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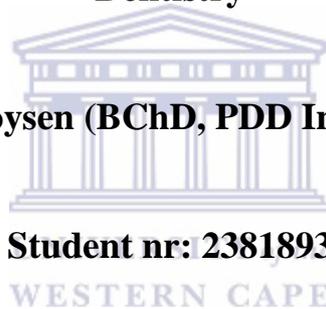
A thesis submitted in fulfilment of the requirements for the degree of Master of Science Dentistry in the Department of Orthodontics, Faculty of Dentistry

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Proposed degree: MSc Dent (Orthodontics)

Supervisor: Prof A. Harris

Faculty of Dentistry

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Title

Orthodontic treatment need and demand in the Upington area of the Northern Cape Province

Jeannette Leigh Booysen

A thesis submitted in fulfilment of the requirements for the degree of Master Scientiae in Dentistry in the Department of Orthodontics, University of the Western Cape.

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Keywords:

Adolescents

Orthodontic Treatment need

Index of Orthodontic Treatment need (IOTN)

The Aesthetic Component (AC)

The Dental Health Component (DHC)

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Aesthetic Orthodontic need

Upington

Abstract

Orthodontic treatment need and demand in the Upington area of the Northern Cape Province

J Borghesi

MSc Dent Thesis, Department of Orthodontics, University of the Western Cape

Introduction:

When considering a person's self-esteem, behavioural patterns and personal interactions, the one feature having the most impact is their physical appearance. In an ideal world, every person should have a fair opportunity to reach their full potential in life.

Orthodontics can improve a person's quality of life by creating confident smiles and a functional occlusion (Sheiham, 1993).

Uncorrected malocclusions can adversely affect one's speech, general health and self-esteem. Improving the general physiological implications malocclusions has on person, may make them more employable and more successful in relationships, creating an overall happier, healthier and more successful community. The more people are offered affordable orthodontic treatment, the more acceptable orthodontic treatment may become. Thus, the perceived benefits of Orthodontic treatment in a population group are Improvement of Oral Health and enhancement of psychosocial welfare. Accurate data on the prevalence, distribution and severity of malocclusion is needed by provincial oral health management. They also need accurate data of the orthodontic treatment need of the children in that specific area. This data is vital for the effective planning of the education, training and deployment of dental workers, as well as the resources and distribution thereof in specific, designated areas (Holtshousen, 1997; So & Tang, 1993).

This study's focus was to estimate the prevalence of malocclusion amongst adolescents in Upington area in the Northern Cape, and to determine the need for orthodontic treatment in the area using the Index for Orthodontic Treatment Need (IOTN).

Aims:

There were three main aims of this study. Firstly, to estimate the prevalence of malocclusion amongst adolescents in the Upington area of the Northern Cape Province. Second, to determine the need for orthodontic treatment in the area using the Index for Orthodontic Treatment Need (IOTN). Finally, with every need that identified, the level of demand was also measured.

Methodology:

A cross-sectional study on 103 adolescents aged between 14 and 15 years was done. 43.8% were male and 56.2 % were female. The sample was chosen from the two main schools in Upington in the Khara Hais District of Northern Cape using a multi-stage sampling technique. In the study group, Caucasian, thus represented 41.75% of the study group, coloured participants represented 38.83% of the study group. The black participants made up 19.42% out of the Study group. Perceived need was assessed using a questionnaire and the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN). An intra-oral examination was conducted using the modified Dental Health Component (DHC) of the IOTN to assess Dental Health treatment need. An intra-oral occlusal photograph was taken for record purposes; it allowed the examiner to recheck against the DHC, while analysing the data at the time of collection.

Results:

The Aesthetic Component of the Index of Orthodontic Treatment Need and the Dental Health Component was used in combination to determine a definite need for treatment in 86.41% of the sample group. It was further determined that 82.52% of the sample group needed Orthodontic treatment; 9.71% were regarded as borderline cases, and 7.77% did not require treatment at all. The sample group however was too small to draw conclusions and a recommendation for further studies to measure the exact level of need could only be given. Nevertheless, the sample size was big enough to support a hypothesis theory. The examiner suspected that the figure for orthodontic treatment need is too low for the Upington area, thus the research proposal was conducted using the nationwide study of Drummond (2003) as guide. Null hypothesis – H0: p = 0.532 (53.2%) or the alternative hypothesis – Hα: p ≠ 0.532 (53.2%).

Conclusion:

Ethnic divide reflected the Census of 2011 within the study, as Coloured and White participants far exceeded the black students.

From the results a conclusion could be made that the orthodontic treatment need exceeds 50%. Thus, a definite need of more than 50% for orthodontic treatment was established by the examiner, with a corresponding demand from the guardians and participating students. Comparing this to Drummond (2003) which reported that 52.3 % of his study group presented group with identifiable malocclusion it could be concluded that there is a need in the Upington area for Orthodontics of at least 50% and even more. Further study to determine the exact need is recommended.

<div align="center">October 2017</div>

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Declaration:

In this declaration, I declare that *Orthodontic treatment need and the demand in the Upington area of the Northern Cape Province* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Jeannette Leigh Booysen   Date:………..

Signed:…………………………………………….

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To all the participants and the authorities involved, I thank you for your kind support and willingness to assist in the study.
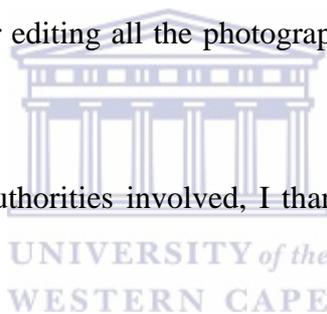
To my Godparents, Dr Alfred (BChD, MSc(Odont), MChD(Orth)) and Elsche Dippenaar, thank you for lighting a fire within me as child, to rise above my circumstances. You are almost fully responsible for all the decisions I have made in order to be where I am today.

