study Number instead of their name in all documents related to the study. All information obtained from this study will be used strictly for research purposes only.

The University of Manitoba Health Research Ethics Board may review study records for purposes of quality assurance only. Despite efforts to keep your personal information confidential, absolute confidentiality cannot be guaranteed. Your personal information may be disclosed if required by law.

All records relating to this study will kept in a secure, locked area and only those persons identified will have access to these records. If any of your medical/research records need to be copied to any of the above, your name and all identifying information will be removed. No information revealing any personal information such as your name, address or telephone number will leave the University of Manitoba.

Voluntary participation / withdrawal from the study

Your decision to participate in the study is voluntary. You may refuse to participate in the study or withdraw from it at any point in time. Whichever your decision is, it will remain confidential. Your decision not to participate or to withdraw from the study will not affect your child's care or health. If the research staff feels that it is in your best interest to withdraw you from the study, they will remove you without your consent.

We will tell you about any new information that may affect your health, welfare, or willingness to stay in this study.

Questions

Please feel free to ask questions regarding the study or anything related to it that requires further clarification. To contact the research staff regarding a question, please call Dr. O. Khatib at (204) 557-3312 or Dr. W. Wiltshire at (204) 789-3865.

"Assessing the correlation between malocclusion and lowered psycho-social well-being"
- Consent Form

For questions about your rights as a research participant, you may contact the University of Manitoba, Bannatyne Campus Research Ethics Board Office at (204) 789-3389.

Do not sign this consent form unless you have had a chance to ask questions and have received satisfactory answers to all of your questions.

Statement of consent

I have read this consent form. I have had the opportunity to discuss this study with Dr. O. Khatib and/or his research staff. I have had my questions answered in a language I understand. All risks, benefits, costs, and alternatives regarding this study have been thoroughly explained to me. I believe that I have not been unduly influenced by any research team member to participate in the study by any statements or implied statements. Any relationship I may have with the research team has not affected my decision to participate. I understand I will be given a copy of this consent form after signing it. I understand my participation in the study is voluntary and I may choose to withdraw from it at any point in time. I freely agree to participate in this research study and I give consent for my child to participate in the research study as well.

I understand that any information regarding my personal identity, and my child's identity, will be kept confidential, but that confidentiality cannot be guaranteed. I authorize the inspection of any of my records related to this study by the University of Manitoba Health Research Ethics Board for quality assurance purposes.

By signing this consent form I have not waived any of the legal rights that I have as a participant in a research study.

Parent/legal guardian's signature: _____ Date: _____
(day/month/year)

Parent/legal guardian's printed name: _____

I, the undersigned, attest that the information in the participant Information and Consent Form was accurately explained to, and apparently understood by, the participant or the participant's legally acceptable representative and that the consent to participate in this study was freely given by the participant or the participant's legally acceptable representative.

Witness signature: _____ Date: _____
(day/month/year)

Witness printed name: _____

Appendix E. Incentive Prizes – Email Slip

Thank you for participating in the questionnaire! Kindly write your email below if you wish to participate in the draw. Prizes will include a PC tablet and other gift cards.

Email address: _____

Appendix F. Winner's Email

Dear,

First, I would like to thank you for participating in the questionnaire conducted the graduate orthodontic clinic at the University of Manitoba, I would also like to inform you that you are the winner of the draw! Congratulations on winning a _____.

In order to claim your prize, kindly come to the graduate orthodontic clinic at the University of Manitoba within 7 days. If you do not claim your prize within 7 days of the date on this email, you will be disqualified and the draw will be repeated.

Thanks again,

Dr. O. Khatib

Appendix G. Clinical Examination Form

Clinical Exam		
1. Patient code 		
2. Gender ☐ Male ☐ Female		
3. Age 		
4. Date of Birth (MM/DD/YYYY) 		
5. Ethnicity ☐ Asian ☐ Black ☐ Caucasian ☐ East Indian ☐ First Nation ☐ Hispanic ☐ Metis ☐ Other: _____		
6. Body Height 		
7. Body weight 		
8. Facial Type: ☐ Mesognathic ☐ Retrognathic ☐ Prognathic		
9. Profile Type: ☐ Straight ☐ Convex ☐ Concave		
10. Facial asymmetry: ☐ Present ☐ Absent		
11. Nose size ☐ Average ☐ Prominent ☐ Small		
12. Upper lip: ☐ Average ☐ Protruded ☐ Retruded		
13. Lower lip: ☐ Average ☐ Protruded ☐ Retruded		

14. Interlabial gap (>4mm)

☐ Present

☐ Absent

15. Upper arch crowding

☐ Mild (1-4 mm)

☐ Moderate (4-7 mm)

☐ Severe (>7 mm)

16. Lower arch crowding

☐ Mild (1-4 mm)

☐ Moderate (4-7 mm)

☐ Severe (>7 mm)

17. Midline diastema

☐ Present

☐ Absent

18. Overjet

☐ Negative

☐ Edge-edge

☐ Normal (1-2 mm)

☐ Mild (2-4 mm)

☐ Moderate (4-6 mm)

☐ Severe (>6 mm)

19. Overbite:

☐ Normal (10-20%)

☐ Mild (20-50%)

☐ Moderate (50-80%)

☐ Severe - impinging (100%)

☐ Open bite

20. Anterior crossbite (2 teeth or more)

☐ Present

☐ Absent

21. Posterior crossbite (2 teeth or more)

☐ Present

☐ Absent

22. Smile line

☐ Average

☐ High/Gummy

☐ Low

23. IOTN DHC

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

24. IOTN AC

☐ 1

☐ 2

☐ 3

Appendix H. Patient Self-Assessment Questionnaire

Patient Questionnaire					
1. Patient code					
2. Age					
3. Date of Birth (MM/DD/YYYY)					
4. Are you male or female?					
☐ Male					
☐ Female					
5. Which of the following statements describe why you came to the orthodontic clinic? (you may select more than one answer)					
☐ I have crooked teeth					
☐ I want to correct my appearance					
☐ I have difficulties speaking or eating					
☐ My classmates laugh at my crooked teeth					
☐ I have been referred by my dentist					
☐ My parents wanted me to visit the orthodontist					
6. How satisfied are you regarding your:					
	Very satisfied	Satisfied	Dissatisfied	Very dissatisfied	I don't care
Height	☐	☐	☐	☐	☐
Weight	☐	☐	☐	☐	☐
Strength	☐	☐	☐	☐	☐
Hair	☐	☐	☐	☐	☐
Eyes	☐	☐	☐	☐	☐
Nose	☐	☐	☐	☐	☐
Ears	☐	☐	☐	☐	☐
Lips	☐	☐	☐	☐	☐
Jaws	☐	☐	☐	☐	☐
Chin	☐	☐	☐	☐	☐
Teeth	☐	☐	☐	☐	☐

7. On a scale from 1-5, how crowded do you think your teeth are? (1 being minimal crowding, 5 being severe crowding)

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

8. Compared to your face in general, do you find your teeth to be:

- ☐ The most attractive
☐ Attractive
☐ Like the rest of my face
☐ Less attractive
☐ The least attractive

9. Do you find that your teeth look better or worse than those of your classmates?

- ☐ Much better
☐ Somewhat better
☐ Like most of the others
☐ Somewhat worse
☐ Much worse

10. Have you ever been bullied or teased about your:

	Yes	No
Height	☐	☐
Weight	☐	☐
Strength	☐	☐
Hair	☐	☐
Eyes	☐	☐
Nose	☐	☐
Ears	☐	☐
Lips	☐	☐
Jaws	☐	☐
Chin	☐	☐
Teeth	☐	☐

11. If you answered YES to being bullied or teased about your teeth, chin, jaws or lips, please select which items on the following list you have been bullied about: (you may select more than one answer)

