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Dr Carmen Tracey Gordon (BChD, PDD Interceptive Ortho)

Student Number: 9136815

Proposed degree: MSc Dent (Orthodontics)

Supervisor: Prof A Shaikh

Co-Supervisor: Ms Natalie Gordon

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The Impact of Fixed Orthodontic Treatment on the Oral Health-Related Quality of Life in Adolescents

A thesis submitted in fulfillment of the requirements for the degree of

Master Scientiae in Dentistry in the Department of Orthodontics,

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Supervisor: Prof Amenah Shaikh

Co-Supervisor: Ms. Natalie Gordon

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Summary

This study aimed to determine whether fixed orthodontic treatment impacts on the oral health-related quality of life (OHRQoL) in adolescents aged 11-16 years. Oral health determinants, as well as demographic and psychosocial factors, may have an impact on oral health-related quality of life.

This study explored whether sociodemographic and clinical factors impacted the emotional and social well-being of participants and whether these participants experienced any functional limitation at the start of treatment (T0) and 6-8 months later (T1).

Materials and methodology: A prospective study design was applied, within the orthodontic clinics at Mitchell's Plain and Tygerberg Oral Health Centre's. A cohort of eighty-three adolescent participants receiving fixed orthodontic treatment was evaluated for oral health – related quality of life. All participants completed a set of validated questionnaires at baseline (T0), and then 6-8 months later (T1). Questionnaires included the Orthodontic Oral Health-Related Quality of Life Survey ($OQoLAS_{11-14}$) and a socioeconomic status (SES). The $OQoLAS_{11-14}$ measured the social, emotional and functional domains and the SES assessed the sociodemographic characteristics of participants' and their caregiver; age, sex, educational level, employment status and combined household income. In addition, the clinical assessment was done using the Dental Aesthetics Index (DAI) score card, in order to assess the complexity of malocclusion and orthodontic treatment need. A statistical analysis and evaluation were applied to assess the correlation between functional, social and emotional domains, OHRQoL scores and

pre-treatment malocclusion scores. Sociodemographic characteristics were evaluated to determine whether it affected the OHRQoL of participants.

Results: 83 participants were recruited in the study. 53 were female and 30 were males. A low household wage demonstrated a statistical significance (p = 0.0094) whereby 19 participants having a household of <R3000 experienced a poor OHRQoL (85.05, SD = 17.1) as compared to participants caregivers earning a household wage of >R3000 experienced a better OHRQoL (68, SD = 13.37). A higher trend of female participants (86.79%) presented within the "definite" orthodontic treatment need category on DAI scorecard. Female participants (58.82%) reported that their lives were impacted by the condition of their teeth and mouth. The mean OHRQoL score was 68.64 (SD = 13.03) for participants who presented with slight malocclusion as compared to a considerably higher score of 81.42 (SD = 17.3) for participants who presented with severe malocclusion. Within the first 6-8 months (T1) of orthodontic treatment, the participants' who self-perceived their teeth as "poor" demonstrated an overall mean OHRQoL score improvement from 79.8 (SD = 18.7) to 53.5 (SD = 18.6), (p = 0.5166). Since a higher score indicates a low quality of life, the study revealed the emotional well-being score of female participants increased from 12.13 (SD = 4.88) to 20.27 (SD = 6.53). A positive Spearman's correlation between orthodontic treatment need and emotional well-being domain was statistically significant at T0, r_s = 0.3056, p = 0.0050. A decrease in the functional well-being score from 28.55 (SD = 7.7) to 22.69 (SD = 56.3) and social well-being score from 25.98 (SD = 7.9) to 17.07 (SD = 5.6) demonstrated an improvement of participants quality of life.

Conclusions: The results of this study reveal that there is an association between household wage and QoL, that female participant's emotional well-being was impacted 6-8 months after

treatment commenced and that the functional and social well-being improved when evaluated at 6-8 months after treatment commenced. Households with a combined income of less than R3000 revealed lower quality of life scores as compared to participants whose caregivers earned >R3000 per week. Socioeconomic disparities and lack of resources could impact QoL.

Gender showed a statistically significant **(***p* = 0.0050) difference between emotional well-being score with females displaying a higher OHRQoL score at T1 as compared to T0 12.13 (SD = 4.88), 20.27 (SD = 6.5) respectively.

Participants' quality of life in the functional and social well-being domain improved 6 to 8 months after placement of fixed orthodontic appliances.

Keywords:

Dental Aesthetic Index

Malocclusion

Orthodontic appliance

Quality of Life

Oral Health–Related Quality of Life

Adolescence

Oral health

Clinical relevance: In context, the patient is regarded as both a recipient of care and a partner who co-designs his or her care delivery in a person-centered environment. This approach considers the combined patient psychosocial and clinician-centered diagnostic evaluation.

Beneficial effects in orthodontics could include improved patient and clinician satisfaction to treatment outcomes and improved compliance to treatment plans.

Learning about the effects and discomfort of fixed orthodontic treatment is important for informed consent.

Patients gain insight into the benefits of fixed orthodontic treatment at various intervals during appliance therapy. This is could alleviate the misconception and frustration of not meeting patient high treatment expectations.

Declaration

I the undersigned declare that *The Impact of Fixed Orthodontic Treatment on Oral Health-Related Quality of Life in Adolescents* is my own work and that it has not been submitted before for any degree or examination in any other university.

Carmen Tracey Gordon November 2022

Signed: ……

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Contents

List of Abbreviations

COHIP	Child Oral Health Impact Profile
CPQ_{11-14}	Child Perception Questionnaire
DAI	Dental Aesthetic Index
EMW	Emotional Well-being
FL	Functional Limitation
HRQoL	Health-Related Quality of Life
OHIP-14	Oral Health Impact Profile
OHRQoL	Oral Health- Related Quality of life
OHS	Oral Health Status
OIDP	Child Oral Impact on Daily Performance
$OQoLAS_{11-14}$	Orthodontic Quality of Life Assessment Survey
UNICEF	United Nations Children's Fund
OTN	Orthodontic Treatment Need
QoL	Quality of Life
SWB	Social Well-being
WHO	World Health Organisation

Chapter 1

Introduction

Research on Quality of Life (QoL) has steadily grown over the past four decades for several different reasons. The use of metrics to assess patient-centered outcomes in clinical research has received special attention from the World Health Organization (WHO). To this end, various health conceptual models were created to highlight the relevance of assessing patient-centered outcomes. These models measure both biological and psychological outcomes of patients' health (O'Brien *et al.,* 2006; Sischo & Broder, 2011). Literature has demonstrated much about the clinical effects of orthodontic treatment but needs to catch up with how it affects the psychological well-being of orthodontic patients (Brown *et al.,* 1991). According to Kiyak (2008), it can no longer be assumed that patients' lives are enhanced when receiving orthodontic treatment as according to the author, this claim has not been proven by research. There was therefore the need to explore the possible effect fixed orthodontic therapy has on adolescents' quality of life.

Beauty is in the eye of the beholder. Subjective perception is deemed admirable to one and might not appeal to another. It is important to understand how people view how oral disorders and how they affect thereof on their quality of life. The phrase "quality of life" has changed over time to encompass a wide range of factors. The application of quality of life in the orthodontic setting has seen a paradigm shift from an objective clinical approach to one that is patient-centered (WHO, 2003; Sischo & Broder, 2011). The era of Oral Health-Related Quality of Life (OHRQoL) factors in research methodologies have now begun. Although in its infancy stages, dental research in this field expanded over the past 15 years. There has been an increasing

demand for orthodontic treatment with the aim to effect an improvement of malocclusion and any negative impact it has on the social and psychological well-being of individuals. Orthodontic treatment aims to correct malocclusion, aberrant craniofacial development, and orofacial neuromuscular dysfunction, which individually or collectively may result in any of the following: Speech impairment, poor facial aesthetics, poor mastication, and a propensity for dental cavities and periodontal disease (Perillo *et al.,* 2014).

The basis for orthodontic treatment should not only focus on morphologic and functional determinants but should also holistically incorporate biological, psychosocial, and cultural factors. (Proffit 2000, pg. 14). Fixed orthodontic treatment is a common practice and could result in functional restrictions, discomfort, and pain (Firestone *et al.*, 1999; Bergius *et al.,* 2002). The opposite applies where fixed orthodontic treatment improves patients' functional limitations and psychosocial factors. Normative or clinician-based means are more traditional methods of determining treatment outcome (Asgari *et al.,* 2013).

That said, there has been surge of interest in the assessment of OHRQoL (Sischo & Broder, 2011). This concept seems a somewhat vague, imperceptible, and intangible entity and a difficult one to define. One author describes it as "the absence of negative impacts of oral conditions on social life and positive sense of dentofacial self-confidence" (Inglehart *et al.,* 2002). A different perspective identifies OHRQoL as health and wellness that are complete in their physical, mental, and social well-being (Slade *et al.,* 1994).

The benefits of a combined patient - and - clinician - outcomes approach, vary depending on the research being conducted and the context in which OHRQoL impacts are assessed. Patients are in the best position to relay or elaborate on their oral symptoms and how it influences their day-to-day lifestyle activities, thus affording patients to be proactively involved in their healthcare. It

has also been reported that when patients are provided with information about the benefit orthodontic treatment has on their oral health, the chances of noncompliance will probably decrease (Sergl *et al.,* 1998).

Although instruments that assess OHRQoL were mainly limited to research assessing caries or periodontal disease it has also been used to measure the impact of malocclusion and orthodontic intervention on individuals. As more people seek orthodontic care for various reasons, research interest in the relationship between orthodontic therapy and OHRQoL is growing (Locker & Slade, 1997). Various instruments have been developed as clinical tools to assess OHRQoL. One validated tool that ideally measures OHRQoL in adolescents is the Child Perception Questionnaire, which is designed for 11–14-year-olds (Jokovic *et al.,* 2002; O' Brien *et al.,* 2006). Other validated instruments used include the Oral Health Impact Profile (OHIP-14), (Slade *et al*., 1994) and the Orthodontic Quality of Life Assessment Survey (OQoLAS 11-14), (Stewart *et al.,* 2008).

1.1 The aim of this study was:

To determine whether fixed orthodontic treatment impacts the oral health-related quality of life in adolescent patients, aged 11-16 years, attending the orthodontic clinics at the University of the Western Cape (UWC), Oral Health Centre's.

1.2 The objectives of this study were:

1. To obtain socio-demographic factors of the study sample using a socio-demographic questionnaire and to determine whether there is a link between these factors and participants' quality of life.
2. To grade the malocclusion of participants at T0 using the Dental Aesthetic Index.
3. To determine whether the severity of a malocclusion impacts on OHRQoL.
4. To assess oral health- related quality of life using the Orthodontic Quality of Life Assessment Survey (OQoLAS) instrument, before commencement of orthodontic treatment (T0).
5. To assess the oral health – related quality of life of the same participants using the Orthodontic Quality of Life Assessment Survey, at T1 (6-8 months), after placement of fixed orthodontic brackets.
6. To compare oral health – related quality of life scores between T0 and T1.

The significance of this study:

The terms "quality of life" (QOL) and "oral health-related quality of life" (OHRQoL) have increasingly been mentioned in medical literature during the last 10–15 years. The improvement of health-related quality of life is used to justify much of the orthodontic treatment that is provided. Orthodontic patients may benefit from having their OHRQoL evaluation included in the orthodontic assessment and treatment plan as this would recognize their subjective experiences. This would require clinicians to be informed about the notion of OHRQoL, how it is measured and evaluated, as well as the insight it would provide in delivering patient-centered care.

This is a shift from a largely biomedical approach to providing care where the need is determined from a normative, professional perspective to a more psychosocial approach where the views and experiences of patients are considered (Petersen, 2003). Aesthetics and social norms are contributing factors that motivate patients to seek orthodontic treatment and a measure of these factors should complement the objective clinician-centered approach to managing quantitative orthodontic parameters (Shaw *et al.,* 1985).

There are generic instruments that have been used to measure these factors and assess patient OHRQoL. An orthodontic-specific instrument called the Orthodontic Quality of Life Assessment Survey (OQOLAS $_{11\text{-}14}$), (Stewart *et al*., 2008) was identified as an appropriate instrument for this study in order to realise a patient-centered approach to treatment. The OQOLAS 11-14 instrument was recognized as an age-specific and orthodontic-specific questionnaire and was suitable for data collection and analysis of the variables tested.

Malocclusion does impact OHRQoL as most patients present for orthodontic treatment due to aesthetic appearance concerns (de Oliveira *et al.,* 2004), research studies are now including the patients' perception of ideal dental aesthetics as well. Therefore, it is important that these OHRQoL measures should be incorporated at the onset during the orthodontic treatment planning stage (Hua, 2019). Additionally, the assessment of OHRQoL has important implications for dental research, the clinical practice of dentistry and for public health policy implementations (Hua, 2019). This study may provide the opportunity to identify gaps in research in the field of OHRQoL in orthodontics and to construct and validate revised orthodontic-specific instruments, which are patient-centered.