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List of Abbreviations

AC   Aesthetic Component

DHC   Dental Health Component

IOC   Index for Orthodontic need

TMJ   Temporomandibular joint

MOCDO   Abbreviation for charting teeth under Orthodontic problems: Missing, Overjet, Crossbite Displacement and Overbite,

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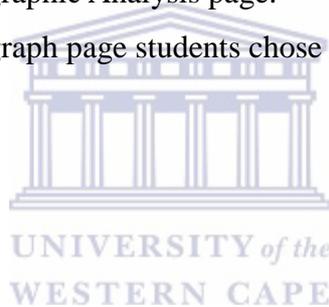
Chapter 1: Introduction

Orthodontics originate from the Greek words 'orthos' and 'dontos' – 'Orthos' meaning normal, correct, or straight, and 'dontos' meaning teeth. Orthodontics is concerned with correcting or improving the position of teeth, therefore aligning teeth and correcting any malocclusion. When considering a person's self-esteem, behavioural patterns and personal interactions, the one feature having the most impact is their physical appearance. In an ideal world, every person should have a fair opportunity to reach their full potential in life. Orthodontics can improve a person's quality of life by creating confident smiles and a functional occlusion (Sheiham, 1993)**.** Thus, the perceived benefits of Orthodontic treatment in a population group are Improvement of Oral Health and enhancement of psychosocial welfare.

Orthodontic treatment may be more often influenced by demand than by need (Jarvinen, 2001; Bernabe, Kresevic, Cabrejos, Flores-Mir, F. & Flores-Mir, C., 2006). Previously, the need for orthodontic treatment was measured from a strictly professional viewpoint, taking on a more paternalistic method from the practitioner. However, numerous studies have quantified that self-perceived dental appearance is also vital in the choice to seek orthodontic treatment (Espeland & Stenvik, 1991). Current literature shows that the level of need has been mostly measured by the IOTN (Index of Orthodontic Treatment Need). It was developed by Brook and Shaw (1989) and has been used all over the world for studies and research related to the analyses of orthodontic treatment needs (Brook & Shaw, 1989). The IOTN reflects clinical judgments better than previous indexes. Accurate data on the prevalence, distribution and severity of malocclusion is needed by provincial oral health management. They also need accurate data of the orthodontic treatment need of the children in that specific area. This data is vital for the effective planning of the education, training and deployment of dental workers, as well as the resources and distribution thereof in specific, designated areas (Holtshousen, 1997; So & Tang, 1993).

This study aimed to estimate the prevalence of malocclusion amongst adolescents in the Upington area in the Northern Cape, and to determine the need for orthodontic treatment in the area using the Index for Orthodontic Treatment Need (IOTN). A demand for Orthodontic treatment was determined using the participant questionnaires.

Chapter 2: Literature review

2.1 Problems with malocclusions in patients

Literature has identified three types of problems with malocclusions in patients. The first problem covers the psychological problems in patients because of discrimination due to their dento-facial appearance. The second problem is with oral function, and lastly, the problems associated with the relationship of malocclusion and injury or dental disease (Proffit, Henry, Fields & Sarver, 2007).

2.1.1 Dento-facial appearance

In malocclusion, especially if the malocclusion is in the anterior area, it can often be very noticeable. It may provoke hostile societal responses and be the root of a low self-esteem (Tung & Kiyaj, 1998; Marques, Ramos-Jorge, Paiva & Pordeus, 2006; Soh, Chew, & Chan, 2006).

While some researchers may not deem the effects of malocclusion as handicapping (Shaw, Addy & Ray, 1980), the literature appears to support the view that malocclusion does indeed affect a person's oral health quality in life. Numerous studies reported on the impact of malocclusion on children. For example, the prevalence of oral impacts for children with definite need for orthodontic treatment was twice as high as for children with no or little need for orthodontic treatment (Bernabe, Sheiham & De Oliveira, 2008). In the same way, Australian children who had less acceptable occlusal traits reported poorer Oral Health Quality of life (Foster, Thomson, Jokovic & Locker, 2005).

A study of 414 college students supported the following findings. Persons with incisor crowding and anterior maxillary irregularity greater than two millimetres, were twice as likely to experience an influence on smiling, laughing, and showing teeth without embarrassment. Furthermore, persons with overjet greater than five millimetres were almost four times more likely to experience effects on their emotional state (Traebert & Peres, 2007). In general, the effects of self-perceived malocclusion primarily affected psychological and social everyday-activities such as smiling, emotion, and social contact (Bernabe *et al*, 2008; Johal, Cheung, & Marcene, 2007; O'Brien, Benson, & Marshman, 2007). Altogether, there is a trend for teenagers

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with clinically recognizable malocclusions to report poorer oral health quality of life compared to teenagers with ideal occlusion. It was found that the aesthetic effects of malocclusion were not different between treated and untreated children; however, the untreated teenagers who wanted orthodontic treatment perceived worse aesthetic effects (Mandall, McCord, Blinkhorn, Worthington & O'Brien, 2000).

Clearly, awareness of occlusal traits and satisfaction with one's own occlusal condition varies among different individuals (Espeland & Stenvik, 1991; Brown, Spencer, & Tolliday, 1987). It is also reasoned that the want for orthodontic treatment may differ according to the patient's psychological status. These weak associations can be explained by the fact that clinical indices, such as the IOTN (Brook & Shaw, 1989), can emphasize malocclusions that may not be important to oral health quality of life, such as posterior crossbites (Marshman, Rodd, Stern, Mitchell, Locker, & Jokovic, 2005). Improving the appearance of the teeth is the main reason why most orthodontic treatment is done. Even though it might be alluring to dismiss this as a trivial need, there is little uncertainty that poor dental appearance can have a profound psychosocial effect on children.

Orthodontic treatment can have a beneficial psychosocial effect on individuals. It was found by Shaw *et al*. (1980) as can be seen in table 2.1, that children were teased more about their teeth than anything else in their appearance (Roberts-Harry & Sandy, 2003).