	YES	NO
Top front teeth are sticking out	☐	☐
Bottom front teeth are sticking out	☐	☐
Chin is sticking out	☐	☐
Chin is too far back	☐	☐
Crooked teeth	☐	☐
Shape or color of teeth	☐	☐
Having a gap between the top front teeth	☐	☐
Top teeth not covering your bottom teeth	☐	☐
Showing too much gums when you smile	☐	☐
Being unable to close your lips comfortably	☐	☐

12. Please answer by YES or NO:

	YES	NO
Do you have a nickname in school as a result of being bullied or teased about your teeth?	☐	☐
Have you ever been physically bullied?	☐	☐
Have you parents said anything about your teeth?	☐	☐
Do you hide your teeth when you smile?	☐	☐
Do you think having straight teeth will give you more confidence?	☐	☐
Do you think having straight teeth will improve how you feel about yourself being in public?	☐	☐
Do you think having straight teeth will improve your school performance?	☐	☐
Do you think having straight teeth will increase your chances of success in life?	☐	☐

13. Do you bully or tease any of your classmates about the appearance of his/her teeth?

- ☐ Yes, often
- ☐ Yes, occasionally
- ☐ Yes, rarely
- ☐ No, never

Appendix I. Caregiver Assessment Questionnaire

Parent/Caregiver Questionnaire	
1. Patient code 	
2. Are you: ☐ Parent ☐ Guardian ☐ Other: _____	
3. What is your highest level of education? ☐ Up to Grade 8 ☐ Up to Grade 12 ☐ High School Diploma ☐ Some College ☐ College Diploma ☐ Some University ☐ Undergrad Degree ☐ Graduate Degree	
4. What is your annual household income (in thousands) before tax? (to help us know who we are serving) ☐ 0-25\$ ☐ \$26-35 ☐ \$36-45 ☐ \$46-55 ☐ \$56-65 ☐ \$66-75 ☐ \$76-80 ☐ \$81+ ☐ I refuse to answer	
5. Ethnicity: I identify my child as: ☐ Asian ☐ Black ☐ Caucasian ☐ East Indian ☐ First Nation ☐ Hispanic ☐ Metis ☐ Other: _____	
6. What is the reason(s) you seek Orthodontic treatment for your child? (you may select more than one answer) ☐ He/she has crooked teeth ☐ He/she wants to correct his/her appearance ☐ He/she has difficulties speaking or eating ☐ His/her classmates laugh at his/her crooked teeth ☐ He/she has been referred by the dentist ☐ You wanted your child to visit the orthodontist	

7. How satisfied are you regarding your child's:

	Very satisfied	Satisfied	Dissatisfied	Very dissatisfied	I don't care
Height	☐	☐	☐	☐	☐
Weight	☐	☐	☐	☐	☐
Strength	☐	☐	☐	☐	☐
Hair	☐	☐	☐	☐	☐
Eyes	☐	☐	☐	☐	☐
Nose	☐	☐	☐	☐	☐
Ears	☐	☐	☐	☐	☐
Lips	☐	☐	☐	☐	☐
Jaws	☐	☐	☐	☐	☐
Chin	☐	☐	☐	☐	☐
Teeth	☐	☐	☐	☐	☐

8. On a scale from 1-5, how crowded do you think your child's teeth are? (1 being minimal crowding, 5 being severe crowding)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. Do you find that your child's teeth look better or worse than those of his/her classmates?

☐ Much better

☐ Somewhat better

☐ Like most of the others

☐ Somewhat worse

☐ Much worse

10. Has your child ever been bullied or teased about his/her:

	Yes	No
Height	☐	☐
Weight	☐	☐
Strength	☐	☐
Hair	☐	☐
Eyes	☐	☐
Nose	☐	☐
Ears	☐	☐
Lips	☐	☐
Jaws	☐	☐
Chin	☐	☐
Teeth	☐	☐

11. If you answered YES to your child being bullied or teased about his/her teeth, chin, jaws or lips, please select which items on the following list he/she has been bullied about: (you may select more than one answer)

	YES	NO
Top front teeth are sticking out	☐	☐
Bottom front teeth are sticking out	☐	☐
Chin is sticking out	☐	☐
Chin is too far back	☐	☐
Crooked teeth	☐	☐
Shape or color of teeth	☐	☐
Having a gap between their top front teeth	☐	☐
Top teeth not covering bottom teeth	☐	☐
Showing too much gums when they smile	☐	☐
Being unable to close lips comfortably	☐	☐

12. Please answer by YES or NO:

	YES	NO
Have you ever commented to your child about the appearance of his/her teeth?	☐	☐
Does your child have a nickname in school as a result of being bullied or teased about his/her teeth?	☐	☐
Has your child ever been physically bullied?	☐	☐
Does your child hide his/her teeth when he/she smiles?	☐	☐
Do you think having straight teeth will give your child more confidence?	☐	☐
Do you think having straight teeth will improve how your child feels about him/herself being in public?	☐	☐
Do you think having straight teeth will improve your child's school performance?	☐	☐
Do you think having straight teeth will increase your child's chances of success in life?	☐	☐

13. On a scale from 1 to 5 (1 being poor, 5 being excellent), how would rate your child's academic performance in school?

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

14. On a scale from 1 to 5 (1 being poor, 5 being excellent), how would rate your child's social performance in school?

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

15. Does your child bully or tease any of his/her classmates about the appearance of his/her teeth?

- ☐ Yes, often
☐ Yes, occasionally
☐ Yes, rarely
☐ No, never

Appendix J. Index of Orthodontic Treatment Need Dental Health Component (IOTN DHC). Proffit et al., 2007.

INDEX OF TREATMENT NEEDS (IOTN) TREATMENT GRADES	
Grade 5 (Extreme/Need Treatment)	
5.i	Impeded eruption of teeth (except third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathologic cause.
5.h	Extensive hypodontia with restorative implications (more than one tooth per quadrant) requiring preprosthetic orthodontics.
5.a	Increased overjet greater than 9 mm.
5.m	Reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties.
5.p	Defects of cleft lip and palate and other craniofacial anomalies.
5.s	Submerged deciduous teeth.
Grade 4 (Severe/Need Treatment)	
4.h	Less extensive hypodontia requiring prerestorative orthodontics or orthodontic space closure (one tooth per quadrant).
4.a	Increased overjet greater than 6 mm but less than or equal to 9 mm.
4.b	Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties.
4.m	Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory or speech difficulties.
4.c	Anterior or posterior crossbites with greater than 2 mm discrepancy between retruded contact position and intercuspal position.
4.l	Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments.
4.d	Severe contact point displacements greater than 4 mm.
4.e	Extreme lateral or anterior open bites greater than 4 mm.
4.f	Increased and complete overbite with gingival or palatal trauma.
4.t	Partially erupted teeth, tipped, and impacted against adjacent teeth.
4.x	Presence of supernumerary teeth.
Grade 3 (Moderate/Borderline Need)	
3.a	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips.
3.b	Reverse overjet greater than 1 mm but less than or equal to 3.5 mm.
3.c	Anterior or posterior crossbites with greater than 1 mm but less than or equal to 2 mm discrepancy between retruded contact position and intercuspal position.
3.d	Contact point displacements greater than 2 mm but less than or equal to 4 mm.
3.e	Lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm.
3.f	Deep overbite complete on gingival or palatal tissues but no trauma.
Grade 2 (Mild/Little Need)	
2.a	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with competent lips.
2.b	Reverse overjet greater than 0 mm but less than or equal to 1 mm.
2.c	Anterior or posterior crossbite with less than or equal to 1 mm discrepancy between retruded contact position and intercuspal position.
2.d	Contact point displacements greater than 1 mm but less than or equal to 2 mm.
2.e	Anterior or posterior open bite greater than 1 mm but less than or equal to 2 mm.
2.f	Increased overbite greater than or equal to 3.5 mm without gingival contact.
2.g	Prenormal or postnormal occlusions with no other anomalies.
Grade 1 (No Need)	
1.	Extremely minor malocclusions, including contact point displacements less than 1 mm.