Chapter 2

Literature Review

2.1 Introduction

Oral health encompasses the capacity to smile, express oneself through speech, taste, mastication, touch, swallow and express emotions without discomfort and pain (Glick et al., 2017). OHRQoL is a patient-reported outcome measure. It measures the impact of oral health on daily life, in terms of functional well-being, social well-being, and emotional well-being of patients. To date, various OHRQoL instruments have been designed and implemented, to measure and assess these impacts. According to Sischo and Broder's theoretical model, there is a link between environmental factors and their impact on OHRQoL (Sischo & Broder, 2011). The literature review centers on assessing the impact of environmental factors and various instruments that a currently being used in research. The pros and cons of each instrument were interrogated in order to determine whether it was suitable to use in this orthodontic research study.

2.2 Conceptual Background

2.2.1 Quality of Life (QoL)

According to the World Health Organization (WHO, 1993), QoL is,

"An individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards, and concerns. It is a broad-ranging concept affected in a complex way by the person's physical health, psychological

state, and level of dependence, social relationships, and their relationships to salient features of their environment" (WHO, 1993)

When evaluating treatment outcomes QoL has been defined as the differences between expectations and experiences. This vague and amorphous term is commonly used in the medical and social science field. The assessment of QoL is usually done through instruments such as surveys or self-completed questionnaires, proxies, and face-to-face or telephonic interviews (Guyatt et al., 1993).

When referring to the bio-psychosocial determinants of health, the WHO defines oral health as:

"the standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being" (Petersen, 2003).

2.2.2 Oral Health-Related Quality of Life (OHRQoL)

According to Locker & Allen (2007), OHRQoL is defined as,

"The impact of oral diseases and disorders on aspects of everyday life that patient values, that are sufficient magnitude, in terms of frequency, severity or duration to affect their experience and perception of their life overall"

Instruments used to measure OHRQoL are designed with items grouped and categorized into domains or subscales. The subscale is the overarching area of focus that has been identified as pertinent to the survey, for example, the "functional limitation" or "emotional well-being" domain, which may require the response to single or multiple items. An item is regarded as a

single question, such as “How has the condition of your teeth and mouth affected your life overall?” Data is a collection of answers to these questions, which are scored according to a scale.

2.3 Sociodemographic Factors

Wilson-Clearly (1995) and Sischo and Broder (2011), both incorporated personal, social, and environmental factors as determinants of an individual’s OHRQoL. Variables including age, sex, educational level, employment, and combined household income can influence the impact of OHRQoL (Newton, 2005; Wong et al., 2006). For example, young females were found to be more conscious about facial aesthetics than males (Shaw, 1981; de Oliveira & Sheiham, 2004; Klages et al., 2004). Additionally, poor self-perception of body image and oral health status was also found to be more prevalent in females than males (Agou et al., 2008; Foster Page, 2013).

Honkala and colleagues (2007), reported that self-esteem in adolescents may also be correlated to socioeconomic standing. According to Locker (2007), household income remained a predictor for OHRQoL whereby children from low-income households presented with poorer OHRQoL in comparison to children who were from high-income households. The author concludes that disparities in socioenvironmental factors could explain the differences in these experiences. Cultural differences and social background have also been reported to influence an individual’s perception and evaluation of malocclusion (Newton et al., 2005). Related socioeconomic inequalities and oral health status were important features for determining OHRQoL (Davey-Smith et al., 1994; Piovesan et al., 2010).

2.4 The Adolescent Patient.

Due to the growth potential and the stage of dental development in children in this age group, many authors regard it to be the most appropriate time to start fixed orthodontic treatment. (Pietila et al., 1992; Tarvit & Freer, 1998). The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) define any young person between 10 and 19 years old as an adolescent, (WHO, 1993). The "awkward" adolescent is not clearly understood; hence it becomes pertinent for dental clinicians to know what factors contribute to the health and well-being of adolescents in order to promote their positive development.

These years are marked by challenges in many areas, together with rapid physiological and psychological changes occurring. There is also a change in social behavior as cognitive development and maturation continue and the adolescent gains the ability to think systematically and reason abstractly about all logical relationships within a problem (Newton, 2005). Adolescents meet the requirements and demands of completing self-reported questionnaires as they have independent reading and language comprehension skills. In addition, Piaget's stage of formal operations suggests that, due to adolescents' rapid cognitive growth, they have the ability to recall, apply and retrieve information related to specific events and experiences (Gathercole & Pickering, 1998). It is usually around the age of 8 years that children begin to understand how social activities are impacted by ill health; hence, the adolescent is more than capable of making comparative judgments of oral health status and OHRQoL (Jokovic et al., 2005).

A dental clinician may now reason with an adolescent when formulating treatment goals since they will most likely question the appropriateness of these orthodontic goals.

Increasing awareness of tooth appearances and facial aesthetics are prominent, and adolescents tend to compare themselves to peers, mainly due to exposure to idealized media images of dental health for example, “I want straight white teeth”. It is the responsibility of the clinician to support the development of adolescents’ understanding of health and more specifically oral health as they transition into adulthood and provide them with appropriate information so that they can make healthy and informed choices (Clark et al., 1993; Newton, 2005,).

2.5 Impact of Malocclusion on QoL

Malocclusion was initially classified by Edward Angle, in 1899, who is regarded as the father of modern orthodontics (Proffit, 2000). His classification is regarded as a significant step in the advancement of orthodontics, as he defined normal occlusion in the natural dentition as well as three subdivisions of malocclusion (Proffit, 2000). A deviation from normal occlusion is regarded as malocclusion and can be further described according to dental, skeletal, and soft tissue aberrations (Proffit, 2000). It is recognized as a major health problem worldwide (Petersen, 2003) even though it’s not a disease, it has been considered the third most common oral pathology following periodontal disease and dental caries (Brito et al., 2009).

It has been reported that malocclusions do affect the quality of life of adolescents and young adults (Johal, 2007; Bernabe, 2008) and have a variety of physiological, social, and economic implications (Petersen, 2003; Barnabe et al., 2008). It is estimated that 39% to 93% of children and adolescents have malocclusions, according to World Health Organisation (Dos Santos et al., 2012). This wide range reflects differences in age, sex, cultural diversity, and malocclusion

registration, grading them as either "mild", “moderate” or "severe" (Moyers et al., 1980; Roth, 1981; Rinchuse et al., 2007).

Generally, the eyes and mouth are considered the most attractive features of the face (Baldwin, 1980). Negative social and psychological impacts on quality of life were experienced by adolescents who were dissatisfied with their facial appearance because of malocclusion (Shaw, 1981; Helm et al., 1985).

Tuominen and his co-workers (1994) showed that dental appearance is the main reason for patients seeking orthodontic treatment. de Oliveira et al’s finding (2004), confirmed that adolescents’ quality of life improved after orthodontic treatment, as they were better able to smile, chew and show more teeth without being embarrassed.

Reports have revealed that bullying and teasing; due to malocclusion among adolescents have been linked to poor emotional and social well-being (O’Brien et al., 2006; Seehra et al., 2011; Patel et al., 2016). Social media also contributes by emphasizing what kind of facial appearance is aesthetically pleasing and socially acceptable (Twigge et al., 2016). There is evidence that reveals how specific kinds of malocclusion have been linked to bullying and teasing, including large overjets, as seen in Class II division 1, as well as missing teeth and diastemas (Wong et al., 2006; Seehra et al., 2011; Kunz et al., 2019). Since orthodontic management of these patients has been shown to improve, the social and emotional domains of OHRQoL an improvement in appearance and function has been suggested (Javidi et al., 2017).

2.6 Objective measurement of malocclusion

The Dental Aesthetic Index (DAI), formulated by Cons and Jenny in 1986, is an index based on aesthetic standards that are socially defined (Cons & Jenny, 1983). It is useful in orthodontic screening in order to determine priority for subsidized orthodontic treatment.

As illustrated in table 1, the DAI score was derived using regression analysis to choose 10 occlusal traits. The measurements are recorded and multiplied by a pre-determined weight. The products are summed, and a constant is added. The scores are then categorized into four grades according to the complexity of malocclusion and orthodontic treatment needs (Table2). The WHO has adopted this index to examine and determine malocclusion status in oral health research surveys (WHO, 1993).

Table1: Dental Aesthetic Index components, regression coefficients and their weights.

No.	Dental Aesthetic Index Component	Actual weights	Rounded weights
1	*No of missing visible teeth (incisors, canines, premolars) in the maxillary and mandibular arches*	*5.76*	*6*
2	*Assessment of crowing in the incisal segment (0=No segment; 1=one segment; 2=two segments)*	*1.5*	*1*
3	*Assessment of spacing in the incisal segment (0=No segment; 1=one segment; 2=two segments)*	*1.31*	*1*
4	*Midline diastema in mm*	*3.3*	*3*
5	*Largest anterior irregularity on the maxilla in mm*	*1.34*	*1*
6	*Largest irregularity on the mandible in mm*	*0.75*	*1*
7	*Anterior maxillary overjet in mm*	*1.62*	*2*
8	*Anterior mandibular overjet in mm*	*3.68*	*4*
9	*Vertical anterior open bite in mm*	*3.9*	*4*
10	*Anteroposterior molar relationship: 0=Normal; 1=half; 2=one full cusp*	*2.9*	*3*
11	*Constant*	*13.36*	*13*

Table 2 Categories of the Dental Aesthetic Index score

Score	Severity of Malocclusion	Complexity of OTN
<=25	*Normal/minor malocclusion*	*No/slight treatment need*
26-30	*Definite malocclusion*	*Elective treatment*
31-35	*Severe malocclusion*	*Treatment highly desirable*
>=36	*Very severe/handicapping malocclusion*	*Mandatory treatment*

OTN = Orthodontic Treatment Need

2.7 The Impact of Fixed orthodontic treatment on QoL

It is useful to quantify how fixed orthodontic appliances affect patients' daily lives in order to identify potential issues. This is especially relevant given the finding that patients could potentially experience less anxiety if they had access to adequate information about their experiences (Nagarajappa et al., 2014). The impact of fixed appliances on a patient's daily activities will not lessen as they progress through treatment (Nagarajappa et al., 2014). How they manage and cope with orthodontic treatment all starts at the onset, when patients and their parents are informed of the impact orthodontic appliances may have on their daily living. Treatment expectations are realistic and they tend to cope better through the course of their treatment. It has also been suggested that treatment should be commenced as early as possible, as younger individuals may be better able to adapt to fixed orthodontic appliances due to their lesser influence on everyday living (Nagarajappa et al., 2014).

2.8 Current instruments employed

Overview:

In the field of dentistry, several tools have been developed over the years to evaluate the impact of oral health, on the quality of life for various age groups, including children and adolescents. These tools are essential in understanding how dental conditions and orthodontic treatment affect a patient's well-being. Some notable instruments currently used include The Child Perceptions Questionnaire (CPQ_{11-14}) The Oral Health Impact Profile (OHIP) Child Oral Impact on Daily Performance (OIDP) Child Oral Health Impact Profile (COHIP) COHIP ortho and The Orthodontic Quality of Life Assessment Survey ($OQoLAS_{11-14}$).

The Orthodontic Quality of Life Assessment Survey for 11-14-year-old was regarded as a suitable option for this research investigation, as it assesses OHRQoL in adolescents undergoing orthodontic treatment. OQoLAS, which was designed and validated in 2008, recognizes the necessity for an age-specific and orthodontic-specific questionnaire. It has shown validity and reliability in assessing the influence of orthodontic treatment on the well-being of teenagers. OQoLAS studies have indicated improvement in emotional well-being throughout the first six months of orthodontic treatment, with subsequent improvements in social, emotional, and functional constraints during the final six months of therapy.

There is a myriad of instruments that were developed for the assessment of OHRQoL in adults. Instruments developed for use in children were designed incorporating generic questions including, but not limited to dental caries, pain, sepsis, occlusal discrepancy, and so forth. They include The Child Perceptions Questionnaire (CPQ_{11-14}), The Oral Health Impact Profile (OHIP), Child-Oral Impact on Daily Performance (COIDP), Child Oral Health Impact Profile (COHIP), COHIP-ortho and The Orthodontic Quality of Life Assessment Survey ($OQoLAS_{11-14}$).

2.8.1 The Child Perceptions Questionnaire for 11-14-year-old children ($CPQ_{11–14}$)

Jokovic and his colleagues (2002), developed the Child Perceptions Questionnaire ($CPQ_{11–14}$), for children, since most fixed orthodontic treatment commences between the ages of 11-14 years, It was initially set out as a 37-tier instrument, but since has been adjusted into four substrates, including, functional limitation (FL), oral symptoms (OS), social well-being (SWB) and emotional well- being (EWB). The variables measured, include the frequency of activities in the past 3 months, relating to dentition, jaws, and lips. The subscale scores are calculated by the addition of the response codes. Worse OHRQoL is denoted by high scores (Jokovic et al., 2002).

In 2011, Costa and his colleagues carried out a cross-sectional study with 11-14-year-old Brazilian adolescents. The malocclusion of five hundred and seventy-nine children was clinically examined. They were also asked to complete the proposed $CPQ_{11–14}$ questionnaire which was measured against a control group of children who had no existing malocclusion. The scores calculated, showed a considerable negative impact on OHRQoL.

Agou and co-workers (2008) conducted a longitudinal study in a sample of 118 individuals aged 11-14 years, of these there were 74 comprised the treatment group and the remaining participants were the control group. The questionnaires were completed by the study sample before and after treatment. Assessment with this tool showed that OHRQoL improved over time (Agou et al., 2008).