Table 2.1 – Features children most dislike or are teased about (Shaw et al, 1980)

Feature	Disliked appearance or teased (%)
Teeth	60.7
Clothes	53.8
Ears	51.7
Weight	41.5
Braces	33.3
Nose	29.3
Height	25.3

According to Macgregor (1969), "a disfiguring malocclusion is a physical handicap, since it limits a person's social stereotype and opportunities". Being part of a societal system, there is an

intrinsic need for one to feel recognized and accepted. Any substantial deviations from the average may result in feelings of diffidence related to appearance, self-consciousness in societal interactions, and judgment of self, where others are considered to be better; all of which may harmfully affect the value of life of that person (Sarver & Proffit, 2005; Rufenach, 1990; Klages, Bruckner, & Zentner, 2004).

Dental appearance can make a difference in the way society would treat a person with malocclusion, due to the comparisons drawn related to malocclusions in everyday life. It can determine what teachers expect from certain students, employability of a person, and the relationships that they choose. Tests conducted to assess the physiological reactions in certain ethnic groups to malocclusions, showed that any group or country where the norm is to have straight teeth, an individual with a malocclusion would be unattractive (Sarver & Proffit, 2005.; Rufenach, 1990; Klages *et al,* 2004). Handicapping malocclusion should be placed in a more important context. Social responses conditioned by the appearance of individual teeth can affect the individual's entire life. If the ways you interact with other people are affected by the appearance of your teeth, it should be regarded as a handicap and not just a minor physiological problem. It was noted that psychological problems where not proportional to the anatomical severity of that individual's malocclusion (Sarver & Proffit, 2005; Rufenach, 1990; Klages *et al.,* 2004).

A person who has severe malocclusion problems will constantly have a negative response from other individuals. Another person with a less severe malocclusion problem is sometimes treated differently than one with more severe problems, and sometimes they are treated the same. It would be easier to cope with a problem if the responses to the problem where always the same. Unpredictable responses can cause an individual with a malocclusion physiological stress. A person's own self-esteem will also play a major role in the influence these responses will have on them physiologically. This means that a person with a good self-esteem will have a different physiological response compared to a person with a lower self-esteem but with the same dental problem. Physiological problems may be the main reason why patients seek treatment, attempting to reduce the physiological stress they experience because of their dental and facial appearance (Sarver & Proffit, 2005; Rufenach, 1990; Klages *et al*, 2004).

These problems are not just aesthetic; they can be regarded as holistic. It affects every aspect of the individual's life, and directly also the quality of life the individual may have. The

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improvement of the look of teeth is a key motivating factor for most orthodontic patients. The psychosocial issues related to a patient's self-image, must be included in the assessments of patient malocclusions before treatment can commence. Orthodontic patients should be recognized as individuals rather than a just set of maligned teeth. It is therefore essential to also determine the psychosocial impact of a presenting malocclusion (Sarver & Proffit, 2005; Rufenach, 1990; Klages *et al.,* 2004).

2.1.2   Oral function

Teeth which do not occlude properly can make mastication problematic and may predispose to temporomandibular joint (TMJ) dysfunction. Individuals, who have poor occlusion, may find it difficult and uncomfortable to eat in front of others, because they cannot bite through food using their incisors (Roberts-Harry & Sandy, 2003).

Masticatory problems are routinely reported in adults due to malocclusions, where some patients report difficulty chewing. After orthodontic treatment, it has been seen that these problems are mostly resolved - a malocclusion can therefore also be seen as a functional handicap. Adaptive alterations in swallowing may sometimes be required in cases of severe malocclusion. It must be taken into consideration that malocclusion can affect an individual's speech. Certain sounds can be difficult to make with malocclusions. For example, sounds formed with the teeth, such as the letters S and R, can be difficult to form as can be seen in Figure 2.1. Speech therapy may therefore be required after orthodontic treatment has been provided (Roberts-Harry & Sandy, 2003).

Every degree of malocclusion is it big or small, may ultimately affect an individual's functioning (Roberts-Harry & Sandy, 2003). For example, if a normal mastication pattern is compared to people with malocclusions; those with malocclusion may need to chew their food more than those with normal occlusion, before they can swallow it (Roberts-Harry & Sandy, 2003). This is also seen in jaw movement where proper lip relationship is achieved for speech. Normal oral functioning and jaw movement is therefore directly affected. This may include muscle incoordination or pain, mastication problems, problems with swallowing or speech, and temporomandibular joint dysfunction (Roberts-Harry & Sandy, 2003).

Some individuals with malocclusions will compensate for the distortion by putting in more effort to speak normally, without others noticing. More appreciation for the effect of malocclusion on oral functioning, which includes mastication and speech, is being noticed as more quantifiable methods are developed. It is suggested than even minute malocclusion may cause bruxism. This is a real indication for the need for perfect occlusion, as malocclusion can cause chronic facial pain (Roberts-Harry & Sandy, 2003).

Pain associated with the temporomandibular joint and malocclusion, is understood more today than it was the past. Usually, the pain is from muscle spasm or fatigue, but it may also be from pathologic changes within the temporomandibular joint (Roberts-Harry & Sandy, 2003). The discomfort associated with muscle pain is almost always in conjunction with bruxism due to stressful situations associated with the incorrect relationship of the temporomandibular joint to achieve occlusion, even if it is in the incorrect relationship. If 50% to 75% of the population have some degree of malocclusion, it is far more in number compared to those with temporomandibular dysfunction, which only compromises of 5% to 30%. It is therefore deducted that malocclusions are not the only cause of oral and facial muscle fatigue and stress (Roberts-Harry & Sandy, 2003). Because stress is mostly manifested in different systems, but not always on all of them, it can be said that for most individuals, there is no correlation between malocclusion and temporomandibular dysfunction. For those who do manifest stress in bruxism, having malocclusion may aggravate the problem. Therefore, if facial pain, muscle spasm and or spasm in mastication are in conjunction with a malocclusion, orthodontics can be considered as a route of treatment for the pain (Roberts-Harry & Sandy, 2003).

Figure 2.1: Missing 11 in a case where the 11 was impacted. The patient had impaired speech and struggled to form certain sounds.