Appendix K. The Aesthetic Component (AC) of the IOTN. Proffit et al., 2007.



FIGURE 1-19 The stimulus photographs of the IOTN esthetic index. The score is derived from the patient's answer to "Here is a set of photographs showing a range of dental attractiveness. Number 1 is the most attractive and number 10 the least attractive arrangement. Where would you put your teeth on this scale?" Grades 8 to 10 indicate definite need for orthodontic treatment, 5 to 7 moderate/borderline need, 1 to 4 no/slight need.

Appendix L. Correlation Tables.

Child satisfaction index and caregiver satisfaction index.

Correlations

		ChildSatisfac tionIndex	ParentSatisfac tionIndex
ChildSatisfactionInd ex	Pearson Correlation	1	.995**
	Sig. (2-tailed)		.000
	N	86	86
ParentSatisfactionInd ex	Pearson Correlation	.995**	1
	Sig. (2-tailed)	.000	
	N	86	86

Child's Satisfaction with Teeth + IOTN dental health grade.

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0		
	P_q1	C_q1
P_q1	1.00000	0.03640

P_q1		0.7394
C_q1	0.03640	1.00000
C_q1	0.7394	

Child's Satisfaction with Teeth + IOTN Aesthetic Component Grade

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0		
	P_q2	C_q2
P_q2	1.00000	-0.01661
P_q2		0.8793
C_q2	-0.01661	1.00000
C_q2	0.8793	

Caregiver's Satisfaction with teeth + IOTN dental health grade

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0		
	p_Q3	C_Q3

p_Q3	1.00000	0.15486
p_Q3		0.1545
C_Q3	0.15486	1.00000
C_Q3	0.1545	

Caregiver's Satisfaction with teeth + Aesthetic Component Grade

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0		
	p_q4	C_q4
p_q4	1.00000	0.22657
p_q4		0.0359
C_q4	0.22657	1.00000
C_q4	0.0359	

Caregiver's Satisfaction with teeth/Chin/jaws/lips + Income

			Q7KSatisfactionre gardingChildsTeet h_P	Income in thousands before tax	Q7HSatisfactionre gardingChildsLips _P	Q7JSatisfactionre gardingChildsChin _P	Q7ISatisfactionreg ardingChildsJaws _P
Spearman's rho	Q7KSatisfactionregardingChild sTeeth_P	Correlation Coefficient	1.000	-.063	.306**	.347**	.379**
		Sig. (2-tailed)	.	.567	.004	.001	.000
		N	86	86	86	86	86
	Income in thousands before tax	Correlation Coefficient	-.063	1.000	-.021	.007	-.043
		Sig. (2-tailed)	.567	.	.846	.952	.692
		N	86	86	86	86	86
	Q7HSatisfactionregardingChild sLips_P	Correlation Coefficient	.306**	-.021	1.000	.839**	.732**
		Sig. (2-tailed)	.004	.846	.	.000	.000
		N	86	86	86	86	86
	Q7JSatisfactionregardingChilds Chin_P	Correlation Coefficient	.347**	.007	.839**	1.000	.802**
		Sig. (2-tailed)	.001	.952	.000	.	.000
		N	86	86	86	86	86
	Q7ISatisfactionregardingChilds Jaws_P	Correlation Coefficient	.379**	-.043	.732**	.802**	1.000
		Sig. (2-tailed)	.000	.692	.000	.000	.
		N	86	86	86	86	86

Caregivers' motivation to seek orthodontic treatment + Income

Pearson Correlation Coefficients, N = 86 Prob > |r| under H0: Rho=0

	p_q5_income	p_q5a	p_q5b
p_q5_income Q4AnnualHouseholdIncome	1.00000	0.08756 0.4227	-0.10244 0.3480
p_q5a Q6AReasonforseekingOrthodonticTreatmentCrookedTeeth	0.08756 0.4227	1.00000	0.16601 0.1266
p_q5b Q6BReasonforseekingOrthodonticTreatmentCorrectAppearance	-0.10244 0.3480	0.16601 0.1266	1.00000
p_q5c Q6CReasonforseekingOrthodonticTreatmentDifficultySpeaking	-0.02290 0.8343	0.29524 0.0058	-0.06675 0.5414
p_q5d Q6DReasonforseekingOrthodonticTreatmentClassmateslaughatteeeth	-0.07056 0.5185	0.05902 0.5893	-0.00818 0.9404
p_q5e Q6EReasonforseekingOrthodonticTreatmentReferredbyaDentist	-0.02521 0.8178	-0.04042 0.7117	-0.19045 0.0790
p_q5f Q6FReasonforseekingOrthodonticTreatmentParent	0.04527 0.6789	0.29557 0.0057	0.19997 0.0649

Pearson Correlation Coefficients, N = 86 Prob > |r| under H0: Rho=0

	p_q5c	p_q5d	p_q5e	p_q5f
p_q5_income Q4AnnualHouseholdIncome	-0.02290 0.8343	-0.07056 0.5185	-0.02521 0.8178	0.04527 0.6789
p_q5a Q6AReasonfor seekingOrthodonticTreatment CrookedTeeth	0.29524 0.0058	0.05902 0.5893	-0.04042 0.7117	0.29557 0.0057
p_q5b Q6BReasonfor seekingOrthodonticTreatment CorrectAppearance	-0.06675 0.5414	-0.00818 0.9404	-0.19045 0.0790	0.19997 0.0649
p_q5c Q6CReasonfor seekingOrthodonticTreatment DifficultySpeaking	1.00000	0.03135 0.7745	0.09360 0.3914	0.25148 0.0195

p_q5d Q6DReasonfor seekingOrthod onticTreatment Classmateslaug hatteeth	0.03135 0.7745	1.00000	-0.07250 0.5071	0.01377 0.8998
p_q5e Q6EReasonfor seekingOrthod onticTreatment ReferredbyaDe ntist	0.09360 0.3914	-0.07250 0.5071	1.00000	0.07875 0.4711
p_q5f Q6FReasonfor seekingOrthod onticTreatment Parent	0.25148 0.0195	0.01377 0.8998	0.07875 0.4711	1.00000

Caregiver's Motivation to seek orthodontic treatment + Child's Motivation to seek orthodontic treatment

- Crooked teeth

Test of H0: Gamma = 0	
ASE under H0	0.2407
Z	2.8972
One-sided Pr > Z	0.0019
Two-sided Pr > Z	0.0038

- Correct appearance

Test of H0: Gamma = 0	
ASE under H0	0.2115
Z	1.8763
One-sided Pr > Z	0.0303
Two-sided Pr > Z	0.0606

- Difficulty speaking/eating

Test of H0: Gamma = 0	
ASE under H0	0.5190
Z	1.6709
One-sided Pr > Z	0.0474
Two-sided Pr > Z	0.0947

- Classmates laugh at teeth

Test of H0: Gamma = 0	
ASE under H0	0.8442
Z	0.8461
One-sided Pr > Z	0.1987
Two-sided Pr > Z	0.3975

- Referred by dentist

Test of H0: Gamma = 0	
ASE under H0	0.1729
Z	3.9082
One-sided Pr > Z	<.0001
Two-sided Pr > Z	<.0001

- Parents

Test of H0: Gamma = 0	
ASE under H0	0.2523
Z	1.5687
One-sided Pr > Z	0.0584
Two-sided Pr > Z	0.1167

Gender + Being bullied about teeth.