2.8.2 The Oral Health Impact Profile (OHIP):

This tool is beneficial for all age groups, even though it was originally designed for adults. Currently, it has been adapted and validated for teenagers as well (Navabi et al., 2012). In 2012, Navabi and his colleagues conducted a cross-sectional study, with a sample of 302 Iranian

adolescents, of which 152 comprised the control group. Individuals over the age of 14 years completed a self-administered questionnaire at a follow-up session after the placement of fixed orthodontic brackets. They measured domains such as social, physical, and functional limitations, and concluded that orthodontic treatment leads to an improvement in OHRQoL. A similar cross-sectional study of 1675 Brazilian adolescents aged 15-16 years, assessed their OHRQoL using the OHIP tool. On completion of orthodontic treatment, it was reported that they had better OHRQoL scores than those who were under treatment or those who never had treatment (de Olivier et al., 2004).

In another longitudinal study done by Chen et al. (2010), whereby 250 Chinese adolescents, comprising an average age group of 15 years, completed the OHIP questionnaire, at six designated time frames: 1 week, 1, 3, and 6 months, post appliance placement and post-treatment. It was found that the OHRQoL measures were better post-orthodontic treatment as compared with those undergoing treatment a month after the commencement of treatment.

2.8.3 Child-Oral Impact on Daily Performance (OIDP)

The OIDP instrument measures the oral impacts on certain daily activities such as oral hygiene, social and emotional contact, eating, smiling, speech, studying, laughing, sleeping as well as relaxing (Locker, 2007). They measured variables such as frequency scales with possible responses ranging from 0 (never) to 5 (every day) and severity on a scale of 0 (none) to 5 (very severe). The child- OIDP follows the same principle as OIDP, with picture illustrations, applicable to its age group (Gherunpong et al., 2004).

Gherunpong et al. (2004) evaluated the Child-OIDP index, among 1100 children aged 11-12 years. Their main finding of severe oral symptoms was related to difficulty in eating and smiling. The author regarded this construct as reliable and valid.

Bernabe et al. (2008) recruited 1657 Brazilian adolescents, between the ages of 15-16 years old. The sample was randomly selected from 11 public schools and 10 private schools. Current orthodontic patients were allowed to participate. They were interviewed face-to-face with the structured OIDP instrument. The author's main findings demonstrate that oral symptom scores were worse than the other subscales and that a quarter of patients reported side effects to wearing orthodontic appliances.

2.8.4 Child Oral Health Impact Profile (COHIP)

Broder et al. (2007) developed the 38-item COHIP questionnaire which is regarded as a refinement of the CPQ questionnaire. COHIP is applicable to paediatric, orthodontic, and craniofacial clinical groups for children aged 8-16 years. It is also the only tool that uses both positively and negatively formulated questions.

It consists of 38 items divided into six domains, including oral health status, well-being functionally, emotionally, and socially, schooling, treatment expectations, and awareness of self-image (Dunlow et al., 2007). COHIP-38 comprises five subscales exactly the same as $CPQ_{11–14}$. In addition, peer pressure and schooling are incorporated into the questionnaire. It uses a Likert scale of 1-5 as well as an extra “I don't know "option. A further adaptation of this instrument is the COHIP-Ortho, which is more applicable to individuals undergoing orthodontic treatment where 11 items were selected from COHIP-38, to construct the short version (Kragt et al., 2015). Kragt and colleagues conducted a cross-sectional study of 243 orthodontically treated patients.

The children were between 8 and 15 years of age. 11 items were selected from the short version, COHIP-38 questionnaire, to construct the COHIP –Ortho instrument. The COHIP-ortho was designed to use specifically on children and to make the investigation of OHRQoL more simplified. The low scores obtained in the study showed high OHRQoL.

Osta (2015), recruited 311 children to participate in a study, to test the validity of COHIP questionnaire. They conclude that COHIP was able to dissect varying clinical conditions and found that the tool was more sensitive to measuring OHRQoL of orthodontic and cleft lip and palate patients.

2.8.5 The Orthodontic Quality of Life Assessment Survey for 11-14-year-old adolescents. (OQoLAS$_{11-14}$)

The OQoLAS 11-14 was developed in 2008, by Stewart and his colleagues (Feusier, 2015). The premise for this design was the recognition of an age-specific and orthodontic-specific questionnaire. The authors were able to demonstrate validity and reliability. In another study, Feusier (2015), used the practice-based research network approach, to recruit subjects from a private setting. 145 subjects from 16 orthodontic surgeries were surveyed using the OQoLAS 11-14. Patients between the ages of 11 and 14 years completed the survey twice with a 6-8-month intervals. To assess the severity of malocclusion, they used pretreatment radiographs and the Index of Complexity, Outcome, and Need (ICON), prior to receiving orthodontic treatment. The author demonstrated that during the first six months of treatment, the patient's emotional well-being improved significantly. It was noted that social, emotional, and functional limitations and overall OHRQoL improved significantly during the last six months of treatment.

Chapter 3

Research design and methodology

3.1 Study design:

Prospective Cohort study.

3.2 Population Sample

3.2.1 Study Population:

The participants were patients with a dental age between 11-16 years, who entered the orthodontic fixed appliance treatment program.

3.2.2 Selection criteria: All patients requiring orthodontic treatment was selected consecutively. Convenience sampling was employed.

3.2.3 Sample size: A total of 60 subjects with a 10% margin of error was required for the research study. However, a sample of 75 participants was required to account for a 20% attrition rate. The final sample size was 83 participants out of 203 patients that received fixed orthodontic treatment.

3.2.4. Inclusion criteria: All adolescent patients aged between 11 and 16 years, who were to receive fixed orthodontic appliance therapy, were eligible for the study. Patients and their caregivers who were willing to participate needed to sign the relevant consent forms provided, prior to receiving treatment. Patients should also have had the cognitive ability to answer a questionnaire.

3.2.5 Exclusion criteria: Patients who had previously received any form of orthodontic treatment were not eligible to participate in the study. Certain handicapping malocclusions involving orthognathic surgery were also excluded.

3.2.6 Patient consultation:

When a patient and their caregiver entered the orthodontic clinic, they were approached and informed about the research study. The purpose of the study was explained by the researcher to the caregiver; that it could possibly assist the Orthodontic department with providing better patient-centered quality care. Once they had volunteered to participate in the study, an information sheet together with a consent was provided to the caregiver. At this stage, they completed the socio-demographic assessment form and a validated Orthodontic Quality of Life Assessment Survey (OQOLAS $_{11\text{-}14}$) form. The pair of participant and parent/caregiver were informed that orthodontic treatment would commence and continue as scheduled by the attending clinician.

3.2.7 Sociodemographic questionnaire: The caregiver completed the socio-demographic questionnaire as outlined in Appendix 5. The caregiver was assured of privacy and confidentiality concerning the sensitive information on this form.

3.2.8 Orthodontic Quality of Life Assessment Survey (OQOLAS $_{11\text{-}14}$): (Appendix 6)

Each participant completed the OQoLAS $_{11\text{-}14}$ questionnaire at the same visit, just before they received fixed orthodontic treatment. The questionnaire was collected by the researcher and stapled to the corresponding socio-demographic questionnaire. The OQOLAS $_{11\text{-}14}$ questionnaire was completed again 6-8 months later, from the date of banding the participant.

The questionnaire is divided into 3 subscales or domains including functional well-being, emotional well-being and social well-being. The individual scores for each question, the cumulative scores for each domain, and an overall total score were calculated.

3.2.9 Dental Aesthetic Index (DAI): (Appendix 7)

The complexity of malocclusion and normative need for orthodontic treatment was assessed using the Dental Aesthetic Index (DAI) on the patients' study models. Measurements obtained from orthodontic study models were added to the DAI scorecard. The DAI score card had a unique code which corresponded with the participants' OQoLAS questionnaire, as well as the parents' socio-demographic questionnaire. The total DAI score for each of the participants being assessed was noted.

3.2.10 Control group

Each participant was his or her own control, as the questionnaire was completed prior to receiving fixed orthodontic treatment. This served as a baseline measure.

3.2.11 Place and Time

The research study was conducted at the two Oral Health Centre sites of the Dental Faculty, University of the Western Cape, viz, Mitchell's Plain and the Tygerberg Hospital complex. All questionnaires were completed by the participants in a quiet area without distractions. All forms and questionnaires were completed at the time of their scheduled orthodontic appointment at T0 and T1.

3.3 Ethics

(Ethics No: BM19/3/21)

3.3.1 Research on children: Oral health during childhood predicts the oral health in adulthood and is of particular importance to conduct OHRQoL research in children, since they comprise the majority seeking orthodontic treatment. Due to immense growth and development of the craniofacial tissues of adolescents during this dental age, it becomes pertinent to carry out research during this age group. A window of opportunity exists between the ages of 12 -14 years, when orthodontic treatment during this time yields beneficial results in shorter time frames of 18-24 months as compared to treatment extending an extra 3-4 years if instituting treatment at a later age.

3.4 Calibration

Two examiners, previously trained and calibrated, performed the DAI examinations. Training consisted of a theoretical discussion followed by a practical exercise. Calibrations resulted in an intraclass correlation coefficient greater than 0.92, indicating satisfactory inter- and intra-examiner agreement.

3.5 Statistical analysis

The data analysis was performed using REDCAP ®, Microsoft Excel 2019 and STATA version 17 (StataCorp. 2021. Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC) . REDCAP ® was used for data capturing. RECDAP and Microsoft Excel was used for data cleaning, editing, sorting, and coding. The excel file was then imported into STATA software. Descriptive statistics (i.e., frequencies, percentages, means, standard deviations) and first-order analysis (i.e. Fisher's exact test) were performed. Likewise, t-tests or one-way ANOVA or Kruskal Wallis tests were performed to determine significant relations of the mean emotional, functional, social-wellbeing and OHRQoL and sociodemographic information. All

statistical tests were considered significant at 95% confidence interval with a p-value less than 0.05.

3.6 Informed consent procedure:

Information Sheet: (Appendix 2). The researcher verbally explained the details of the study to prospective participants and their caregivers and invited patients to participate. Once they expressed a desire to participate, the parent as well as the participant received an information sheet, which explained the research in detail. The information sheet contained the following information:

- Aim of the study
- The importance of the studysTo ask for their participation

Assent (Appendix 3) **and Consent:** (Appendix 4) Once the parent and patient voluntarily accept to participate in the study, three forms were signed.

A consent form was signed by the primary caregiver. This allowed the researcher to have access to their socio-demographic records. A second consent form was signed by the primary caregiver, to allow their child/minor to participate in the study.

3.7 Confidentiality:

Confidentiality was assured to patients and their caregiver, in the information and consent letters. All data collected was kept confidential. Participants were made aware of the unique coding system that was to be used to link all four documents. No names or address were on these forms

nor used or released to any staff member of the orthodontic clinic, to any family member or any treating clinician. Participants' dental records were accessed only to obtain clinical and demographic information, for record purposes. Patients' questionnaire and parents' socio demographic responses, were kept in a locked filing cabinet at the orthodontic clinic. Only the researcher had access to the data material.

Chapter 4

Results

4.1 Introduction

Baseline characteristics are presented as demographic and socioeconomic status of participants and parents/caregivers respectively. Data on the severity of malocclusion status and the complexity of orthodontic treatment need using the Dental Aesthetic Index were also recorded. The overall scores for oral health- related quality of life using the Orthodontic Quality of Life Assessment Survey (OQoLAS) instrument at the start of treatment (T0), and again 6-8 months at follow-up (T1), are presented in tables 6-9. A comparison of oral health – related quality of life scores between T0 and T1 is presented in tables

4.2 Baseline characteristics.

Descriptive data for all the registered variables is expressed in Table 3. A total of 310 adolescents presented for fixed orthodontic treatment from June 2019 to March 2021. The demographic results show that of the 83 eligible patients who participated in this study, 58 % were in the 11-13-year age category comprised a higher ratio of females (64%).

The socioeconomic status of the parent /caregiver show a statistically significant correlation between household wages and $OQoLAS_{11\text{-}14}$ mean (SD), ($p = 0.0094$).

4.3 The Severity of Malocclusion and Complexity of Orthodontic Treatment Need

The distribution of participants DAI score and overall $OQOLAS_{11\text{-}14}$ scores as presented in Table 3 revealed no statistically significant association ($p = 0.5220$).

Majority of participants (n = 29) demonstrated highly desirable treatment need and 26 participants a high OHRQoL score of 81.42(SD = 17.3) were categorized as mandatory need for treatment as per DAI.