2.1.3 The relationship of malocclusion and injury or dental disease

According to Roberts-Harry and Sandy (2003), there is an increased risk of dental fracture in individuals with malocclusions. For example, anterior teeth which are protruding have a greater risk of fracture and can even cause soft tissue trauma in the patient. Individuals with a retruded lower mandible and protruding upper teeth, have an increased risk of dental fracture or trauma (Roberts-Harry & Sandy, 2003).

It is important to remember that individuals with malocclusions who participate in contact sports such as rugby, will need a better fitting mouth guard compared to those with aligned teeth. Shop bought mouth guards may not fit these individuals, forcing them to play without a mouth guard, increasing their risk of severe dental and soft tissue injury. Sport injuries are more common in adolescents, who are more competitive in sport and more willing to take risks, not considering the consequences thereof (Roberts-Harry & Sandy, 2003).

Severe overbites can also cause soft tissue trauma in the palate and to the upper incisors. In extreme cases, the upper incisors must be extracted. Increased overbites can also cause attrition and thinning of the enamel; it closes the bite and makes restoration of these facets difficult (Roberts-Harry & Sandy, 2003). Malocclusion can also make it easier for food to get trapped between teeth, making it more difficult for individuals to clean their teeth properly. Where oral health cannot be maintained, it is certain to cause gingival disease and an increase in prevalence of caries (Roberts-Harry & Sandy, 2003). It must also be noted at this point, that oral health is patient specific. Some patients with malocclusion have pristine oral hygiene habits as they take extra care of their teeth. It must therefore be considered that even though malocclusions make it more difficult to keep up the oral health environment, it does not mean it has to cause gingival problems or caries. Startlingly enough, there is no strong association between dental irregularity and dental caries or periodontal diseases such as gingivitis. It seems that dietary factors are considered much more important than the alignment of the teeth in the aetiology of caries (Roberts-Harry & Sandy, 2003).

Although straight teeth may be easier to clean than skew ones, patient motivation and dental hygiene seems to be the superseding factor in preventing gingivitis and periodontitis. It is important to take into consideration that studies which have explored the connection between

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crowding and periodontal disease, have been longitudinal and included older adults (Roberts-Harry & Sandy, 2003).

Aligned teeth are of no benefit to those who clean their teeth properly, because they can keep their teeth clean irrespective of any irregularity. Likewise, alignment will not help those with poor oral hygiene habits. If there are poor oral hygiene habits, periodontal diseases will develop no matter how straight the teeth are. Nevertheless, having aligned teeth may help moderate brushers, although there is no firm proof to support or refute this statement. This is an area that requires further study (Roberts-Harry & Sandy, 2003). One must also take into consideration that an individual with a bad oral health regime is not a good candidate for orthodontics. Orthodontics will only worsen the problem if the individual does not step up their oral hygiene regime (Roberts-Harry & Sandy, 2003). Malocclusions may damage both the teeth and soft tissues if they are left untreated. It is well known that the more protruding the upper incisors are, the more prone to trauma it may be (Roberts-Harry & Sandy, 2003).

Table 2.2. – Relation between size of overjet and prevalence of traumatised anterior teeth.

Overjet (mm)	Incidence %
5	22
9	24
>9	44

When the overjet is 9mm or more, the risk of injuring the upper incisors increases to over 40%. Decreasing a large overjet is not only beneficial from an aesthetic point of view, but reduces the risk of trauma and long-term problems to the dentition. Some other occlusal relationships are also likely to cause long-term problems (Roberts-Harry & Sandy, 2003).

In a case where an anterior cross bite was associated with mandibular displacement – The continuous attrition of the lower incisors against the upper when the patient occluded together produced some considerable wear. If permitted to continue, the long-term prognoses for those teeth were tremendously poor. To preserve the teeth, the patient accepted orthodontic treatment that eliminated the cross bites and helped prevent additional wear (Roberts-Harry & Sandy, 2003). Another example of problems caused by an anterior cross bite is a traumatic anterior occlusion which produced a displacing force on the lower incisors with apical migration of the

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gingival attachment as a result. Provided this situation is treated early, the soft tissue injury stops and as the rest of the gingivae mature, the situation will often resolve naturally and no long-term problems usually develop. Deep overbites can occasionally cause stripping of the soft tissues, thus being the reason for substantial damage to the soft tissues. If this problem continues, there is a high risk of early loss of the lower incisors that would result in a difficult restorative problem (Roberts-Harry & Sandy, 2003).

Proffit *et al,* 2007 stated that it is vital to consider two aspects when determining the optimal timing for orthodontic treatment. These include "effectiveness" and "efficiency" of treatment. According to these principles, the golden standard for orthodontic timing is during the adolescent growth spurt, beginning in the late mixed or early permanent dentition (Proffit *et al,* 2007). It is important to establish what the cause of malocclusion is, before deciding on a treatment plan (Proffit *et al,* 2007). According to literature, there are many classification systems available to determine the possible causes of malocclusion. These include classifications by White and Gardiners, Salzmann, Moyers and Graber (Singh, 2007). Moyers' classification includes the craniofacial skeleton, dentition, orofacial musculature and soft tissues of the masticatory system. According to him, there are many contributing factors (genetic and environmental) and these often appear in clusters (Singh, 2007).
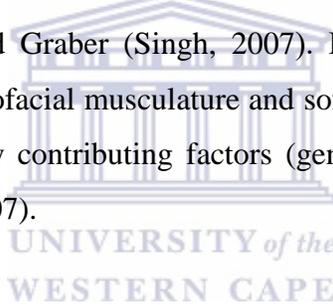
2.2   Indexes for determining the Orthodontic treatment need

Orthodontic treatment may be more often influenced by demand than by need (Jarvinen, 2001; Bernabe, Kresevic, Cabrejos, Flores-Mir, F. & Flores-Mir, C., 2006). Previously, the need for orthodontic treatment was measured from a strictly professional viewpoint, taking on a more paternalistic method from the practitioner. However, numerous studies have quantified that self-perceived dental appearance is also vital in the choice to seek orthodontic treatment (Espeland & Stenvik, 1991).