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0		
	Sex	P_q7
Sex	1.00000	-0.06932
Sex		0.5259
P_q7	-0.06932	1.00000
Q10KBulliedorteasedaboutTeeth	0.5259	

IOTN DHC + IOTN AC + being bullied about teeth.

Pearson Correlation Coefficients, N = 86 Prob > r under H0: Rho=0			
	pt_q19	c_q19a	c_q19b
pt_q19	1.00000	-0.05812	0.03411
pt_q19: Patients: Bullied about teeth		0.5950	0.7552
c_q19a	-0.05812	1.00000	0.84834
	0.5950		<.0001

c_q19a: Clinical: IOTN DHC			
c_q19b c_q19b: Clinical: IOTN AC	0.03411 0.7552	0.84834 <.0001	1.00000

Male/female satisfaction factors comparison.

- Height

Statistic	DF	Value	Prob
Chi-Square	1	0.8705	0.3508
Likelihood Ratio Chi-Square	1	0.8439	0.3583
Continuity Adj. Chi-Square	1	0.3388	0.5605
Mantel-Haenszel Chi-Square	1	0.8595	0.3539
Phi Coefficient		0.1050	
Contingency Coefficient		0.1044	

Cramer's V		0.1050	

- Weight

Statistic	D F	Value	Prob
Chi-Square	1	2.7256	0.0988
Likelihood Ratio Chi-Square	1	2.9569	0.0855
Continuity Adj. Chi-Square	1	1.8541	0.1733
Mantel-Haenszel Chi-Square	1	2.6923	0.1008
Phi Coefficient		-0.1823	
Contingency Coefficient		0.1794	

Cramer's V		- 0.182 3	
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- Strength

Statistic	DF	Value	Prob
Chi-Square	1	0.2573	0.6120
Likelihood Ratio Chi-Square	1	0.2620	0.6088
Continuity Adj. Chi-Square	1	0.0470	0.8283
Mantel-Haenszel Chi-Square	1	0.2541	0.6142
Phi Coefficient		-0.0571	
Contingency Coefficient		0.0570	
Cramer's V		-0.0571	

- Hair

Statistic	DF	Value	Prob
Chi-Square	1	0.0552	0.8142
Likelihood Ratio Chi-Square	1	0.0559	0.8131
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0546	0.8153
Phi Coefficient		-0.0256	
Contingency Coefficient		0.0256	
Cramer's V		-0.0256	

- Eyes

Statistic	DF	Value	Prob
Chi-Square	1	0.6313	0.4269

Likelihood Ratio Chi-Square	1	0.6892	0.4064
Continuity Adj. Chi-Square	1	0.0995	0.7524
Mantel-Haenszel Chi-Square	1	0.6236	0.4297
Phi Coefficient		-0.0877	
Contingency Coefficient		0.0874	
Cramer's V		-0.0877	

- Nose

Statistic	DF	Value	Prob
Chi-Square	1	0.2874	0.5919
Likelihood Ratio Chi-Square	1	0.2954	0.5868
Continuity Adj. Chi-Square	1	0.0347	0.8522

Mantel-Haenszel Chi-Square	1	0.2837	0.5943
Phi Coefficient		-0.0611	
Contingency Coefficient		0.0610	
Cramer's V		-0.0611	

- Ears

Statistic	DF	Value	Prob
Chi-Square	1	0.3328	0.5640
Likelihood Ratio Chi-Square	1	0.3525	0.5527
Continuity Adj. Chi-Square	1	0.0024	0.9607
Mantel-Haenszel Chi-Square	1	0.3283	0.5666
Phi Coefficient		-0.0666	

Contingency Coefficient		0.0665	
Cramer's V		-0.0666	

- Lips

Statistic	DF	Value	Prob
Chi-Square	1	0.5926	0.4414
Likelihood Ratio Chi-Square	1	0.5759	0.4479
Continuity Adj. Chi-Square	1	0.1481	0.7003
Mantel-Haenszel Chi-Square	1	0.5852	0.4443
Phi Coefficient		0.0861	
Contingency Coefficient		0.0857	
Cramer's V		0.0861	

- Jaws

Statistic	DF	Value	Prob
Chi-Square	1	1.0858	0.2974
Likelihood Ratio Chi-Square	1	1.1420	0.2852
Continuity Adj. Chi-Square	1	0.5177	0.4718
Mantel-Haenszel Chi-Square	1	1.0719	0.3005
Phi Coefficient		-0.1180	
Contingency Coefficient		0.1172	
Cramer's V		-0.1180	

- Chin

Statistic	DF	Value	Prob
Chi-Square	1	0.0080	0.9287

Likelihood Ratio Chi-Square	1	0.0080	0.9285
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0079	0.9291
Phi Coefficient		-0.0102	
Contingency Coefficient		0.0102	
Cramer's V		-0.0102	

- Teeth

Statistic	DF	Value	Prob
Chi-Square	1	3.5773	0.0586
Likelihood Ratio Chi-Square	1	3.4711	0.0624
Continuity Adj. Chi-Square	1	2.6063	0.1064

Mantel-Haenszel Chi-Square	1	3.5337	0.0601
Phi Coefficient		-0.2089	
Contingency Coefficient		0.2045	
Cramer's V		-0.2089	

Patient/caregiver bullying reports' comparison.

- Height

Test of H0: Gamma = 0	
ASE under H0	0.3547
Z	2.5026
One-sided Pr > Z	0.0062
Two-sided Pr > Z	0.0123

- Weight

Test of H0: Gamma = 0	
ASE under H0	0.2284
Z	4.2234
One-sided Pr > Z	<.0001
Two-sided Pr > Z	<.0001

- Strength

Test of H0: Gamma = 0	
ASE under H0	0.4997
Z	1.5420
One-sided Pr > Z	0.0615
Two-sided Pr >	0.1231

Z	
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- Hair

Test of H0: Gamma = 0	
ASE under H0	0.5434
Z	1.8099
One-sided Pr > Z	0.0352
Two-sided Pr > Z	0.0703

- Eyes

Test of H0: Gamma = 0	
ASE under H0	0.9002
Z	0.9066

One-sided Pr > Z	0.1823
Two-sided Pr > Z	0.3646

- Nose

Test of H0: Gamma = 0	
ASE under H0	0.9399
Z	0.9638
One-sided Pr > Z	0.1676
Two-sided Pr > Z	0.3351

- Ears

Test of H0: Gamma = 0

ASE under H0	0.6681
Z	1.4238
One-sided Pr > Z	0.0772
Two-sided Pr > Z	0.1545

- Lips

Test of H0: Gamma = 0	
ASE under H0	0.8870
Z	-1.1274
One-sided Pr < Z	0.1298
Two-sided Pr > Z	0.2596

- Jaws

Test of H0: Gamma = 0	
ASE under H0	0.9608
Z	0.9912
One-sided Pr > Z	0.1608
Two-sided Pr > Z	0.3216

- Chin

Test of H0: Gamma = 0	
ASE under H0	0.9197
Z	0.9356
One-sided Pr > Z	0.1747
Two-sided Pr >	0.3495

Z	
---	--

- Teeth

Test of H0: Gamma = 0	
ASE under H0	0.2588
Z	2.8098
One-sided Pr > Z	0.0025
Two-sided Pr > Z	0.0050

Male/female bullying reports' comparison.