Table 3: Sociodemographic characteristics of adolescent, and participants' parent/caregiver (n = 83)

Variable	n (%)	OQoLAS$_{11-14}$ Mean (SD)	P value
Demographic adolescent			
Age			
11-13 yrs.	48(58)	74.4(18,1)	0.931
14-16 yrs.	35(42)	74.6(16,7)	
Sex			
Male	30(36)	70,97(16,62)	
Female	53(64)	76,96(17,63)	0.0277
Socioeconomic status parent/caregiver			
Level of education			
Grade 12 or less	41(50)	72,78(19,29)	
High school graduate	26(32)	78,04(15,58)	
Tertiary Education	15(18)	73,33(14,68)	0,4667
Employment			
Full time	34(42,5)	74,41(17,63)	
Part time	17(21,25)	80,47(15,56)	
Unemployed looking for work	19(23,75)	66,53(17,84)	
Unemployed not looking for work	10(12,50)	81,6(17,19)	0,058
Household Wages			
<R3000	19(22,89)	85,05(17,12)	
>R3000	9(10,84)	68(13,37)	
Chose not to answer	55(66,27)	72,36(16,89)	
			0,0094
Household Salary			
<R7000	27(32,53)	75,37(18,75)	
>R7000	15(18,07)	71,8(16,33)	
Chose not to answer	41(49,40)	75,51(17,19)	0,7666
Complexity of Orthodontic treatment need (DAI Category)			
No/Slight (<25)	11(13,25)	68,64(13,03)	
Elective (26-30)	17(20,48)	72,71(22,99)	0,5220
Highly desirable (31-35)	29(34,94)	72,41(13,91)	
Mandatory (> 35)	26(31,33)	81,42(17,30)	

Complexity of Orthodontic Treatment Need and OQOLAS$_{11-14}$ Mean (SD) scores. 66% of participants needed orthodontic treatment, whereas the remainder required slight or elective orthodontic treatment. 49% and 55% of the caregivers chose not to disclose their household salary and wage respectively. There was quite a high non-response rate to household wage and salary.

4.3.1 Severity of Malocclusion and Complexity of Orthodontic Treatment Need by Age (Table 4)

Table 4: Distribution of Participants' Complexity of Orthodontic Treatment by Age

Severity of malocclusion	Complexity of Orthodontic Treatment Need by Age in years						Total n (%)
	11 n (%)	12n (%)	13n (%)	14n (%)	15n (%)	16n (%)	
Normal/Slight Slight OTN	1(5.88)	3(20.00)	2(12.50)	2(15.38)	2(18.18)	1(9.09)	11(13.25)
Elective OTN	3(17.65)	3(20.00)	3(18.75)	1(7.76)	5(45.45)	2(18.18)	17(20.48)
Highly Desirable	7(41.18)	3(20.00)	7(43.75)	4(30.77)	3(27.27)	5(45.45)	29(34.94)
Mandatory	6(35.29)	6(40.00)	4(25.00)	6(46.15)	1(9.09)	3(27.27)	26(31.33)
Total	17(20.48)	15(18.07)	16(19.28)	13(15.66)	11(13.25)	11(13.25)	83(100)

$p = 0.75$ 65% of participants orthodontic treatment need was highly desirable or mandatory

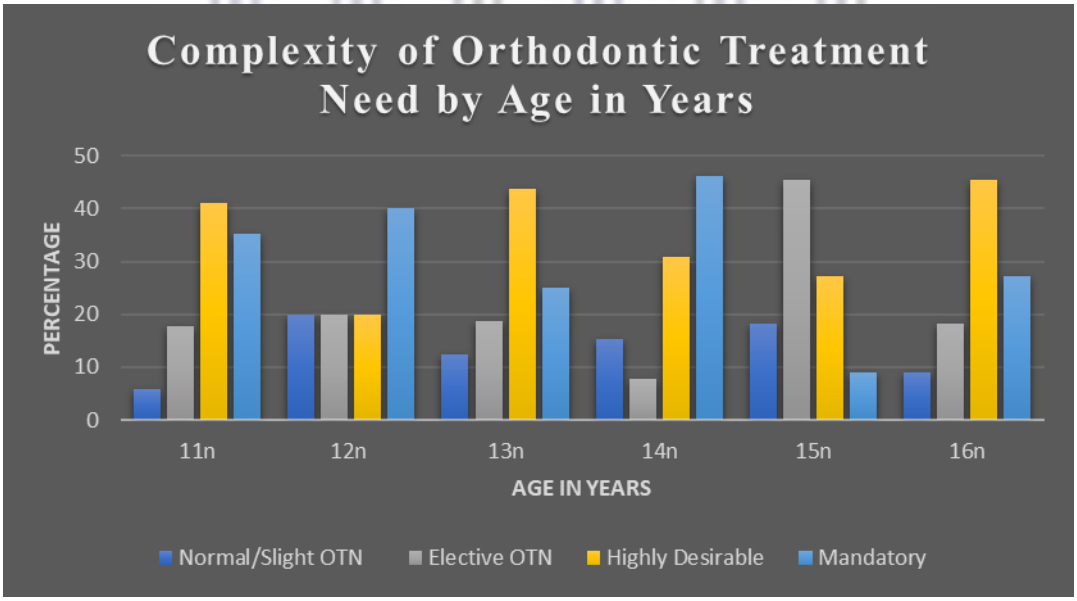

Fig 1: *Percentages of participants Complexity of OTN by Age.*

All age groups present a significant percentage of participants requiring "Highly Desirable" orthodontic treatment (20-40%).

4.3.2 Severity of Malocclusion and Complexity of Orthodontic Treatment Need by Sex (Table 5)

Table 5: Distribution of Participants' Complexity of Malocclusion and Orthodontic Treatment Need by Sex

Complexity of Orthodontic Treatment Need by Sex									
Sex	**n (%)**	**Slight**	**Total (Slight)**	**Elective**	**Total (Elective)**	**Desirable**	**Total (Desirable)**	**Mandatory**	**Total (Mandatory)**
Male	30(36.14)	4(13.33)	4(36.36)	9(30.00)	9(52.94)	19(33.33)	10(34.48)	7(23.33)	7(26.92)
Female	53(63.66)	7(13.21)	7(63.64)	8(15.09)	8(47.06)	19(35.85)	19(65.52)	19(35.85)	19(73.08)

p = 0.388 There is no SS association between DAI cat and sex, p =0.388 [Fishers exact test]

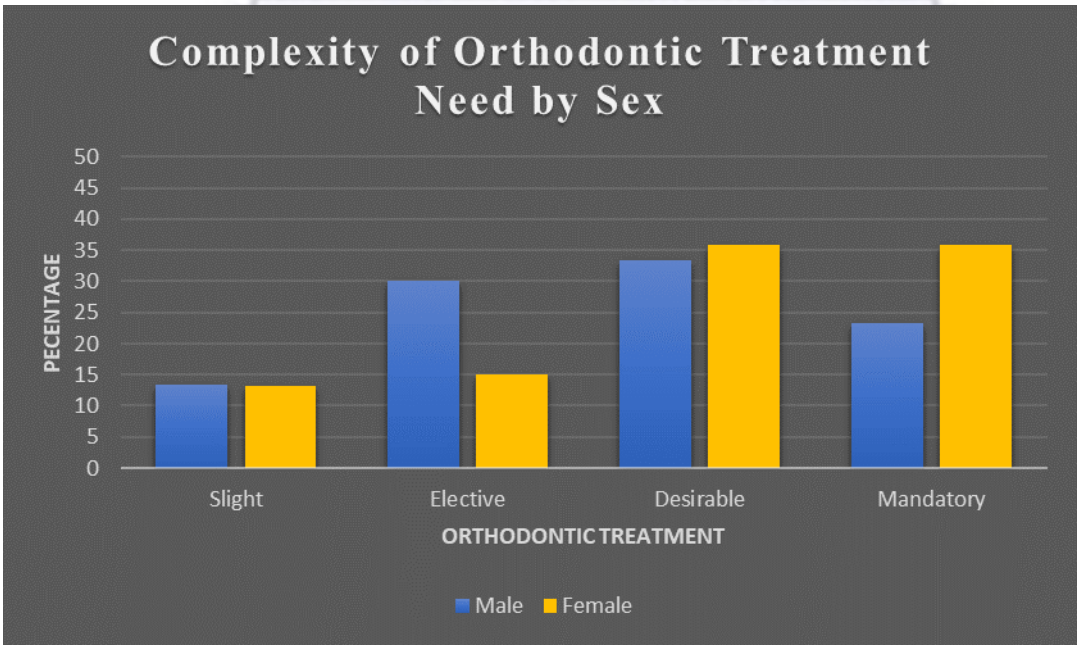

Fig.2: *Percentage distribution of participants Complexity of OTN by Sex.*

Female scores were higher in all categories except 52% of male participants' required elective orthodontic treatment.

4.4.1 Self-Perception of Oral-Health Status by Dental Aesthetic Index (DAI) Scores (Table 6)

Table 6: Distribution of Participants according to DAI scores and Self-perceived Oral-Health Status

Dental Aesthetic Index score (Orthodontic Treatment Need)						
Self-perceived Oral - Health Status	Slight Need n (%)	Elective n (%)	Desirable n (%)	Mandatory n (%)	*p* value	Total n (%)
The health of your teeth and mouth is…						
Excellent	1(20.00)	1(20.00)	0(0.0)	3(60.00)	0.431	5(6.02)
Very good	2(20.00)	0(0.00)	5(50.00)	3(30)		10(12.05)
Good	4(12.90)	8(25.81)	11(35.48)	8(25.81)		31(37.35)
Fair	4(14,81)	4(14,81)	9(33,33)	10(37,04)		27(32,53)
Poor	0(0.00)	4(40.00)	4(40.00)	2(20.00)		10(12.05)
Total	11(13.25)	17(20.48)	29(34.94)	26(31.33)		83(100)
Does the condition of your teeth/ mouth affect your life overall?						
Not at all	0(0.00)	1(33.33)	1(33.33)	1(33.33)	0.762	3(3.61)
Very little	0(0.00)	1(25.00)	1(25.00)	2(50.00)		4(4.82)
Some	5(17.24)	5(17.24)	13(44.83)	6(20.69)		29(34.94)
A lot	4(13.33)	4(13.33)	10(33.33)	12(40.00)		30(36.14)
Very much	2(11.76)	6(35.29)	4(23.53)	5(29.41)		17(20.48)
Total	11(13.25)	17(20.48)	29(34.94)	26(31.33)		83(100)
How pleased are you with your teeth and mouth?						
Not at all	0(0.00)	2(11.76)	3(10.34)	1(3.85)	0.382	24(28.2)
Very little	1(9.09)	0(0.00)	0(0.00)	1(3.85)		29(34.94)
Some	4(36.36)	6(35.29)	7(24.14)	5(19.23)		22(26.51)
A lot	5(45.45)	5(29.41)	12(41.38)	7(26.92)		2(2.41)
Very much	1(9.09)	4(23.53)	7(24.4)	12(46.15)		6(7.23)
Total	11(13.25)	17(20.48)	29(34.94)	26(31.33)		83(100)

More than 50% of participants regarded their teeth and mouth to be good to excellent. More than 50% of participants regarded the condition of their teeth and mouth to affect their life overall. Moe than 60% reported they were not pleased with their teeth and mouth.

4.4.2 Self-perception of Oral Health Status according to Age (Table 7).

Table 7: Distribution of Participants according to Self-Perception of Oral-Health Status by Age

Self-Perceived Oral-Health Status						
	T0			**T1**		
	11-13 yrs.	**14-16yrs**	***p value***	**11-13 yrs.**	**14-16 yrs.**	***p* value**
The health of your teeth and mouth is…						
Excellent	3(60.00)	2(40.00)	0.606	5(55.56)	4(44.44)	0.996
Very good	5(50.00)	5(50.00)		7(53.85)	6(46.15)	
Good	16(51.61)	15(48.39)		14(60.87)	9(39.13)	
Fair	16(59.26)	11(40.74)		14(58.33)	10(41.67)	
Poor	8(80.00)	2(20.00)		8(57.14)	6(42.86)	
Total	48(57.83)	35(42.17)		48(57.83)	35(42.17)	
Does the condition of your teeth/ mouth affect your life overall?						
Not at all	2(66.67)	1(33.33)	0.908	3(42.86)	4(57.14)	0.522
Very little	3(75.00)	1(25.00)		10(76.92)	3(23.08)	
Some	18(62.07)	11(37.93)		9(50.00)	9(50.00)	
A lot	16(53.33)	14(46.67)		8(53.33)	7(46.67)	
Very much	9(52.94)	8(47.06)		18(60.00)	12(40.00)	
Total	48(57.83)	35(42.17)		48(57.83)	35(42.17)	
How pleased are you with your teeth and mouth?						
Not at all	15(62.50)	9(37.50)	0.436	10(66.67)	5(33.33)	0.737
Very little	13(44.83)	16(55.17)		5(50.00)	5(50.00)	
Some	14(63.64)	8(36.36)		11(47.83)	12(52.17)	
A lot	2(100)	0(0.00)		9(64.29)	5(35.71)	
Very much	4(66.67)	2(33.33)		13(61.90)	8(38.10)	
Total	48(57.83)	35(42.17)		48(57.83)	35(42.17)	

60% of the 11-13-year-old reported the health of their teeth as excellent, whereas 80% 0f participants regarded it to be poor in comparison to the 14-16-year-old group. However, at T1, the younger age category reported an improvement of their oral health status.

4.4.3 Distribution of Participants according to Self-Perception by Sex. (Table 8)

Table 8: Distribution of Participants' according to Self-perception of Oral-Health Status by Sex.