To measure the need for orthodontic treatment, various indices have been developed. The most commonly used index is the Index of Orthodontic Treatment Need (IOTN). This index tries to rank malocclusion in order, from most severe malocclusion to least severe. It comprises two parts: an Aesthetic Component and a Dental Health component. Different indexes, such as the Index of Orthodontic Treatment Need (IOTN), the Dental Aesthetic Index (DAI), and the Index

of Complexity Outcome and Need (ICON), were developed as a recording system for malocclusion, and may be used to determine the potential patients who may need orthodontic intervention. The IOTN is a recording system that grades malocclusion based on occlusal characters for oral health and aesthetic problems (Brook & Shaw, 1989; Firestone, Beck, Beglin, & Vig, 2002). The assessment of the aesthetic The Aesthetic Component (AC) of the IOTN has frequently been used to measure treatment need on an aesthetic level, measured by dentists or patients (Grzywacz, 2003).

2.2.1 The qualities of an ideal index

No index has yet been accepted over the world as the go to index to do these type of studies, even though many has been developed.(Richmond, Shaw, O'Brien, Buchanan, Jones, Stephens *et al,*1992) The selection of an index for measuring any condition is dependent upon two main factors:

・The objective of the study.

・The capability of the examiner to consistently reproduce the finding on which the index is based (So & Tang, 1993).

The literature reports that Indices used in an epidemiological studies, will vary immensely from those used in clinical studies where detail is most important to draw conclusions. (Burden, Pine & Burnside, 2001). The ideal qualities would be an index that is objective, valid and reliable when used by general dental practitioners (Cardoso, Drummond, Lages, Pretti, Ferreira & Abreu, 2011; Burden *et al*, 2001; Beglin, Firestone, Vig, Beck, Kuthy & Wade, 2001). It is also good if the index technique can be thought quickly. (Burden *et al,* 2001).

These epidemiological indices record every characteristic in a malocclusion to permit approximation of the prevalence of malocclusion in each population; for instance, the epidemiologic recording of malocclusion described by Björk, Krebs, and Solow in 1964, the Federation Dentaire Internationale (FDI) method by Baume, Horowitz, Summers, Backer Dirks, Brown, Carlos *et al* in 1973. Also, the Summer's Occlusal Index (OI) by Summers in 1971 permit approximation of the prevalence of malocclusion in a given population. Other indices of this type score tooth alignment in a way that allows study of tooth irregularity and periodontal diseases (Lau, Griffiths, Shaw, 1984), or treatment stability (Little, 1975).

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For orthodontic treatment to become a significant part of any health care system, basic information on the treatment need is necessary (Ngom, Diagne, Dieye, DiopBa & Thiam, 2007). Many indices were developed with the purpose of categorizing the severity of malocclusion and the need for treatment to guarantee that, in poor areas where funds are limited, those patients with the highest need for treatment are placed first in line for treatment. The Orthodontic Component used in oral health surveys should aim to clearly classify those persons who have a definite need for orthodontic treatment (Burden *et al,* 2001).

Other benefits of an Orthodontic Treatment Need index include:
- That those with the severe malocclusion and definitive need for Orthodontic Treatment; need urgent treatment thereof.
- Protection against overtreatment.
- As well as creating a platform on which essential and constructive discussions between the Orthodontist and Patient can be made regarding the treatment plan for Orthodontics. (Birkeland, Bøe & Wisth, 1996)

2.2.2 Treatment complexity index

The Index of Complexity, Outcome and Need (ICON) measures treatment complexity, the outcome of the orthodontic treatment and orthodontic treatment need. (Daniels & Richmond, 2000)

2.2.3 Occlusal Index of Summers

A disagreement prevails among examiners concerned with measuring occlusion for epidemiologic purposes, thus Summers developed an index of occlusion which would serve these purposes. This index was named the Occlusal Index (OI).The method scored nine features in the OI. These features included dental age, molar relation, overbite, overjet, posterior cross-bite, posterior open-bite, tooth displacement (actual and potential), midline relations, and missing permanent maxillary incisors. (Summers, 1971)

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2.2.4 Dental Aesthetic Index

In response to the demand for an orthodontic index that includes psychosocial measurements in assessing need for orthodontic treatment and for use in epidemiological studies, the Dental Aesthetic Index (DAI) was developed by Cons, Jenny & Kohout in 1986. This index combined the psychosocial and physical features of malocclusion. The Dental Aesthetic Index (DAI) is an orthodontic index based on socially defined aesthetic standards. The DAI is mostly sensitive to occlusal conditions that have the potential for causing psychological or social dysfunction.

There are 10 malocclusions measured; missing teeth, incisal segment crowding, incisal segment spacing, diastema, largest anterior maxillary irregularity, largest anterior mandibular irregularity, anterior maxillary overjet, anterior mandibular overjet, vertical anterior open bite and antero-posterior molar relationship. The DAI score is then categorized into 4 Orthodontic treatment need categories.

1. If the score is less than 25 there is normal occlusion or minor malocclusion and no or slight treatment needed.
2. A score between 26 and 30 indicates a definite malocclusion and treatment is optional.
3. A score between 31-35 specifies severe malocclusion for which treatment is highly needed,
4. A score over 36 concludes there is a very severe or handicapping malocclusion, which requires definitive Orthodontic treatment (Borzabadi-Farahani, 2011; Jenny & Cons, 1996).
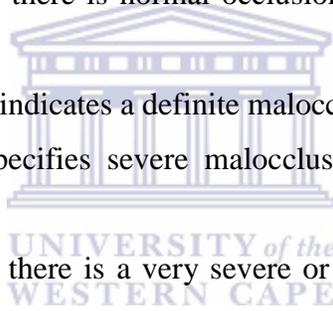
2.2.5 Priority Index of need for Orthodontic treatment

Various indexes of determining the orthodontic need has been drawn up over the world. For instance, the Swedish Dental Society and the Swedish Medical Board drew up a priority index of need for orthodontic treatment in 1966 (Linder-Aronson, 1974).