- Height

Statistic	DF	Value	Prob
Chi-Square	1	1.8724	0.1712
Likelihood Ratio Chi-	1	1.7985	0.1799

Square			
Continuity Adj. Chi-Square	1	1.0653	0.3020
Mantel-Haenszel Chi-Square	1	1.8506	0.1737
Phi Coefficient		0.1476	
Contingency Coefficient		0.1460	
Cramer's V		0.1476	

- Weight

Statistic	DF	Value	Prob
Chi-Square	1	1.0017	0.3169
Likelihood Ratio Chi-Square	1	1.0383	0.3082
Continuity Adj. Chi-Square	1	0.5332	0.4653

Mantel-Haenszel Chi-Square	1	0.9901	0.3197
Phi Coefficient		-0.1079	
Contingency Coefficient		0.1073	
Cramer's V		-0.1079	

- Strength

Statistic	DF	Value	Prob
Chi-Square	1	0.0767	0.7818
Likelihood Ratio Chi-Square	1	0.0758	0.7831
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0758	0.7830
Phi Coefficient		0.0299	
Contingency Coefficient		0.0299	

Cramer's V		0.0299	

- Hair

Statistic	DF	Value	Prob
Chi-Square	1	0.3543	0.5517
Likelihood Ratio Chi-Square	1	0.3408	0.5593
Continuity Adj. Chi-Square	1	0.0038	0.9506
Mantel-Haenszel Chi-Square	1	0.3502	0.5540
Phi Coefficient		0.0642	
Contingency Coefficient		0.0641	
Cramer's V		0.0642	

- Eyes

Statistic	DF	Value	Prob
Chi-Square	1	1.7520	0.1856
Likelihood Ratio Chi-Square	1	2.7429	0.0977
Continuity Adj. Chi-Square	1	0.5064	0.4767
Mantel-Haenszel Chi-Square	1	1.7317	0.1882
Phi Coefficient		-0.1427	
Contingency Coefficient		0.1413	
Cramer's V		-0.1427	

- Nose

Statistic	DF	Value	Prob
Chi-Square	1	0.0099	0.9206

Likelihood Ratio Chi-Square	1	0.0100	0.9202
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0098	0.9211
Phi Coefficient		-0.0107	
Contingency Coefficient		0.0107	
Cramer's V		-0.0107	

- Ears

Statistic	DF	Value	Prob
Chi-Square	1	2.3645	0.1241
Likelihood Ratio Chi-Square	1	3.6853	0.0549
Continuity Adj. Chi-Square	1	1.0090	0.3152

Mantel-Haenszel Chi-Square	1	2.3370	0.1263
Phi Coefficient		-0.1658	
Contingency Coefficient		0.1636	
Cramer's V		-0.1658	

- Lips

Statistic	DF	Value	Prob
Chi-Square	1	1.7520	0.1856
Likelihood Ratio Chi-Square	1	2.7429	0.0977
Continuity Adj. Chi-Square	1	0.5064	0.4767
Mantel-Haenszel Chi-Square	1	1.7317	0.1882
Phi Coefficient		-0.1427	

Contingency Coefficient		0.1413	
Cramer's V		-0.1427	

- Jaws

Statistic	DF	Value	Prob
Chi-Square	1	1.1541	0.2827
Likelihood Ratio Chi-Square	1	1.8148	0.1779
Continuity Adj. Chi-Square	1	0.1084	0.7420
Mantel-Haenszel Chi-Square	1	1.1407	0.2855
Phi Coefficient		-0.1158	
Contingency Coefficient		0.1151	
Cramer's V		-0.1158	

- Chin

Statistic	DF	Value	Prob
Chi-Square	1	2.3645	0.1241
Likelihood Ratio Chi-Square	1	3.6853	0.0549
Continuity Adj. Chi-Square	1	1.0090	0.3152
Mantel-Haenszel Chi-Square	1	2.3370	0.1263
Phi Coefficient		-0.1658	
Contingency Coefficient		0.1636	
Cramer's V		-0.1658	

- Teeth

Statistic	DF	Value	Prob
Chi-Square	1	0.4133	0.5203

Likelihood Ratio Chi-Square	1	0.4216	0.5161
Continuity Adj. Chi-Square	1	0.1422	0.7061
Mantel-Haenszel Chi-Square	1	0.4085	0.5227
Phi Coefficient		-0.0693	
Contingency Coefficient		0.0692	
Cramer's V		-0.0693	

Patient/caregiver satisfaction comparison.

- Height

Test of H0: Gamma = 0	
ASE under H0	0.8801
Z	0.8672
One-sided Pr >	0.1929

Z	
Two-sided Pr > Z	0.3858

- Weight

Test of H0: Gamma = 0	
ASE under H0	0.7204
Z	0.4926
One-sided Pr > Z	0.3112
Two-sided Pr > Z	0.6223

- Strength

Test of H0: Gamma = 0	
ASE under H0	0.6815

Z	1.4673
One-sided Pr > Z	0.0711
Two-sided Pr > Z	0.1423

- Hair

Test of H0: Gamma = 0	
ASE under H0	1.0307
Z	-0.9702
One-sided Pr < Z	0.1660
Two-sided Pr > Z	0.3319

- Eyes: Row or column sum zero. No statistics computed for this table

- Nose

• Test of H0: Gamma = 0	
ASE under H0	1.0234
Z	-0.9771
One-sided Pr < Z	0.1643
Two-sided Pr > Z	0.3285

- Ears

Test of H0: Gamma = 0	
ASE under H0	1.0933
Z	-0.9147
One-sided Pr < Z	0.1802

Two-sided Pr > Z	0.3603
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- Lips

Test of H0: Gamma = 0	
ASE under H0	0.8533
Z	0.8289
One-sided Pr > Z	0.2036
Two-sided Pr > Z	0.4071

- Jaws

Test of H0: Gamma = 0	
ASE under H0	0.4273
Z	1.7976

One-sided Pr > Z	0.0361
Two-sided Pr > Z	0.0722

- Chin

Test of H0: Gamma = 0	
ASE under H0	0.6123
Z	1.2359
One-sided Pr > Z	0.1082
Two-sided Pr > Z	0.2165

- Teeth

Test of H0: Gamma = 0

ASE under H0	0.2764
Z	-0.3289
One-sided Pr < Z	0.3711
Two-sided Pr > Z	0.7422

Male/female assessment of teeth crowding.

Statistic	DF	Value	Prob
Chi-Square	4	2.9906	0.5594
Likelihood Ratio Chi-Square	4	3.7514	0.4407
Mantel-Haenszel Chi-Square	1	0.0082	0.9278
Phi Coefficient		0.1865	
Contingency Coefficient		0.1833	
Cramer's V		0.1865	

Appendix M. Principal Component Analysis – patient/caregiver satisfaction indices.

Item	Patients		Caregivers	
	Satisfaction Index		Satisfaction Index	
	Factor Loadings	Factor Weights	Factor Loadings	Factor Weights
Height	0.663	0.137	0.997	0.105
Weight	0.539	0.112	0.998	0.105
Strength	0.538	0.111	0.997	0.105
Hair	0.669	0.139	0.998	0.105
Eyes	0.664	0.138	0.998	0.105
Nose	0.583	0.121	0.997	0.105
Ears	0.711	0.147	0.739	0.078
Lips	0.842	0.175	0.998	0.105
Jaws	0.771	0.160	0.996	0.105
Chin	0.793	0.164	0.997	0.105
Teeth	0.374	0.077	0.086	0.009
Percentage of Cumulative Variance Explained	43.858%		86.404%	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				

Appendix N. Z-tests

Teeth satisfaction among patients' sample

	Sample 1	Sample 2	Difference
Sample proportion	0.7441	0.2093	0.5348
95% CI (asymptotic)	0.6519 - 0.8363	0.1233 - 0.2953	0.3855 - 0.6841
z-value	7		
P-value	<0.0001		

Straight teeth will improve school performance (patients' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.3139	0.686	0.3721
95% CI (asymptotic)	0.2158 - 0.412	0.5879 - 0.7841	0.2227 - 0.5215
z-value	4.9		
P-value	<0.0001		

Straight teeth will improve how you feel about yourself in public (patients' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.6511	0.3372	0.3139
95% CI (asymptotic)	0.5504 - 0.7518	0.2373 - 0.4371	0.1645 - 0.4633
z-value	4.1		
P-value	<0.0001		

Having straight teeth will boost confidence (patients' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.7674	0.2325	0.5349
95% CI (asymptotic)	0.6781 - 0.8567	0.1432 - 0.3218	0.3855 - 0.6843
z-value	7		
P-value	<0.0001		

Teeth Satisfaction regarding caregivers' sample.