Distribution of Participants' Self-Perception of OHS by Sex						
	T0			**T1**		
	Male n (%)	**Female n (%)**	***p* value**	**Male n (%)**	**Female n (%)**	***p* value**
The health of your teeth and mouth is…						
Excellent	2(40.00)	3(60.00)	0.494	5(55.56)	4(44.44)	0.804
Very good	3(30.00)	7(70.00)		4(30.77)	9(69.23)	
Good	8(25.81)	23(74.19)		8(34.78)	15(65.22)	
Fair	13(48,15)	14(51.85)		8(33.33)	16(66.67)	
Poor	4(40.00)	6(60.00)		5(35.71)	9(64.29)	
Total	30(36.14)	53(63.86)		30(36.14)	53(63.86)	
Does the condition of your teeth/ mouth affect your life overall?						
Not at all	1(33.33)	2(66.67)	0.925	2(28.57)	5(71.43)	0.779
Very little	1(25.00)	3(75.00)		6(46.15)	7(53.85)	
Some	9(31.03)	20(68.97)		8(44.44)	10(55.56)	
A lot	12(40.00)	18(60.00)		5(33.33)	10(66.67)	
Very much	7(41.18)	10(58.82)		9(30.00)	21(70.00)	
Total	30(36.14)	53(63.86)		30(36.14)	53(63.86)	
How pleased are you with your teeth and mouth?						
Not at all	8(33.33)	16(66.67)	0.212	6(28.57)	15(71.43)	0.438
Very little	7(24.14)	22(75.86)		8(57.14)	6(42.86)	
Some	12(54.55)	10(45.45)		9(39.13)	14(60.68)	
A lot	1(50.50)	1(50.50)		3(30.00)	7(70.00)	
Very much	2(33.33)	4(66.67)		4(26.67)	11((73.33)	
Total	30(36.14)	53(63.66)		30(36.14)	53(63.86)	

The results in table 8 present the female participants not pleased with their oral health status as compared to male participants. More than 60% of females reported that they were not pleased with their teeth at T0. This increased to over 70% at T1.

4.5.1 OHRQoL using overall OQoLAS*11-14 scores* according to Age (Table 9)

Table 9: Distribution of Participants overall OQOLAS$_{11-14}$ score by Age

OQOLAS$_{11-14}$									
Age in years	**T0**			**T1**			**T1-T0**		
	n (%)	**Mean (SD)**	***p* value**	**n (%)**	**Mean (SD)**	***p* value**	**n (%)**	**Mean (SD)**	***p* value**
11-13	48 (57.83)	74.94 (18.1)	0.931	48 (57.83)	50.77 (16.2)	0.4	48 (57.83)	-24.17 (17.17)	0.4
14-16	35 (42.17)	74.6 (16.7)		35 (42.17)	53.43 (10.6)		35 (42.17)	-17(19.6)	

The 11-13-year age group reported a higher OHRQoL score after 6-8 months into treatment [-24.17 (17.17)] compared with the 14-16 age group [-21.17 (19.6)].

4.5.2 OHRQoL using overall OQoLAS*11-14* scores according to Age according Sex (Table 10)

Table 10: Distribution of Participants' OQOLAS*11-14* Score by Sex

OQoLAS *11-14*									
Sex	**T0**			**T1**			**Difference (T1-T0)**		
	n (%)	Mean (SD)	*p* value	n (%)	Mean (SD)	*p* value	n (%)	Mean (SD)	*p* value
Male	30 (36.14)	70.97 (16.62)	00277	30 (36.14)	50.57 (13.98)	0.5231	30 (36.14)	-20.4 (18.69)	0.3479
Female	53 (63.86)	76.96 (17.63)		53 (63.86)	52.64 (14.25)		53 (63.86)	-24.32 (17.88)	

There is a statistical significance of OHRQoL score at T0Both age groups score were similar, showing an improved OHRQoL at T1, (-20.4 and -24.32 respectively).

4.6.1 OHRQoL using OQoLAS$_{11-14}$ Functional Limitation Domain scores at T0 and T1 According to Age (Table 11)

The domains of this instrument presented varied outcomes and are reflected in Tables 11- 18.

Table 11: Distribution of Participants' Functional Limitations by Age Category

Functional Limitation (FL)						
Age in years	**T0**		**T1**		**Difference (T1-T0)**	
	Mean (SD)	***p* value**	**Mean (SD)**	***p* value**	**Mean (SD)**	***p* value**
11-13	28.5(8.52)	0.9409	22.38(6.64)	0.6038	-6.13 (7.34)	0.7268
14-16	28.63(6.62)		23.11(6.01)		-5.51 (8.48)	

Both age categories did not show much improvement in FL domain score.

4.6.2 OHRQoL using OQoLAS$_{11-14}$ Functional Limitation Domain scores at T0 and T1 According to Sex (Table 12)

Table 12: Distribution of Participants' Functional Limitation score by Sex.

Functional Limitation (FL)						
Sex	**T0**		**T1**		**Difference (T1-T0)**	
	Mean (SD)	*p* value	Mean (SD)	*p* value	Mean (SD)	*p* value
Male	27.47 (6.47)	0.3383	22.13 (5.93)	0.5538	-5.33 (8.13)	0.614
Female	29.17 (8.36)		23. (6.62)		-6.17 (7.66)	

Functional limitation domain scores did not improve as much when compared to other domains.

4.6.3 OHRQoL using OQoLAS$_{11-14}$ Emotional Well-Being (EWB) Domain scores at T0, T1 according to Age (Table 13)

Table 13: Distribution of Participants' Emotional Well-Being by Age category

Emotional Well-Being (EWB)						
Age in years	**T0**		**T1**		**T1-T0**	
	Mean (SD)	***p* value**	**Mean (SD)**	***p* value**	**Mean (SD)**	***p* value**
11-13	20.54(6.45)	0.654	11.69(5.55)	0.3345	-8.85 (7.30)	0.2738
14-16	19.89(6.70)		12.74(3.78)		-7.14 (6.54)	

EWB mean scores across the 2 age categories were similar, with 11-13-year-old presenting a higher score (20.54), than 14-16-year old (19.89). This indicates that EWB is not impacted as much as the 14-16 year old group. However, at T1, it is the 14-16-year old who scored more, indicating a lower quality of life with reference to EWB.

4.6.4 OHRQoL using OQoLAS$_{11-14}$ Emotional Well-being Domain scores at T0, T1 according to Sex (Table 14)

Table 14: Distribution of Participants Emotional Well-being by Sex.

Emotional Well-Being (EWB)						
Sex	**T0**		**T1**		**T1-T0**	
	Mean (SD)	*p* value	Mean (SD)	*p* value	Mean (SD)	*p* value
Male	19.27 (7.01)	0.2973	12.07 (5.78)	0.9271	-7.2 (8.04)	0.3641
Female	20.83 (6.24)		12.17 (4.36)		-8.66 (6.35)	

Female participants display a higher EWB at the start of treatment compared to male participants. This presents as poorer quality of life according to the EWB domain.

4.6.5 OHRQoL using OQoLAS$_{11-14}$ Social Well-being Domain scores at T0, T1 according to Age (Table 15)

Table 15: Distribution of Participants' Social Well-being by Age Category

Social Well-Being (SWB)						
Age in years	**T0**		**T1**		**Difference (T1-T0)**	
	Mean (SD)	*p* value	Mean (SD)	*p* value	Mean (SD)	*p* value
11-13	25.90(7.55)	0.9147	16.71(6.45)	0.4929	-9.19 (6.52)	0.6866
14-16	26.086(8.47)		17.57(4.27)		-8.51 (8.64)	

No statistical significance noted across the age categories.

4.6.6 OHRQoL using OQoLAS$_{11-14}$ Social Well-being Domain scores at T0 and T1 according to Sex (Table 16)

Table 16: Distribution of Participants' Social Well-being by Sex

Social Well-Being (SWB)						
Sex	**T0**		**T1**		**Difference (T1-T0)**	
	Mean (SD)	*p* value	Mean (SD)	*p* value	Mean (SD)	*p* value
Male	24.23 (7.93)	0.1314	16.37 (5.2)	0.3927	-7.87 (7.25)	0.3426
Female	26.96 (7.78)		17.47 (5.86)		-9.49 (7.55)	

Female participants scored higher at than males at T0 and T1.

4..7 Mean Score of OQoLAS$_{11\text{-}14}$ Domains at T0 and T1 (Table 17)

Table 17 Mean and Standard Deviation of all Domains

Domain	T0			T1			Difference (T1-T0)		
	Mean (SD)	Min score	Max score	Mean (SD)	Min score	Max score	Mean (SD)	Min score	Max score
Functional limitation	28.55(7.74)	12	44	22.69(6.36)	11	37	-5.87(7.79)	-25	10
Emotional Well-being	12.13(4.88)	7	35	20.27(6.53)	7	35	8.13(6.99)	-21	21
Social Well-being	25.98(7.90)	10	44	17.07(5.62)	10	40	-8.90(7.44)	-29	11

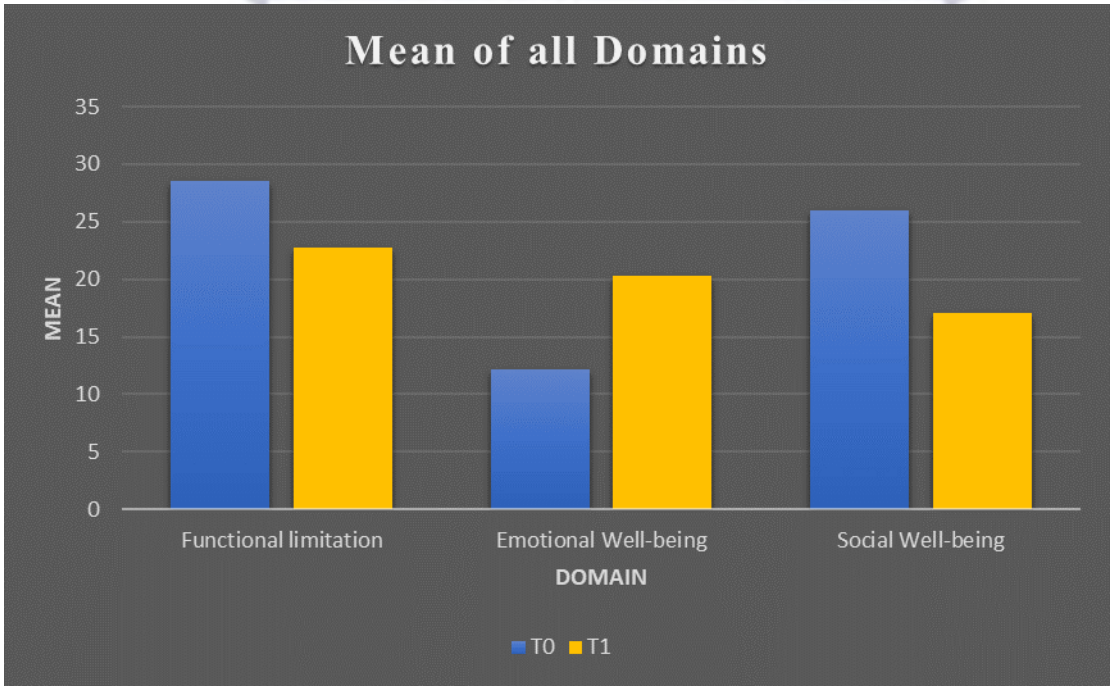

Fig 1: *Comparison of the Mean of all Domains*

Functional limitation mean values at T0 and T1 were high, indicative of limited improvement in function limitation. However, Emotional well-being mean score increased at T1, which reflect that participants were worse emotionally at T1 as compared to the start of treatment.

4..8 Mean Score of Complexity of OTN by OQoLAS$_{11-14}$ Domain

(Table 18)

Table18: Spearman correlation coefficients of Complexity of OTN by OQoLAS Domain

Complexity of Orthodontic Treatment Need		
OQOLAS$_{11-14}$	**r's**	***p* value**
Total	0.2579	0.0186
Functional Limitation	0.1191	0.2836
Emotional Well-being	0.3056	0.0050
Social Well-being	0.1801	0.1032

A Spearman's correlation was applied to assess the associations between the OQoLAS $_{11-14}$ domains: Functional Limitation, Emotional Well-being and Social Well-being.

Chapter 5

Discussion

5.1 Introduction

The OQoLAS11-14 tool is used to assess how participants' opinions of their dental health and the use of fixed orthodontic appliances affect their overall oral-health-related quality of life (Feusier, 2015). It shows how fixed orthodontic therapy enhances or degrades patients' overall quality of life. In this study, a prospective cohort design was utilized to investigate the influence of fixed orthodontic treatment on OHRQoL in adolescents. The goal was to collect information on socio-demographics, malocclusion status, and the complexity of treatment need for fixed orthodontic therapy as assessed using the DAI scores. All of these variables were studied to ascertain whether they had an impact on adolescents' oral health-related quality of life.

Dental practitioners should be mindful of the unique characteristics of change experienced during adolescence, including physical, psychological, and social parameters (Meade *et al.*, 2016). As dental practitioners become more aware of patients' perspectives and needs regarding their malocclusion status, instruments such as OHIP-14 (as mentioned previously) highlight the importance of not only improving the patients' malocclusion but also their psychological well-being. The primary purpose is to measure the quality of life in order to holistically evaluate the quality of their healthcare.

Researchers ubiquitously are increasingly aware of the relevance of measuring the QOL in areas related to a person's well-being. The impact factors include oral health status, functional, emotional, and social well-being, schooling, treatment expectations, and self-image awareness (Kok *et al*., 2004).

In this study, we used the Orthodontic Quality of Life Assessment Survey OQoLAS$_{11\text{-}14,}$ in adolescents up to the age of 16 years. The domains of this instrument presented varied outcomes, with the emotional well-being (EWB) domain presenting as statistically significant (p = 0.005). Feusier (2015), reported an EWB improvement only during the last 6 to 8 months of treatment, which was significant in adolescents.