It consisted of a four-grade index scale:

- 4 –Very urgent need: Aesthetic and/or functionally severe problems;
- 3 – Need: Mild Aesthetic and/or occlusion problems;
- 2 – Mild Need: Mild aesthetic and malocclusions like proclined or retroclined incisors, deep bite with gingival contact but without gingival irritation, severe crowding or spacing

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of teeth, infra-occlusion of deciduous molars and permanent teeth, moderate frontal rotations; and

- 1 – Little need: Mild differences from normal or perfect occlusion.

The above-mentioned index of treatment requirements was intended to be used more as a basic guide, as the practical implementation thereof called for a sound sense of judgment. An accepted index of treatment requirements is a tool to help justify orthodontic treatment and is useful in organizing the orthodontic services, notably so when resources are limited (Linder-Aronson, 1974).

2.2.6 The IOTN

Current literature shows that the level of need has been mostly measured by the IOTN (Index of Orthodontic Treatment Need). It was developed by Brook and Shaw (1989) and has been used all over the world for studies and research related to the analyses of orthodontic treatment needs (Brook & Shaw, 1989). The IOTN's developer's intended to identify those individuals who are more likely to need and benefit from orthodontic treatment. It is a way of determining the degree of malocclusion that may shorten the "life span" of specific teeth (Zreaqat, Hassan, Ismail, A., Ismail, N., & Aziz, 2013). The IOTN reflects clinical judgments better than previous indexes. It places patients in five grades of treatment to determine the level of treatment needed. It includes an Aesthetic Component (AC) with ten severity levels, and a Dental Health Component (DHC) with five levels. (Proffitt *et al*, 2007 & Burden *et al, 2001*). Many medical aids that cover orthodontic treatment, will not accept patients in categories 1 to 3 of the Dental Health Component (DHC) or grade 6 or less of the Aesthetic Component (AC) of the IOTN. Dental hospital schools may accept them, if they are appropriate for undergraduate teaching purposes (Roberts-Harry & Sandy, 2003).

2.2.6.1 The Aesthetic Component (AC):

The Aesthetic Component (AC) consists of a series of ten photographs ranging from most to least attractive. The idea is to match the patient's malocclusion as closely as possible with one of the photographs. It is not likely that a perfect match will be found, but the dental practitioner should use his or her best deduction to match the patient's malocclusion to the closet corresponding photograph (Roberts-Harry & Sandy, 2003).

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Grades are from 1-10, 1 being most pleasing smile, to 10 being the worst:

- Grade 1-4: No or slight Orthodontic treatment need
- Grade 5-7: Moderate or borderline Orthodontic treatment need
- Grade 8-10: Definite need for Orthodontic treatment.

Recording the Aesthetic Component (AC) in the modified Index of Orthodontic Treatment Need (IOTN), grades the aesthetically pleasing image of the anterior teeth. It is awarded for overall attractiveness rather than the morphological characteristics which are the same as the photographs. It must be noted that first impressions are usually a better assumption. Grade 1 includes mild malocclusions; correcting these will do more damage than just leaving it as is (Burden *et al*, 2001).

The Index of Orthodontic Treatment Need (IOTN) has been modified into two categories (Burden *et al*, 2001):

- A need for Orthodontic treatment: YES (Grade 8-10: Definite need for Orthodontic treatment)
- No need for Orthodontic treatment: NO (Grade 1-7: No definite need for Orthodontic treatment).
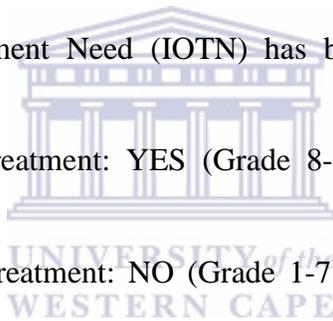
Figure 2.2: The IOTN Aesthetic Index (Proffit *et al*, 2007)
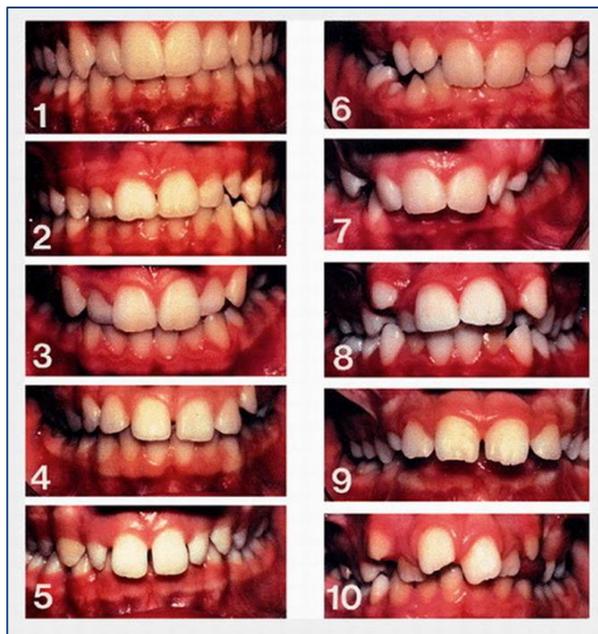
2.2.6.2 Dental Health Component (DHC):

The Dental Health Component (DHC) consists of a series of occlusal traits that could affect the long-term dental health of the teeth. Various features are graded from 1 to 5, least severe trait to worst trait. The worst trait of the presenting malocclusion is compared to the list and then given the appropriate scores (Roberts-Harry *et al.,* 2003).

The Dental Health Component (DHC) in the modified Index of Orthodontic Treatment Need (IOTN) is done by diagnosing the teeth under MOCDO (Burden *et al,* 2001). Once one of the following is graded 3 and above, no further exam is needed and treatment is then imminent:

- Missing teeth
- Overjet's
- Cross bites
- Displacement of contact point
- Overbites

The patient's teeth are then graded under:

- **Grade 1** (No Orthodontic need)
- **Grade 2** (Little need for Orthodontic treatment / mild irregularities)
- **Grade 3** (Moderate need for Orthodontic treatment, borderline case)
- **Grade 4** (Severe irregularities, Orthodontic treatment needed)
- **Grade 5** (Extreme problems notes / Definite Orthodontic treatment needed)

All the grading subcategories can get quite overwhelming; hence Burden *et al* (2001) modified Index of Orthodontic Treatment Need (IOTN). The original Index of Orthodontic Treatment Need (IOTN) has been summarized by Proffit *et al* (2007):

Grade 1 (No Orthodontic treatment needed)

1. Extremely minor malocclusions including contact point displacements less than 1mm.

Grade 2 (Slight need for Orthodontic treatment)

2a.   Increased overjet greater than 3.5mm, but less than or equal to 6mm with competent lips.