	Sample 1	Sample 2	Difference
Sample proportion	0.6395	0.3604	0.2791
95% CI (asymptotic)	0.538 - 0.741	0.2589 - 0.4619	0.1297 - 0.4285
z-value	3.7		
P-value	0.0003		

Straight teeth will improve how you feel about yourself in public (caregivers' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.6395	0.3604	0.2791
95% CI (asymptotic)	0.538 - 0.741	0.2589 - 0.4619	0.1297 - 0.4285
z-value	3.7		
P-value	0.0003		

Having straight teeth will boost confidence (caregivers' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.86	0.14	0.72
95% CI (asymptotic)	0.7867 - 0.9333	0.0667 - 0.2133	0.5706 - 0.8694
z-value	9.4		
P-value	0		

Straight teeth will increase chances of success in life (caregivers' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.756	0.244	0.512
95% CI (asymptotic)	0.6652 - 0.8468	0.1532 - 0.3348	0.3626 - 0.6614
z-value	6.7		
P-value	<0.0001		

Straight teeth will improve school performance (caregivers' answers).

	Sample 1	Sample 2	Difference
Sample proportion	0.395	0.605	0.21
95% CI (asymptotic)	0.2917 - 0.4983	0.5017 - 0.7083	0.0606 - 0.3594
z-value	2.8		
P-value	0.0059		

Male/female satisfaction regarding teeth

	Sample 1	Sample 2	Difference
Sample proportion	0.8	0.3225	0.4775
95% CI (asymptotic)	0.6943 - 0.9057	0.158 - 0.487	0.2647 - 0.6903
z-value	4.4		
P-value	<0.0001		

Having straight teeth will boost confidence (M/F comparison).

	Sample 1	Sample 2	Difference
Sample proportion	0.523	0.244	0.279
95% CI (asymptotic)	0.391 - 0.655	0.0928 - 0.3952	0.0616 - 0.4964
z-value	2.5		
P-value	0.0119		

Having straight teeth will improve how you feel about yourself in public (M/F comparison).

	Sample 1	Sample 2	Difference
Sample proportion	0.442	0.209	0.233
95% CI (asymptotic)	0.3108 - 0.5732	0.0659 - 0.3521	0.022 - 0.444
z-value	2.2		
P-value	0.0305		

Straight teeth will increase chances of success in life (M/F comparison).

	Sample 1	Sample 2	Difference
Sample proportion	0.267	0.186	0.081
95% CI (asymptotic)	0.1501 - 0.3839	0.049 - 0.323	-0.1064 - 0.2684
z-value	0.8		
P-value	0.3969		

Appendix O. Journal Article

Correlation between Malocclusion and Diminished Psychosocial Well-Being

ABSTRACT

OBJECTIVE: To assess the correlation between malocclusion and psychosocial well-being from the perspective of younger patients, their caregivers, through the inclusion of normative criteria.

MATERIALS & METHODS: A cross-sectional study design was employed. Data was collected at a single point in time from a sample of prospective patients who were asked to complete the questionnaires. The mean age of patients was 13.57 +/- 1.57 years (55 females and 31 males). Data collection was undertaken through clinical exams, and each patient was assessed via the Index of Treatment Need (IOTN), both dental health and aesthetic components.

RESULTS: Patients' satisfaction with body image correlated with their caregivers' satisfaction with their children's body image ($p < 0.05$). Caregivers' satisfaction with tooth appearance correlated with the IOTN aesthetic component grade ($p < 0.05$). There is no significant correlation between children's satisfaction with their teeth and the IOTN dental and aesthetic component grades ($p > 0.05$). Caregivers' motivation, in comparison to their children's motivations to seek orthodontic treatment was the same ($p < 0.05$). No significant gender differences were found with regards to being bullied about dental appearance ($p > 0.05$).

CONCLUSIONS: Highest degree of dissatisfaction regarding different physical aspects is dental appearance; bullying experiences are also higher regarding dental appearance with no gender difference. Even patients with mild forms of malocclusion according to IOTN dental health and aesthetic components, suffer from bullying. Malocclusion significantly impacts perceptions of psychosocial well-being and even mild forms of malocclusion may lead to bullying and negative personal perceptions about appearance.

INTRODUCTION AND LITERATURE REVIEW

The reasons for pursuing orthodontic treatment have long been debated in the dental community, making the task of defining orthodontic need a complicated one. Orthodontic treatment is best

defined as the correction of teeth irregularities, whereas malocclusion can include physical and/or psychosocial elements¹. From a physical perspective, malocclusion is viewed as a “broad range of frequently occurring dental-facial mal-relations, referring to physical deviations”². Whereas others stress that definitions of malocclusion should include psychological characteristics³. Despite several studies^{4, 5, 6} on the topic of malocclusion and psychological well-being, the reasons for pursuing orthodontic treatment are still being intently debated.

While there are several studies that attempt to address the relation between orthodontic treatment and psychosocial well-being, there is still no consensus on the topic. This is due to the fact that while some studies reported a correlation between malocclusion and psychosocial consequences, others denied such correlation. This may be owing to varying understandings of what these impacts constitute, sample size, age, and the absence of uniform methods for assessment⁷.

Helm et al.,⁸ demonstrated that the majority of those who suffer from malocclusions have varying levels of negative body image and low self-esteem, depending on the type and severity of their conditions. Badran⁹ found that adolescents that had completed orthodontic treatment exhibited superior self esteem than those who had not. A number of studies¹⁰⁻¹⁵ have shown that the perception of facial appearance by an individual not only affects body image and self-perception, but also has a strong bearing on negative self-image.

Shaw¹⁶ found that both children and adults perceive faces of subjects with normal occlusions, as being more physically appealing, smarter, more amicable, and preferable as friends, than identical faces with occlusal impairment. More than twenty years later, those results were replicated by other researchers¹⁷⁻¹⁹. In a study by Shaw et al.²⁰, 531 school children were asked to identify the most common target of teasing. The results established that out of 14 facial features, teeth were ranked as the fourth most frequent target of teasing for children aged 9 to 12. In a recent Jordanian study²¹ that included 960 boys and girls, teeth were found to be the number one feature identified as the target for bullying, with 50% of the bullied victims acknowledging its importance as a target.

The aim of the present study was to examine the relation between the psychosocial factors and malocclusion, focusing on young children and adolescents, as the more vulnerable patient category with the most potential to benefit psychologically from early detection and treatment. Furthermore, the current study hopes that findings on this topic may facilitate a better assessment of treatment needs as well as contribute towards better healthcare planning necessary for access to orthodontic treatment.

MATERIALS AND METHODS

Ethical approval was attained from the University Health Research Ethics Board. A cross-sectional study design was employed; data was collected at a single point in time from a sample of prospective patients at the University. Prior to commencement of the questionnaires, all caregivers had signed consent forms agreeing to allow their children to participate in the study. 86 patients (ages 11-16) and their caregivers met the inclusion criteria and were asked to complete the questionnaires. Exclusion criteria included: Patients with special health care needs, syndromes and craniofacial anomalies (e.g., cleft lip and palate), mentally handicapped patients, and respondents with language barrier difficulties. Caregivers of children and adolescents eligible to participate in the study were given the “Parent Information and Informed Consent” form. Incentive prizes were offered to elicit questionnaire participation.