5.2 Sociodemographic Factors as determinants of OHRQoL in Adolescents

Patient demographics were evaluated. However, there was no statistically significant association between participants' age and overall OQoLAS 11-14 score (p = 0.931). The sex of the participants which reveals a statistical significance (p = 0.0277) as seen in table 3, does not specify whether this is associated with male or female participants. There are mixed views between sex and OHRQoL, where some studies show no sex difference (Foster Page *et al.,* 2005) and others correlate poor OHRQoL in females (Shaw, 1981; de Paula *et al.,* 2013) or males (Wong *et al.,* 2006).

Apart from clinical oral health factors such as dental caries, gingival problems, or malocclusion, socioeconomic factors may also affect OHRQoL in adolescents. The more traditional indicators associated with poor oral health include parental/caregiver education level, combined household income, and employment status (Galobardes *et al.,* 2006).

Children's oral health status is impacted by the parent's income and education (Van Da Mheen *et al*., 1997; Varga *et al.,* 1998). They continue to say, that a higher income

encourages better living circumstances, including the ability to purchase enough nutritious food that contributes to better general health. This study presented a definite trend between the caregiver's level of education and the OQolAS 11-14 score. Half of the parents/caregivers only had a grade of 12 or less and 47% were unemployed. Parents or caregivers with low socioeconomic status, education level, and income reflect inferior oral health and a resultant poor OHRQoL (O'Brien 2006, Fisher-Owens *et al.,* 2007, Locker 2007, Sabbah *et al.,* 2007, de Paula *et al*., 2013).

5.3 Severity of Malocclusion and Complexity of Orthodontic Treatment Need (OTN)

Table 3 presents the mean OQoLAS11-14 scores at pretreatment as significantly high, and objectively requiring mandatory orthodontic treatment. This demonstrates that the effect of malocclusion on OHRQoL scores was quite high. The result of this study is similar to studies involving other patient groups with malocclusion. (Foster Page, 2005; Zhang, 2008). The literature widely documented the negative impact of malocclusion on adolescents' OHRQoL (de Oliveira & Sheiham, 2004; Marques *et al.,* 2006; Onyeaso, 2009; Choi *et al.,* 2016).

Without knowing the independent impact of the severity of malocclusion, it is difficult to comprehend the impact of orthodontic treatment need complexity and subsequently the impact of orthodontic treatment (Olkun & Sayar, 2019). The expression for the requirement for objective orthodontic treatment as compared to an individual being studied seems greater (Shaw *et al*., 1991). In contrast, orthodontic service providers are interested in the relationship between professionally assessed and self-perceived treatment needs (Cunningham, 1986). This approach encompasses patients' desires, requirements, and preferences and considers aspects such as psychological, social, cultural, and economic dimensions (Cunningham, 1986) which complement the clinician's diagnosis (Delbanco, 1991).

There is a high degree of subjectivity with a variety of perceptions of orthodontic treatment needs among the population. The DAI combines clinical and aesthetic aspects of occlusion that indirectly assess the relative social acceptability of dental appearance. Participants were stratified into age and sex variables to comprehensively determine whether any differences were evident within the subgroups.

5.3.1 Severity of Malocclusion and Complexity of OTN by Age

As presented in table 4, the DAI scores reveal most 15-16-year-olds presented with elective orthodontic treatment. The current trend, to seek orthodontic treatment is influenced by their own opinion, their peers, family members as well as social media. They also have a greater awareness of the benefits of orthodontic treatment, and how their dentofacial appearance can be improved or enhanced. The varied result of the complexity of OTN scores displayed among the 11-14 years could be attributed to a variety of factors such as the psychosocial need for orthodontic treatment similarly seen with the older age group. There was also an uneven distribution of participants according to age, with forty-eight in the 11-14-year age group as compared to thirty-three in the 14-16-year group. Additionally, it is well recognized that patient or parent worries about the necessity of orthodontic treatment do not necessarily align with objective assessments of the same (Onyeasa, 2003; Shue-Te Yeh *et al*., 2000). Another influencing factor is the demand for orthodontic treatment by parents or their children regardless of whether there is a subjective OTN (Hamden, 2004).

5.3.2 Severity of Malocclusion and Complexity of OTN by Sex

In table 5, the data presented a higher percentage of females compared to males, in all of the categories of the complexity of OTN, which was statistically significant (p = 0.388). Females

were more concerned about their dental-facial appearance which may explain the reason why more females present for orthodontic treatment as compared to males.

Since females are more likely to seek orthodontic treatment than males, sex differences may present with an uneven objective score of the complexity of OTN distribution within a study. A record of higher female representation in the study could influence the results obtained. A similar trend was reported by Hamden in 2004, where double the amount of study participants who sought orthodontic treatment were females. A few studies reported that sex plays a role in influencing DAI scores, but in contrast to this study, a higher objective OTN for males in comparison to females (Burden *et al.*, 1994; Esa *et al*., 2001) was revealed.

5.4 Self-Perception of Oral-Health Status (OHS)

The demand for orthodontic treatment might be characterized as subjective or self-perceived (Benson, 2015; Jawaad, 2015). The Webminster dictionary provides a straightforward definition of environmental awareness as being aware of the aspects of the environment through physical sensory information such as touch, sight, hearing, and smell, and that it is interpreted in the context of experience. Even though an objective OTN has been established, individuals who are unaware of a serious malocclusion may express their happiness with the condition of their teeth and mouth and not be disturbed by it. On the contrary, others may be greatly concerned about minor tooth irregularities (Gosney, 1986; Shaw, 1981).

Patients seek orthodontic treatment mainly due to self-perception of the condition of their teeth and mouth and how it affects their daily life (Benson, 2015). In today's culture, emphasis is placed on body image. This is influenced by teeth and an attractive smile (Benson, 2015; Jawaad, 2015). Improvement of aesthetics is an essential goal as tooth irregularities can impair facial appearance (Graber & Lucker, 1980; Birkland *et al.*, 2000) as well as social well-being (Baldwin, 1980; Shaw *et al.*, 1980, Helm *et al.*, 1985). Parental

perception also appears to be a significant influencing factor (Prahl-Andersen, 1978). How individuals perceive an attractive face or smile changes with time and is affected by age, sex, culture, and social and environmental variables (Newton & Minhas, 2005).

According to Grootendorst *et al.* (1997), self-completed surveys or questionnaires are the most common way to deliver OHRQoL instruments, and subjects are the best qualified to measure their own OHRQoL. Answers recorded by participants, regarding self-perception questions of the OQoLAS$_{11\text{-}14}$ tool, were evaluated according to DAI score, age, and sex.

5.4.1 Distribution of Participants' Self-perception of OHS by DAI score (Table 6)

It is interesting to note how subjective and objective scores differ. The subjective score might not correspond with the objective score and vice versa. Of the twenty-seven (32.53%) participants who rated the health of their teeth as "fair", 33.33% required desirable orthodontic treatment, and 37.04% required mandatory orthodontic treatment. Almost half of the participants (46.15%) of the participants requiring mandatory orthodontic treatment, said that they were very much pleased with their teeth and mouth. There is some evidence that the majority of children, fail to accurately describe the anterior occlusal characteristics as was similarly reported in this study, (Shaw, 1981). The difference between an adolescent's perception of their oral health and a clinician's objective assessment could be explained by overscoring treatment needs due to a sense of obligation to provide the best care for their patients (Hamdan, 2004). Poor dental aesthetics is the main motivating factor for undertaking orthodontic treatment, but the demand often exceeds the objective needs (Grzywacz, 2004).

5.4.2 Distribution of Participants' Self-perception of OHS by Age Category (Table 7)

A quantitative increase in participants was recorded in both age groups demonstrating a negative impact in OHRQoL at T1. Most evident were the 11-13-year-olds who initially self-perceived their oral health status as "poor" and that they were not happy, since it affected their overall QoL. A slight improvement was reported at T1, except for eighteen, 11-13-year old participants who reported the condition of their teeth to affect their QoL "very much". In comparison eight of the 14-16-year group were "not pleased" with their teeth at T0 and seventeen participants were "not pleased" with the health of their teeth at T1. Change in OHRQoL measures may be impacted by methodological elements like recollection bias. When patients can't precisely recall their baseline oral health status, memory bias happens, and they end up remembering their oral health as being either better or worse than it was before (McPhail & Heines, 2010). A change in dentofacial appearance usually occurs around the peak growth stage during the mixed dentition and variations in growth and development may be self-perceived as worse since the start of treatment. These variations in development can render growing children as moving participants (McGrath *et al*., 2004). Participants' standards, objectives values, and concepts of QoL are varied and may be modified as they develop and mature (Golembiewski *et al.,* 1975). The value placed on oral health status about orthodontic treatment may not be considered relevant and significant at the time and may likely cause a skewed perception from participants. Cognitive, psychological, and social awareness also evolve with time and could influence self-perception 6-8 months after the start of treatment. Children may be unable to adequately explain their dental appearance, and reactions may range when addressing the aesthetic effects of malocclusion and the difficulty of orthodontic treatment, with some persons exaggerating their dental appearance (Graber & Lucker, 1980; Shaw, 1981). The findings demonstrated a link between adolescent concerns

about appearance and malocclusion in the smile's aesthetic zone, which is more evident in the 11-13year age group. A very severe malocclusion is three times more likely to have an aesthetic impact at this stage of life, which further complicates problems. An analysis of how adolescents' perspectives might vary during this stage of development through early adulthood and even later in their psychological and professional lives might be strengthened by a longitudinal study approach

.5.4.3 Distribution of Participants' Self-perception of OHS by Sex. (Table 8)

This study reveals a definite difference in scores relating to how female participants reflect on their oral health status as compared to male participants. Female participants showed a greater score as compared to males. At T0, the male participants score recorded was 7(41.18), and this reduced to 9(30), revealing that more males were satisfied with their teeth after wearing fixed appliances for about 6-8 months. Contrary, females' score at T0 was 10(58.82), and at T1 increased to 21(70.00), reflecting a lower quality of life.

Again, we must consider why there are self-perception disparities between male and female participants. Research reveals conflicting evidence where some studies show no gender variations in self-perceived oral health status (Marshman *et al.,* 2009; Andrade *et al.,* 2021), whereas other studies demonstrate that females were more concerned about the attractiveness of their smiles than were males, (Bernabe, 2008; Dalaie *et al*., 2018; de Oliviera *et al.,* 2020). Self-esteem, social acceptance, personality, and dentofacial attractiveness are examples of these factors (Marshman *et al.,* 2009; Andrade *et al.,* 2021).

A recent study by Kaieda *et al.,* (2019), pointed out that concerns about dental appearance have been more prevalent among male participants. Biological diversity may influence self-perceived aesthetics in males and females, suggesting that further studies should consider

cultural background and diversity as well. We live in a society where external factors influence and emphasize male appearance aesthetics.

5.5.1 OHRQoL using overall OQoLAS$_{11\text{-}14}$ scores by Age (Table 9)

The current study sought to determine how orthodontic treatment influenced teenagers. According to the findings of this study, fixed orthodontic appliance therapy improves OHRQoL in teenagers at T1 when compared to T0 controls. All age groups began their orthodontic treatment with poor OHRQoL, and both age groups had improved OHRQoL 6-8 months after treatment began. In general, age was a significant factor in the daily impact of fixed equipment, with younger patients appearing to cope better with fixed orthodontic appliances. This indicates either actual decreases felt and experienced adaptation to treatment or learned experience of treatment. There is no literature to compare the impact of age on fixed appliances. These results are valuable and provide answers to many of the questions that have lately been addressed regarding the psychological advantages of fixed orthodontic therapy.

5.5.2 OHRQoL using overall OQoLAS$_{11\text{-}14}$ scores by Sex (Table10)

It is widely known that there are gender disparities in OHRQoL, with boys scoring higher on the life satisfaction scale in adolescence across all age groups than girls. This study showed a similar trend where the female participants even though overrepresented, showed a poor OHRQoL score at T0 and T1 as compared to male participants (Table 10). Poor overall OHRQoL related to females is consistent with earlier studies (Piovesan *et al.,* 2010, de Paula *et al.,* 2013). This conclusion may be explained by females' negative perceptions of their body image and dental health compared to males (O'Brien *et al*., 2006; Agou *et al*.,

2008). According to Foster Page *et al*., (2013), OHRQoL may be impacted by gender-specific psychological traits. The disparities in the instruments used in various research studies could also account for these discrepancies.

5.6 OHRQoL Domains

The OQoLAS$_{11\text{-}14}$ tool was dissected into domains, as alluded to earlier, to evaluate whether differences are evident and why OHRQoL scores are poor or improved.

5.6.1 OHRQoL using overall OQoLAS$_{11\text{-}14}$ Functional Limitation (FL) scores at T0 and T1 by Age (Table11)

The findings of this study suggest that adolescents did not improve or recover from the detrimental functional effects of malocclusion when re-questioned at T1. Participants of both age groups still experienced some measure of FL, whether it related to inefficiencies in speech or mastication. FL varies according to the complexity of malocclusion and as a result, each participant would respond differently.

When examining the effect of age, the 11-13year age group scores were slightly worse as compared with 14-16-year-olds. Because it takes time to manage and improve occlusal abnormalities produced by malocclusion, acceptance of a modified occlusion experienced by 11-13-year-olds may take longer than that of the older group. Participants, regardless of severity, may require a longer time to adjust and compensate for occlusal abnormalities induced by a malocclusion. According to Kok *et al*., (2004), children's responses recorded at a much later date, rather than as early as 6 months after the commencement of treatment, may indicate improved OHRQoL scores, lending weight to this viewpoint.