2b.   Reverse overjet greater than 0mm but less than or equal to 1mm.

2c.   Anterior or posterior cross bite with less than or equal to 1mm discrepancy between retruded contact position and inter cuspal position.

2d.   Contact point displacements greater than 1mm but less than or equal to 2mm.

2e.   Anterior or posterior open bite greater than 1 mm but less than or equal to 2mm.

2f.   Increased overbite greater than or equal to 3.5mm without gingival contact.

2g.   Pre- or post-normal occlusions with no other anomalies (includes up to half a unit discrepancy).

Grade 3 (Borderline Orthodontic treatment needed)

3a   Increased overjet greater than 3.5mm, but less than or equal to 6mm with incompetent lips.

3b   Reverse overjet greater than 1mm, but less than or equal to 3.5mm.

3c   Anterior or posterior cross bites with greater than 1mm, but less than or equal to 2mm discrepancy between retruded contact position and inter cuspal position.

3d   Contact point displacements greater than 2mm, but less than or equal to 4mm.

3e   Lateral or anterior open bite greater than 2mm, but less than or equal to 4mm.

3f   Deep overbite complete on gingival or palatal tissues, but no trauma.

Grade 4 (Orthodontic treatment needed)

4a   Increased overjet greater than 6mm, but less than or equal to 9mm.

4b   Reverse overjet greater than 3.5mm with no masticatory or speech difficulties.

4c   Anterior or posterior cross bites with greater than 2mm discrepancy between retruded contact position and inter cuspal position.

4d   Severe contact point displacements greater than 4mm.

4e   Extreme lateral or anterior open bites greater than 4mm.

4f   Increased and complete overbite with gingival or palatal trauma.

4h   Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis.

4l   Posterior lingual cross bite with no functional occlusal contact in one or both

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buccal segments.

4m   Reverse overjet greater than 1 mm but less than 3.5mm with recorded masticatory and speech difficulties.

4t   Partially erupted teeth, tipped and impacted against adjacent teeth.

4x   Presence of supernumerary teeth.

Grade 5 (Definite Orthodontic treatment needed)

5a   Increased overjet greater than 9mm.

5h   Extensive hypodontia with restorative implications (more than 1 tooth missing in any quadrant) requiring pre-restorative orthodontics.

5i   Impeded eruption of teeth (except for third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth and any pathological cause.

5m   Reverse overjet greater than 3.5mm with reported masticatory and speech difficulties.

5p   Defects of cleft lip and palate and other craniofacial anomalies.

5s   Submerged deciduous teeth
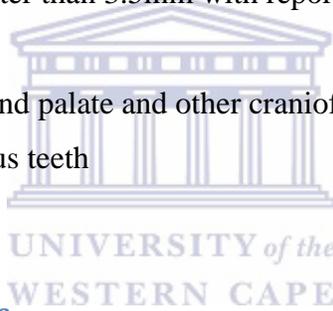
2.2.6.3 MOCDO Simplifying table

The MOCDO table can be used to simplify the above grades to guide the examiner to the single worst feature of the malocclusion. It is an acronym for: Missing teeth, overjet's, cross bites, displacement of contact points and overbites: (Chapel Road Orthodontics, 2015)

Table 2.3 – The modified DHC

	M	**O**	**C**	**D**	**O**
IOTN 5	Cleft lip & Palate Impacted / Ectopic teeth Hypodontia >4 missing teeth	> 9mm Overjet > - 3.5mm reverse Overjet			
IOTN 4	Supernumeraries	>6mm Overjet	Crossbite with >	4mm contact	Deep Overbite +

				point displacement	Trauma >4mm Anterior Open Bite
	Hypodontia <4 missing teeth	-2mm to -3.5mm reverse Overjet	>2mm displacement between RCP and ICP		
IOTN 3		>4mm Overjet <-2mm reverse Overjet	Crossbite with >1mm displacement between RCP and ICP	<4mm contact point displacement	Deep Overbite (no trauma) <4mm Anterior Open Bite
IOTN 2		>2mm Overjet		<2mm contact point displacement	
IOTN 1				Minimal irregularity	

Whilst the IOTN is a valuable guide in arranging treatment and determining treatment need, it does not take into account the degree of treatment difficulty. For example, class II division 2 malocclusions are infamously difficult to treat, however they might have a low IOTN. The IOTN of this patient is only 2, but it is a difficult case to manage and treatment requires a high level of expertise. This may be seen as a shortcoming of the IOTN (Roberts-Harry & Sandy, 2003).

2.2.7 Need and demand

As the health and expectations of the population improve, the demand for orthodontic treatment will dramatically increase. While many may want treatment, it is important to determine whether they really need it. The term 'need' is frequently used to describe the amount of treatment that dentists judge their patients ought to have, whereas 'demand' refers to the treatment requested by the patients themselves (Davenport, Basker, Heath, Ralph, & Glantz, 2000)**.** Most studies of need and demand show that the former focus on the need is larger than the latter. The many reasons for these variations can be considered under the following key reasons (Davenport *et al*, 2000): Availability of treatment; Acceptability of treatment; and Accessibility of treatment.

a) Availability of treatment:

Availability of treatment refers to the number of available dentists at a specific location, their

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skillset, their accessibility to the public, and the economic realities of the public in which they practice (Davenport *et al,* 2000).