Clinical Examination

Clinical data was collected through an oral examination to assess the severity of malocclusion. Dental examination of the subjects was performed at the applicable Graduate Orthodontic Clinic. In addition, the use of dental casts and digital images for patients was employed. The clinical exam was comprised of several components, which provided a summary of dentofacial features. At the end of the clinical exam, patients were given a specific Index of Treatment Need (IOTN) dental health and aesthetic component grade. Following the clinical examination, questionnaires were administered to the selected patients and their caregivers.

Patient Self-Assessment Questionnaire

In a recent study, Al-Bitar et al.,²¹ employed a questionnaire that was modified from that of Shaw et al.,²⁰. For the purpose of this study, the same questionnaire used by Al-Bitar was used, but modified to meet other aspects needed in the study. The first section of the questionnaire involved reason(s) behind the patient's decision to visit an orthodontist. The second section queried patient's satisfaction regarding different body parts. The third section focused on the personal experience of teasing and bullying directed at all body parts first and then regarding dentofacial features specifically. The fourth part identified the dentofacial feature's effect on social life. The questionnaires were completed at the university in the absence of the study investigators.

Caregiver Assessment Questionnaire

The caregiver assessment questionnaire mirrored the patient self-assessment questionnaire; the significant difference between them was the perspective from which the answers were given. Furthermore, level of education was attained from the caregivers as well as their annual income. The questionnaires were completed at the university in the absence of the study investigators.

Validity and Reliability of Clinical Exam, Patient Self-Assessment, and Caregiver Questionnaires

Cohen's Kappa test was used to measure inter-reliability and intra-reliability. The questionnaires were designed by the principal investigator and reviewed by a statistician and a psychometrician to ensure that the results were measurable and valid.

Index of Treatment Need – IOTN

The widely used IOTN, created by Brook and Shaw in 1989²², is the first index to include malocclusion measurements along a socio-psychological angle. The IOTN comprises two separate components, the dental health component (DHC) and the aesthetic component (AC).

The DHC is the clinical component of the IOTN. This component categorizes patients into five grades (from Grade 1-no need for treatment, to Grade 5-extreme need for treatment)²³ based on their occlusal features and their impact on the stomatognathic system.

The AC comprises a scale showing images of 10 dental malocclusions. These images are divided into three grades: AC 1-4 (little or no need for treatment); AC 5-7 (moderate need for treatment); and AC 8-10 (definite need for treatment)²³; this grading system was employed in this study. However, it should be noted that while the AC was designed to be used by the patient to assess his or her perception of their own malocclusion, several studies noted good results and reproducibility when the dentist carries out the AC²³. Therefore, in this study the principal investigator carried out the AC.

Statistical Analysis

Statistical software, SAS 9.2 (SAS Institute Inc. Cary, NC), was used to analyze the data. Simple descriptive statistics of demographic and clinical characteristics were conducted. Correlation and agreement tests were done to compare patients and their caregivers, males and females, and the severity of malocclusion and bullying about teeth. Statistical tests used included Pearson correlation coefficient, Pearson chi-square, Gamma correlations, and Z-tests. Cohen's kappa coefficient test was used to assess reliability tests.

RESULTS

The intra-reliability and inter-reliability coefficients verified the statistical reliability of findings. Cohen's kappa coefficient testing inter-reliability ranged from 0.636 to 0.739. To identify the intra-reliability coefficient, the principal investigator performed the examination twice on 12 patients, with a three-month gap between the two measurements. Here, the Cohen's kappa coefficient ranged from 0.571 to 1.000.

The analyses of data focused on the dental examination and patient/caregiver questionnaires in order to determine any relationships between malocclusion and psychosocial well-being. The initial sample size constituted 99 patients, but only 86 of the completed questionnaires were deemed acceptable, yielding an 86% response rate. The average age of participants was 13.57 +/- 1.57 years old; 55 (64%) were female and 31 (36%) were male.

Clinical Examination

The physical examination of patients consisted of diagnosing the need for orthodontic treatment in accordance with the IOTN guidelines – both in terms of DHC and the AC. The majority of patients (41.9%) were graded as borderline need for treatment according to the IOTN DHC, followed by severe need for treatment (22.1%), and no need for treatment (2.3%). According to the IOTN AC, 34.9% of patients were graded as borderline need for treatment and one-third of patients (32.6%) were graded as definite need for treatment or no need for treatment (32.6%).

Comparative Analysis

The first comparative analysis was conducted on the basis of the degrees of satisfaction of children and caregivers have with various aspects of children's appearance, and the extent to which the opinions of caregivers and patients coincide. The lowest level of shared satisfaction (7%) was recorded for children's teeth. Moreover, shared dissatisfaction for the condition of children's teeth was 46.6%. The next comparison focused on the frequency of reported bullying by children versus their caregivers. The degree of caregivers' and children's responses regarding bullying was high, with weight, height, strength, and teeth which were identified as the traits most associated to bullying.

Comparative analysis on males versus females was also conducted. Findings show that 80% of females, in contrast to 64.5% of males, were dissatisfied with the appearance of their teeth. The Z-test showed statistically significant results indicating that females are more preoccupied with their appearance and are more skeptical about their dental attractiveness. Bullying experiences were also compared. Males were less frequently bullied on a variety of appearance traits in comparison to females, whose bullying on the subject of weight, strength, eyes, nose, ears, etc. was more common. Nevertheless, bullying on the subject of teeth is quite widespread both for male and female respondents, with 14 females and six male patients reporting being bullied about their teeth.

Another aspect of the comparative analysis was the relationship between the IOTN assessment of the need of orthodontic treatment and children's reported bullying. Interestingly, out of 20 children bullied about teeth, 40% had a moderate need for treatment, 25% were diagnosed with severe need for treatment, 10% had an extreme need for treatment, and only 5% did not need

treatment at all – in accordance with the IOTN DHC. As for the IOTN AC, 30% of children who reported being bullied about teeth appeared not to need treatment. 35% of the bullied children were diagnosed with either a definite need or a borderline need for treatment for aesthetic purposes.

Correlation Analysis

Correlation analysis was conducted to determine the relationships between various aspects of clinical conditions and psychosocial experiences of patients and their caregivers. A summary of correlated variables in this study are presented in Table 1.

Table 1. Results of correlations.

Correlated Variables	Test Used	Results
Child's satisfaction with teeth + IOTN dental health grade.	Pearson Correlation	No significant correlation. P=0.7394
Child's satisfaction with teeth + IOTN aesthetic component grade	Pearson Correlation	No significant correlation. P=0.8793
Caregiver's Satisfaction with teeth + IOTN dental health grade.	Pearson Correlation	No significant correlation. P=0.1545
Caregiver's satisfaction with teeth + IOTN aesthetic component grade.	Pearson Correlation	Significant correlation. P=0.0359*
Caregivers' motivation to seek orthodontic treatment + income.	Pearson Correlation	No significant correlation. P>0.05
Caregiver's motivation to seek orthodontic treatment+ child's motivation to seek orthodontic treatment .	Gamma	Significant correlation between caregivers and their children in regards to their motivation to seek orthodontic treatment with respect to crooked teeth (P=0.0038*) and referral by the dentist (P<.0001*). No significant correlation with respect to other motivation factors (P>0.05).
Patient/caregiver	Gamma	No significant correlations

satisfaction comparison.		between patients and caregivers with respect to satisfaction factors ($P>0.05$).
Patient/caregiver bullying reports' comparison.	Gamma	Significant correlation ($P<0.05^*$) with respect to height, weight, and teeth. No significant correlation with respect to other physical factors.
Gender + being bullied about teeth.	Pearson Correlation	No significant correlation. ($P=0.5259$)
Male/female satisfaction factors comparison.	Pearson's chi-square	No significant correlations between males and females with respect to satisfaction factors ($P>0.05$) except for teeth ($P=0.0586^*$).
Severity of malocclusion (IOTN dental health grade) + being bullied about teeth.	Pearson Correlation	No significant correlation. $P=0.5950$
Severity of malocclusion (IOTN aesthetic component grade) + being bullied about. teeth	Pearson Correlation	No significant correlation. $P=0.7552$