However, the findings by Feusier (2015), reported worse FL scores at 6-8 months into treatment, even though not statistically significant. An evaluation after 6-8 months is not a true reflection of the possible outcomes as compared to evaluating patients after 18 or 24 months of fixed orthodontic treatment. A cohort may isolate normal occlusion, and exclude cognitive ability and development as reasons for reporting poor FL scores. The type of orthodontic appliance also greatly impacts a participant's normal functioning as reported by studies that revealed that fixed orthodontic appliances limited the participants eating ability (Bernabe *et al*., 2008; Costa *et al.,* 2011).

5.6.2 OHRQoL using overall OQoLAS$_{11\text{-}14}$ Functional Limitation scores at T0 and T1 by Sex (Table 12)

This study showed a slight improvement in the FL domain in both male and female participants. However, female participants scored less at T1 as compared to the start of treatment at T0, indicative of improved functional domain. Previous studies reported an improvement in FL status but did not mention whether these improvements were displayed by male or female participants (de Oliveira *et al.,* 2004; Bernabe *et al*., 2008, Kiyak, 2008; Mandall *et al*., 2008).

5.6.3 OHRQoL using overall OQoLAS$_{11\text{-}14}$ Emotional Well-Being (EMW) scores at T0 and T1 by Age (Table13)

The EWB domain of both age categories reflects similar scores (Table 12). Participants were emotionally satisfied with the progress of their treatment which could be correlated to certain reasons including but not limited to self-esteem, the severity of malocclusion, the sex of the participant (see 5.6.4) and confidence in their orthodontic specialist as their treatment is

progressing as expected. Adolescents with high self-esteem are more likely to report having improved OHRQoL which in turn could explain how the psychological profile of a participant contributes to emotional development (Agou *et al*., 2008). These reported psychosocial impacts are similar to those reported by Nigerian orthodontic patients, emphasizing the negative consequences of malocclusion on emotional well-being (Onyeaso, 2005). These results do not specify an age category except they mention children. Level and aligning procedures are usually done at the start of fixed orthodontic treatment, which in most cases improves the aesthetic zone, affecting the appearance, and in turn impacts EMW. This boosts patient confidence and lessens the feeling of being embarrassed or shy among peers or family members. In contrast, Feusier (2015), reported an EWB improvement only during the last 6 to 8 months of treatment. The length of orthodontic treatment however differed for each patient in their studies. An improved EMW is a result of many reasons including, feeling more certain about the progress of treatment and surer about the condition of their teeth or mouth. Having good self-esteem, being content, and expressing and experiencing pleasant emotions all contribute to emotional well-being.

5.6.4 OHRQoL using overall OQoLAS*11-14* Emotional Well-Being scores at T0 and by Sex (Table14)

The EMW scores of this study report a moderate positive correlation between orthodontic treatment needs and the emotional well-being domain, which was statistically significant at p = 0.0050 (Table 18). Female participants' EWB score was higher than male scores at both T0 and T1 (Table 14). This correlates with previous research studies that indicated females to be less satisfied with their dental appearance than males (Shaw 1981; Sheats *et al.*, 1998). However, in contrast, no statistically significant correlations were reported between sex and dentofacial appearance in the 2003 study done by Bos *et al*. OHRQOL data from cross-

sectional studies have repeatedly linked orthodontic treatment to better socio-emotional well-being and malocclusion to teasing, bullying, and lower OHRQOL. For example, difficulty with smiling due to the misalignment of teeth has been found to be one of the most important impacts of children's OHROL (Gherunpong *et al.,* 2004).

5.6.5 OHRQoL using overall $OQoLAS_{11\text{-}14}$ Social Well-Being scores by Age (Table 15)

In this study, both age categories reported a marked improvement in SWB scores after 6-8 months of treatment (table 15). The mean scores were close, hence there was no correlation with age except that all participants' scores improved. Facial appearance seems to be the driving factor to being accepted in society. Qualitative studies have found that adolescents who seek orthodontic treatment were influenced by societal norms and were unsatisfied with the appearance of their teeth (Shaw *et al*., 1991; Trulsson *et al.,* (2002); Mohlin *et al*., 2003; Feldens *et al*., 2015). In the Josefsson *et al*., (2010) study, it was found that peer pressure, dental aesthetics, and psychosocial aspects were common reasons for adolescents seeking orthodontic treatment. In lieu of the above, it could be argued that orthodontic treatment provides psychosocial benefits, especially when managing definitive malocclusions (Benson *et al*., 2015; Feldens *et al.,* 2015). Foster Page, in 2005, also found a distinct improvement in SWB scores when undergoing fixed orthodontic treatment.

It is human nature to be dependent on one another, feel connected, and have a sense of belonging and being cared for by others, which provides a sense of security and happiness while being able to be authentic and cherished. These social well-being traits are constantly shaped by an individual's daily experiences, which are influenced by the immediate environment, the people in their lives, and the reactionary choices made in order to cope with

daily challenges (Foster Page *et al*., 2005). In essence, social well-being brings about enjoyment and by being seen by others. Facial appearance plays a major role in being seen by others. Social attractiveness is partly a reflection of dental aesthetics (Foster Page *et al*., 2005). Contributing factors of poor dental aesthetics include, but are not limited to dental irregularities such as diastemas, anterior crowding, and large overjets (Foster Page *et al*., 2005).

5.6.6 OHRQoL using overall OQoLAS$_{11\text{-}14}$ Social Well-Being scores by Sex (Table16)

The data revealed that again it is the female participants expressing an improved SWB score at T1 as compared to male participants (Table 16).

There is little research on whether sex plays a role in lower or higher SWB scores. The notion is that children with undesirable occlusal traits could cause unfavorable social reactions, making them the targets of taunts, harassment, and nicknames from other children irrespective of whether they are male or female (Seehra *et al*., 2013; Benson 2015). In general, adolescents showed in their self-perception scores that they were dissatisfied with the condition of their teeth and mouth. Nicknames based on physical appearance, and being ridiculed and made fun of while struggling with confidence in social situations are common findings (Seehra *et al*., 2013). As previously stated, it may not come as a surprise that most adolescents' reasons for seeking orthodontic treatment are aesthetic ones.

5.7 Mean Score of OQoLAS$_{11\text{-}14}$ Domains at T0 and T1 (Table 17)

The mean FL score dropped significantly after 6-8 months into treatment, thus demonstrating an improvement in OHRQoL in this domain. These findings contradict past studies that

suggested orthodontic appliances could cause pain and FL (Doll *et al.*, 2000; Sergl *et al*., 2000).

Mean EWB scores increased, indicative of lower OHRQoL. The mean scores are consistent with table 13, which revealed an improved overall OHRQoL score in the EWB domain across both age categories. EWB according to sex (Table 14) however showed females reporting a reduced OHRQoL, this correlating with a high EWB mean score (Table 17). Consistent with several other research projects, it is shown that boys experienced OHRQoL more favorably than girls did, particularly in the emotional and social well-being areas (Bittercourt *et al*., 2017; Sun *et al*., 2018). In addition, the mean SWB score also reduced substantially, indicative of improved OHRQoL.

5.8 Mean Score of Complexity of OTN by OQoLAS*11-14* Domain

(Table 18)

A Spearman correlation coefficient of the complexity of orthodontic treatment needs to be reported as a mean emotional well-being domain score as statistically significant ($p = 0.005$). O'Brien (2006) and Agou (2008), on the other hand, found a negative association between OTN and the FL domain. The FL domain consists of three items that measure variables similar to our study, such as difficulty biting or chewing firm foods, difficulty pronouncing some words, difficulty eating favorite foods, and difficulty drinking through a straw. According to Tuominen (1994), adolescents are more concerned about their dentofacial appearance than with chewing or speaking.

Chapter 6

Conclusions and Clinical Relevance

In conclusion, this research offers early evidence that dental aesthetics, social reinforcement, and facial appearance among adolescent orthodontic patients, are accurate predictors of the psychosocial dimension of OHRQoL. According to the World Health Organisation, models of patient-centered outcomes should integrate both biological and psychosocial aspects (Petersen, 2003). This study investigated how adolescents perceive malocclusion, how it affects oral health and function, and how it impacts their functional, emotional, and social well-being. Adolescents benefited within the first six to eight months of fixed orthodontic treatment with fixed appliances. Patients with high expectations tend to complain less about problems associated with wearing fixed appliances such as limited eating, associated pain, and so forth (Sergl, 2000).

Beneficial effects in orthodontic treatment could include improved patient and clinician satisfaction with treatment outcomes and improved compliance with treatment plans, as seen in other studies done throughout the medical profession (Ersoz et al., 2016). In order to be clinically effective, the orthodontic clinician has two responsibilities: firstly, to apply evidence-based orthodontics to the best of his/ her knowledge and clinical experience, and secondly, to establish a patient rapport, display empathy, and embrace the patient not just as another labeled malocclusion case but as a person, capable of understanding and contributing to the desired treatment plan. This approach would effectively provide total care for the orthodontic patient (Sachdeva, 2014).

Research, in OHRQoL assessments, is a potentially useful instrument for highlighting the impact of psychological and social aspects of oral health on adolescent life (Twigge et al., 2016).

- Children who were wearing fixed orthodontic appliances scored significantly higher on the FL, EWB, and SWB subscales than those who were not (suggesting a bigger influence).
- Fixed orthodontic appliance therapy does affect participants' OHRQoL.
- OHRQoL was significantly improved after 6-8 months into treatment.
- Adolescents with very severe malocclusion and mandatory orthodontic treatment need are more likely to report a negative aesthetic impact.

An objectively determined need does not acknowledge crucial psychological factors that affect oral health-related quality of life in adolescents. However, measures of oral health-related quality of life do consider additional aspects of how adolescents view their teeth and mouth. Data collected from OHRQoL instruments may be useful when screening, recognizing, and appropriately prioritizing orthodontic treatment needs. OHRQoL data may also provide insight into health policy planning and allocating resources within the public sector.

Challenges during the study.

An increased sample size would possibly yield better results. The impact of COVID-19 pandemic affected the flow of patient intake. Even though statistically significant changes were observed in patients in relation to both the patients' presenting malocclusion and their response to treatment, the exact clinical level of importance of these findings remains to be determined. Within the field of dentistry and specifically orthodontics, this concept remains relatively 'new' and with the emergence of such evidence, our interpretation and understanding will both improve and more importantly translate to better informed consent and potentially more successful and satisfactory treatment.

There is also a lack of evidence of participants' psychological state before developing a poor oral health status. Those who believe they have poor oral health may feel unhappy and unsatisfied with life, which will negatively affect their subjective well-being. Some participants were not able to divulge their personal information e.g. income status.

Clinical Relevance

OHRQoL assessments are recommended in orthodontics to complement the objective assessment done by the clinician. By including an OHRQoL instrument, the clinician will have baseline information on the psychosocial effect of the oral health status of the patient. This can then be monitored alongside the clinical parameters used to measure the progress of orthodontic treatment. Such subjective information will ensure that the clinician is fully informed of all dimensions of the well-being of the patient (function, emotional and social well-being). The inclusion of quality-of-life instruments will also support the study of treatment needs and outcomes, to study a therapy's efficiency and impact during said period of treatment, and as part of clinical trials, which have the potential to improve the quality of

care. Furthermore, understanding patients' expectations of treatment can help detail the parameters for informed consent as well as help patients develop coping methods to deal with treatment sequelae. Learning about the effects and discomfort of orthodontic treatment contributes to informed consent. Research on the use of these measures among children is promising. Orthodontic researchers are moving away from the traditional clinician-centered model towards the contemporary patient-centered model of assessment. These new research movements are, in fact, both important and timely considering the significant debates regarding the psychosocial benefits of orthodontic treatment.

Recommendations

Research settings are where OHRQoL instruments are most commonly used. However, whether in private practice or an academic setting, the use of these instruments for subjective assessment for orthodontic treatment is non-existent. Training orthodontists who might consider including qualitative measures as part of their treatment strategy is a recommendation. Patients' increased awareness of healthcare is a result of their increasing health literacy. More and more patients are asking pertinent questions about healthcare and their involvement in making informed decisions about their healthcare and specifically oral health. Including them in completing self-assessed questionnaires such as the one done in this study is a step in that direction.

However, the instrument of choice should be orthodontic-specific, such as the one used in this research project. Implementing it within the orthodontic clinical setting and determining its value as a subjective contribution to orthodontic treatment, is yet to be determined. Will orthodontists find the time amidst their busy day-to-day practice, to incorporate a questionnaire for their patients to complete, and then analyze and evaluate these findings? In

addition, specialists would require training in order to become familiarised with the concept of OHRQoL, how it is measured and evaluated, as well as the insight it would provide in delivering patient-centered care.

The orthodontic department at the Faculty of Dentistry (UWC), may find it useful to implement a condensed version of the existing OQoLAS instrument. Another suggestion may be to allow patients to complete the questionnaire in stages, where at the onset during screening where patients' emotional and social well-being are assessed, and evaluate functional limitations toward the end of treatment when an improved occlusion is apparent. The design of the instrument should consider the South African multilingual and diverse culture.