Table 1. Results of correlations. ($p\leq0.05$).*

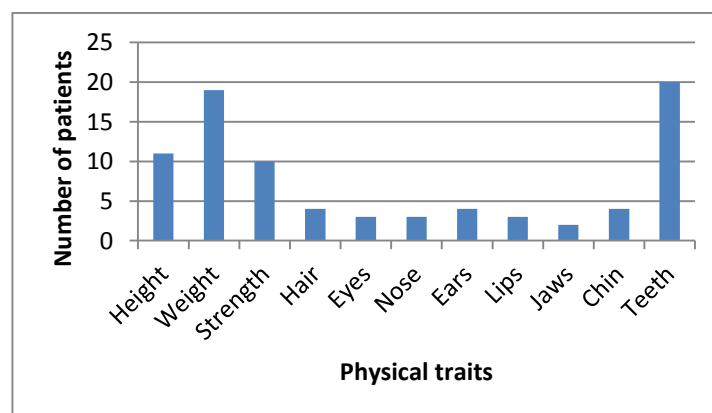
DISCUSSION

Research has verified that malocclusion is strongly associated with various aspects of psychosocial well-being. The psychosocial well-being of a patient with dental problems is negatively affected in a variety of ways: experiences of bullying at school, caregivers' negative remarks, as well as low self-evaluation and complexes. Our study's findings indicate that most of the surveyed patients are dissatisfied with the appearance of their teeth. The majority of both, caregivers and patients, agree on dissatisfaction concerning their dental appearance. Patients reported being bullied because of various dental problems such as crooked teeth, shape and color of their teeth, teeth sticking out, etc. Moreover, the majority of patients and caregivers agree that straight teeth do improve psychosocial factors. These findings are consistent to previous claims^{11, 12, 14}, and a more recent study of Hassan and Amin¹⁰ about facial appearance being an influential

component of the overall self-image determining self-esteem. They also support the findings of Baylon⁴ about children's close psychological association of self-perception with dental appearance.

Based on our study, having a malocclusion was identified as being related to bullying, with more than one fifth of patients reporting being bullied about dental appearance - Fig. 1. In addition, it is vital to note that more than half of the bullied sample either needed no treatment, or minor or moderate/borderline treatment, according to the IOTN dental health guidelines. It is clear that even milder forms of malocclusion are still significant enough to attract bullying regarding patients' teeth, which may be due to having less than ideal dental appearance. In terms of the IOTN aesthetic guidelines, one third of the bullied sample did not need treatment and just more than third of the sample needed definitive treatment. The present evidence suggests that, not only children with a severe need for treatment, visible, and easily detectible dental problems suffer from bullying, but also children who have milder forms of malocclusion and even those who do not meet the IOTN treatment need criteria. These findings were further correlated and showed no statistical significance between the severity of malocclusion according to IOTN guidelines and patients experiences related to teeth bullying. The present research findings support prior findings^{20, 21} that teeth-related bullying is much more abusive than other forms of bullying about height, weight, hair, or other physical attributes. Such bullying experiences intensify anxiety, depression, and poor self-image among children, causing lower self-esteem, loneliness, and insecurity feelings further deteriorating the psychosocial well-being and emotional health of children^{24, 25}.

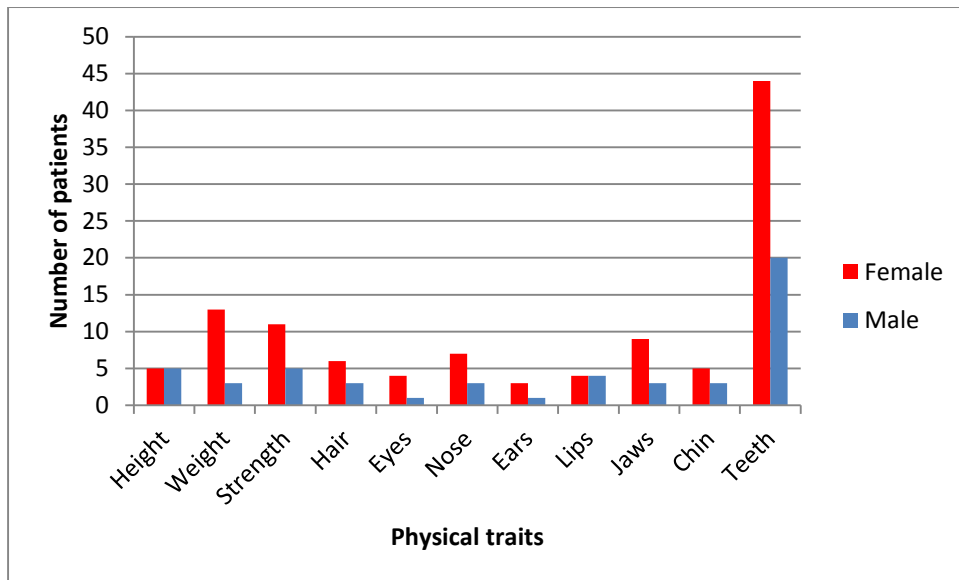
Figure 1. Patients' responses to bullying factors



Alignment of caregivers' motivation to seek orthodontic treatment for their children was validated in this study with respect to crooked teeth and referral by the dentist. Having crooked teeth was recognized by most of the patients and their caregivers, which suggests that caregivers are realistic, and even critical, about their children's dental appearance. Dentist referral motivated over half of the caregivers and almost half of the patients to seek treatment. Although fewer caregivers viewed themselves as being the motivators of visiting an orthodontist, more of the patients stated that they came to seek orthodontic treatment upon their caregivers' wish. These findings support prior research of Wedrychowska-Szulc and Syrynska²⁶ and Samsonyanova and Broukal²⁷.

Preoccupation with physical appearance and psychosocial problems associated with malocclusion was found to be higher for girls. The majority of female patients agreed that straight teeth would improve how they would feel in public and would boost their confidence. The most general assessment showed that females in contrast to males were more dissatisfied with the condition and appearance of their teeth - Fig. 2. These findings support the claims of Jung²⁸ who also observed females to be much more preoccupied with their malocclusion and other dental problems. In the present study, no significant correlation was found between bullying, self-esteem and gender which was supported by the claims of Gavric et al.,²⁹.

Figure 2. Male versus female dissatisfaction responses to physical factors.



The present study included the purposive sampling. Using a random sampling technique would guarantee a higher level of study credibility. It is essential to note that the cross-sectional nature of this study may also serve as a limitation. A longitudinal approach to observing patients undergoing orthodontic treatment might yield a richer dataset for analyzing the dynamics of patients' changing psychosocial well-being, and the extent to which their expectations regarding orthodontic treatment were validated in the progress of treatment.

CONCLUSIONS

- Highest degree of dissatisfaction regarding different physical aspects is dental appearance; bullying experiences are also higher regarding teeth, followed by weight, height and strength.
- No difference between genders with respect to dental appearance and bullying.
- Even patients with mild forms of malocclusion according to IOTN dental and aesthetic components suffer from bullying.
- Patients and caregivers are in agreement about reasons to seek orthodontic treatment.
- Malocclusion impacts perceptions of psychosocial well-being.

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