Nonetheless, the associations between OHRQoL and orthodontic treatment have not been examined longitudinally. Hence, there is an urgent need for a longitudinal evaluation of OHRQoL. However, since longitudinal assessments of children are complicated by a variety of factors (as demonstrated in this research project), the inclusion of a control group, i.e. patients not requiring any orthodontic treatment, is essential, considering the rapid, multi-faceted, and rather unpredictable developmental changes children undergo during this period.

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Appendix 1: Ethics Clearance/Project Registration

UNIVERSITY of the WESTERN CAPE

OFFICE OF THE DIRECTOR: RESEARCH
RESEARCH AND INNOVATION DIVISION

Private Bag X17, Bellville 7535
South Africa
T: +27 21 959 4111/2948
F: +27 21 959 3170
E: research-ethics@uwc.ac.za
www.uwc.ac.za

01 July 2019

Dr CT Gordan

Faculty of Dentistry

Ethics Reference Number: BM19/3/21

Project Title:

Approval Period: 01 July 2019 – 01 July 2020

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

BMREC REGISTRATION NUMBER - 130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 2: Information Sheet

UNIVERSITY of the WESTERN CAPE

FACULTY OF DENTISTRY
Department of Orthodontics
Private Bag X1 Tygerberg 7505
TEL: +27 21 937 3105/6/3030 FAX: +27 21 931 2287
www.uwc.ac.za

Information Sheet to Participate in Research

Date: _____

To the prospective participant and caregiver.

My name is Dr. Carmen Gordon from the Orthodontic Department of the Dental Faculty at the University of the Western Cape.
Contact phone number: 0837007937
Email: 9136815@myuwc.ac.za

You are being invited to allow your dependent to consider participating in a study that involves research on how orthodontic treatment (braces), will impact their quality of life. The aim and purpose of this research, is to see whether they are able to eat, speak, smile, chew certain food, interact in school or read aloud in class. We would also like to see whether they get teased or bullied at school or at home. Once you and you dependant agree to participate, you will complete a questionnaire on the day the braces are fitted. When they come again for a 6-month check-up, they will have to complete the same questionnaire again. This questionnaire will take about 10 - 15 min to complete. There is no need to come for extra visits, as the questionnaire will be done the same day of their orthodontic check-up.

We hope that the study will help the clinical staff in the orthodontic department better understand how children feel or how wearing braces affects their day to day living. This information will be valuable to the scientific community as we strive to improve on the quality of care to you. Once you agree to participate, you and your dependent will sign a consent and assent form. You will complete a socio-demographic form while your dependent complete a questionnaire. All information on the forms will be confidential and locked in a cupboard. We will not forward any of your details to any staff members and your privacy will be maintained at all times and in all academic writing about the study. You will not be paid for participating in the research. This research is voluntary and that you may withdraw from participation at any point, and that in the event of refusal/withdrawal of participation you will not incur penalty or loss of treatment or other benefit to which you are normally entitled. There will not be any costs incurred by you as a result of participation in the study.

This study has been ethically reviewed and approved by the UWC Biomedical Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher at dentist@gordonsurgery.co.za / 0217037206 or the UWC Biomedical Research Ethics Committee, contact details as follows:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
University of the Western Cape
Research Office
New Arts Building
C-Block, Top Floor, Room 28.
Western Cape, SOUTH AFRICA
Tel: 27 219594111

Appendix 3: Assent

Assent Form: To be completed by child participant. (Minor)

Please fill and return the reply slip below and indicate your willingness to be part of my voluntary research project **on "The Impact of Fixed Orthodontic Treatment on Oral Health-Related Quality of Life in Adolescents"**
I, (My name) _____
Agreement to be part of the research project.
I Agree/Do not agree (please delete as appropriate), to be part of the research project.

Please tick the boxes if you agree

	I know that I have to complete a questionnaire for this research project.
	I know that I have to complete the questionnaire just before my braces are fitted in my mouth.
	I know that I have to complete the questionnaire 6 months later, after the braces were fitted on my teeth.
	I am aware that the researcher will keep all my information confidential in all academic writings.
	I am aware that the records of the questionnaires will be kept safely and password protected.
	I am aware that I may withdraw from the study at any time and will not be advantaged or disadvantaged in any way.
	I am aware that I will not be paid for participating in this study.

Signature_____
Date_____

Contact person (Researcher): Dr. Carmen Gordon
Email: 9136815@myuwc.ac.za
Cell: 0837007937

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
University of the Western Cape
Research Office
New Arts Building
C-Block, Top Floor, Room 28.
Western Cape, SOUTH AFRICA

Appendix 4: Consent

UNIVERSITY of the WESTERN CAPE

FACULTY OF DENTISTRY
Department of Orthodontics
Private Bag X1 Tygerberg 7505
TEL: +27 21 937 3105/6/3030 * FAX: +27 21 931 22
www.uwc.ac.za

CONSENT

I _____(Name) have been informed about the study entitled, The Impact of Fixed Orthodontic Treatment on the Quality of Life in Adolescents, by
Dr. Carmen Gordon the researcher.
I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction. I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any treatment or care that I would usually be entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at the Orthodontic Department of the Dental Faculty at the University of the Western Cape.
Contact phone number: 0837007937
Email: 9136815@myuwc.ac.za

If I have any questions or concerns about my rights as a caregiver to the study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
University of the Western Cape
Research Office
New Arts Building
C-Block, Top Floor, Room 28.
Western Cape, SOUTH AFRICA
Tel: 27 219594111
Email: research-ethics@uwc.ac.za

_____ _____
Signature of Participant Date

_____ _____
Signature of Witness Date
(Where applicable)

_____ _____

Signature of Translator Date
(Where applicable)

Appendix 5: Sociodemographic

UNIVERSITY of the WESTERN CAPE

FACULTY OF DENTISTRY
Department of Orthodontics
Private Bag X1 Tygerberg 7505
TEL: +27 21 937 3105/6/3030 * FAX: +27 21 931 22
www.uwc.ac.za

Code:_____

Socio-demographic questionnaire
Parent/Guardian/Caregiver/Patient Code:

_____

Date of patient visit _____ (dd/mm/yy yy)

Instructions

Please answer all the questions honestly, you will not be judged based on your responses. If you do not wish to answer a question, please draw a line through it. When completed, the form will be quickly reviewed to make sure you didn't mistakenly skip questions, your specific responses to the questions will not be reviewed. Please feel free to ask if you need any of the questions explained to you.

Please tick one box for each question where there are check boxes. If you do not wish to answer a question, please draw a line through it.

RACE / ETHNICITY

White _____Coloured____ Black____ Asian____ Other ____

1. EDUCATION OF MOTHER

Highest level of education has completed?

a. Grade 12 or less---------- ☐
b. High school graduate---------- ☐
c. College degree / technical school training---------- ☐
d. University degree/ Masters or Doctorate degree---------- ☐

2. EDUCATION OF FATHER

a. Grade 12 or less ---------- ☐
b. High school graduate---------- ☐
c. College degree / technical school training---------- ☐
d. University degree /Masters/Doctorate degree---------- ☐

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Department of Orthodontics
Private Bag X1 Tygerberg 7505
TEL: +27 21 937 3105/6/3030 * FAX: +27 21 9
www.uwc.ac.za

Code:_____

3. EDUCATION OF PRIMARY CAREGIVER /GUARDIAN/OTHER

a. Grade 12 or less---------- ☐
b. High school graduate---------- ☐
c. College degree---------- ☐
d. Technical school training---------- ☐
e. University degree/ Masters or Doctorate degree---------- ☐

HOUSING

4. How many people are currently living in your household, including yourself? _____

5. Please describe the home where you live (Tick one box)

a. You own the house---------- ☐
b. Someone in the house bought it---------- ☐
c. You don't pay any rent or money where you stay---------- ☐
d. I live with friends---------- ☐
e. I live with family---------- ☐
f. I have no permanent residence---------- ☐

6. INSURANCE

How do you pay for your health care?

(Tick the box that applies)

a. Government funding---------- ☐
b. Private insurance / Medical aid---------- ☐
c. Self-pay, out of pocket---------- ☐

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TEL: +27 21 937 3105/6/3030 FAX: +27 21 931 2287
www.uwc.ac.za

Code:_____

7. JOB

Do you work for pay outside your home?

Tick the box that best corresponds to your current work situation?

a. Working full time---------- ☐
b. Working part time---------- ☐
c. Not working and not looking for work---------- ☐
d. Unemployed and looking for work---------- ☐
e. Disabled or retired and not looking for work---------- ☐
f. Currently in school---------- ☐

8. INCOME

What is your total combined family income, before taxes, wages, public assistance/benefits, help from a relative, child maintenance, and so on?

If you get a wage (weekly pay)

a. Between R200 – R1000---------- ☐
b. Between R1000 – R1500---------- ☐
c. Between R1500 – R3000---------- ☐
d. More than R3000---------- ☐
e. Don't know---------- ☐
f. Chose not to answer---------- ☐

If you get a salary (monthly pay)

a. Between R1000 – R3000---------- ☐
b. Between R3000 – R5000---------- ☐
c. Between R5000 – R7000---------- ☐
d. More than R7000---------- ☐
e. Don't know---------- ☐

Appendix 6: OQoLAS Instrument

DATE_____ CODE_____

Orthodontic Quality of Life Assessment Survey

Are you a boy or girl? □ Boy □ Girl					
1. What is your current age?					
2. The health of your teeth and mouth is: □ Excellent □ Very good □ Good □ Fair □ Poor					
3. How much does the condition of your teeth or mouth affect your life overall? □ Not at all □ Very little □ Some □ A lot □ Very much					
4. How pleased are you with your teeth and mouth? □ Not at all □ Very little □ Some □ A lot □Very much					
5. Did you have any orthodontic treatment (braces) in the past?					
Fixed braces	Yes		No		
Removable braces	Yes		No		

For the following questions, please make a cross (x) in one block only.

Questions	Not at all	Very little	Some	A lot	Everyday
6. How often have you noticed yourself breathing through your mouth?					
7. Have you had trouble sleeping due to problems with your teeth and mouth?					
8. Have you had difficulty saying words that start with a “t” or “d” like “teeth” or “doctor”					
9. Do you have difficulty pronouncing words like “church” or “threw”					
10. Does food get stuck on the roof of your mouth?					

CODE_____

Questions	Not at all	Very little	Some	A lot	Everyday
11. Do you take longer than others to eat a meal?					
12. Is it difficult to bite into foods like apples or corn on the cob?					
13. Have you had trouble chewing tough meats like steak or biltong?					
14. Do you limit the foods you eat due to problems with your teeth and mouth?					
15. How often do you have difficulties eating foods you would like to eat?					
16. How often do you have difficulties drinking with a straw?					
17. Have you ever felt irritable or frustrated because of your teeth or mouth?					
18. Have you felt unsure of yourself because of your teeth and mouth?					
19. Have you felt shy or embarrassed because of your teeth or mouth?					
20. Have you been concerned what other people think about your teeth and mouth?					
21. Have you worried that you are not as good-looking as others because of your teeth or mouth?					
22. Have you worried that you are not as healthy as others because of your teeth or mouth?					
23. Have you worried that you are different than other people because of your teeth or mouth?					

CODE_____

Questions	Not at all	Very little	Some	A lot	Everyday
24. Have you ever not wanted to speak or read out loud in class because of your teeth or mouth?					
25. Have you ever avoided taking part in activities like sports, clubs, drama, music, school trips, because of your teeth or mouth?					
26. Have you ever avoided talking to your peers because of your teeth or mouth?					
27. Do you ever avoid smiling or laughing when you are around your peers because of your teeth or mouth?					
28. How often do you feel uncomfortable eating in front of others because of your teeth or mouth?					
29. How often do you avoid spending time with other youth because of your teeth or mouth?					
30. Have you ever argued with your peers or family because of your teeth or mouth?					
31. Does anyone ever call you names because of your teeth or mouth?					
32. Have other youth ever excluded you because of your teeth or mouth?					
33. How often do people ask you questions about your teeth or mouth?					

Thank you for your time

Appendix 7: Dental Aesthetic Index Score Card

Dental Aesthetic Index Score Card

Dental Aesthetic Index Score Card **Code _____ Date_____**

		A	B	C
		NO.	WT.	
0	Constant			13
1	Missing incisors, canine, premolar teeth – upper		6	
	Lower, (enter total no.)			
2	Crowding in the anterior segment		1	
	0 = no segment crowded			
	1 = one segment crowded			
	2 = two segments crowded			
3.	Spacing in the incisal segment		1	
	0 = no spacing			
	1 = one segment spacing			
	2 = two segments spacing			
4	Midline diastema in mm		3	
5	Largest anterior irregularity in maxilla in mm		1	
6	Largest anterior irregularity in mandible in mm		1	
7	Anterior maxillary overjet in mm		2	
8	Anterior mandibular overjet in mm		4	
9	Anterior open bite in mm		4	
10	Ante203 6ro posterior molar relation: 0 = normal;		3	
	1 = ½ cusp; 2 = One full cusp			
11	Total DAI Score			

Classification according to the DAI score:

DAI Scores	Treatment Category	Severity levels
< 25	No treatment needed/slight need	Normal or minor malocclusion
26 - 30	Treatment elective	Definite malocclusion
31-35	Treatment highly desirable	Severe malocclusion
> 36	Treatment mandatory	Very severe (handicapping) malocclusion