b) Acceptability of treatment

Acceptability of treatment describes the attitudes of individuals to different forms of treatment. These attitudes are influenced by education, personal finance, and cultural background (Davenport *et al,* 2000)

c) Accessibility of treatment

Accessibility highlights important differences between individuals. For example, a specific form of orthodontic treatment may be equally available to young and old patients, but the latter may find that the effort needed to seek out that treatment is just too great (Davenport *et al,* 2000)**.** Although the renewal of appearance can be a powerful motivating factor, not every patient will seek out treatment following a referral for orthodontic treatment. The dentist must avoid preconceptions and consider the thoughts and wishes of the individual before recommending or referring them for orthodontics. The time, effort and understanding taken to make these decisions are likely to prevent unnecessary treatment especially if each patient is scored with the IOTN (Sonakia & Sharma).
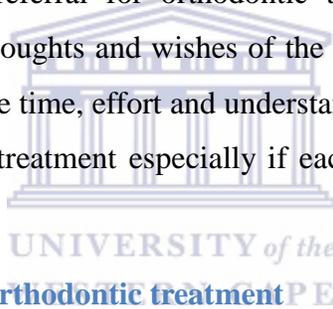
2.2.8 The want or demand for orthodontic treatment

The demand for orthodontic treatment can be defined as the actual number of individuals who go for treatment. (Proffit *et al,* 2007*).* Not all patients with a need for treatment will always seek out treatment. Even those with severe orthodontic problems do not always seek treatment, mostly due to the following reasons:

- Not realizing they have a need for orthodontic treatment,
- Realizing they have an orthodontic treatment need but cannot pay for it, or
- Knowing they have an orthodontic treatment need but it is not offered where they reside.

According to Zreaqat *et al* (2013), "Orthodontic treatment demand is the desire to receive orthodontic care for oneself (or one's child or significant other). Orthodontic treatment need and demand varies in children and adolescents in different populations". Social and cultural circumstances have a direct effect on the demand for orthodontic treatment. Individuals from a higher income group will be more likely to seek out treatment than those who cannot afford it.

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Therefore, people with higher income will have better looks and are more likely to have better jobs. The more a child wants to achieve in life, the more likely the adults will have demand for orthodontic treatment if needed (Proffit *et al,* 2007*)*. Socioeconomic status is a huge factor in determining the demand. Patients from rural areas are less prone to spend income on aesthetics, while patients with higher than the norm salary income will consider expenditures of this types (Proffit *et al,* 2007).

The increase in patients receiving orthodontic treatment can be prescribed to the influence of consumer factors such as perceived need, dental visitation patterns and socio-demographic characteristics, as well as supplier factors, such as availability of specialist orthodontic care and of general dental services (Shaw, Richmond, O'Brien, Brook, & Stephens, 1991). Studies have reported that some referred patients refuse orthodontic treatment for perceived severe malocclusions which can affect them on all levels, while others are keen to undergo treatment for minor malocclusion problems (Shaw *et al*, 1991). It has been proposed that the differentiation between acceptable and unacceptable occlusion is largely dependent on personal judgement (O'Brien, McComb, Fox, & Wright, 1996). A patient may deem other factors above just malocclusion and function as a reason to seek orthodontic treatment (Josefsson, Bjerklin, & Lindsten, 2009).
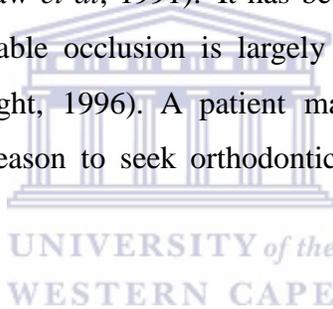
Orthodontic treatment does not only improve dental aesthetics, it also has a significant influence on the psychosocial aspect of an individual's life (Gazit-Rappaport, Haisraeli-Shalish, & Gazit E, 2010). Both social and cultural factors influence the perceived orthodontic treatment need, and currently the demand for treatment greatly surpasses the resources available. Due to increased dental consciousness by the public in combination with an increased social acceptance of fixed braces, a marked increase in demand from both children and adults seeking treatment since the 1980s has been seen (British Orthodontic Society, 2014).

Surveys have proven that the number of orthodontic cases has continued to increase over the last decade. According to the American Dental Association (2002), it was recorded that in the period of 1990 to 1999, the number of orthodontic treatment cases more than doubled, from approximately 25.8 million cases to more than 61 million cases. Most cases in 1999 were for comprehensive or complete orthodontic treatment, around 48million, with 81.5% of these in the 10–19 age groups, and just over 14% in adults age 20 and over. The number of cases has

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increased in the last decade, as the importance of aesthetics has increased and prosperity has led to an increased demand (American Dental Association, 2002; Mao Mao, Kau & Liu 2009)

2.3   Other studies done in South Africa and over the world to determine the orthodontic treatment need among the young.

Drummond (2003) found that historical studies for orthodontic treatment needs in South Africa where isolated. These studies were conducted randomly; therefore, results are not fully representative of South Africa as a diverse country (Zietsman, 1979; Swanepoel, 1985; Briedenhann, Van Wyk, Rossouw & Wolmarans, 1991; Van Wyk, 1994).

The lack of data on the distribution, prevalence and severity of malocclusion in South Africa could have affected the sufficient planning for orthodontic services, which is necessary to address the ever-increasing demand for orthodontic treatment among patients (Drummond, 2003). When considering a specific area in a country, however, an isolated study is more than sufficient in planning for health services in that specific area. It is important to compare the studies against specific guidelines, such as the normal Orthodontic Treatment Need Threshold, but it may differ from area to area.

Drummond (2003) further stated that the potential interest in orthodontic treatment for an increasing percentage of children undoubtedly will affect the type of services provided, as well as organisation and delivery systems (Jenny, 1975). He noted that the priorities set by the Oral Health Management for handling malocclusion, lack the vision to cope with the changed priorities of the community due to oral health promotion. He found that the service statistics of the Gauteng Oral Health Services (Holtshousen, 1997) indicated a total attendance of less than one percent of total patients, who has attended for orthodontic related problems. Orthodontic treatment rendered was only to 180 patients, which is 0.06 % of the total attendance statistics.

Accurate data on the prevalence, distribution and severity of malocclusion is needed by provincial oral health management. They also need accurate data of the orthodontic treatment need of the children in that specific area. This data is vital for the effective planning of the education, training and deployment of dental workers, as well as the resources and distribution thereof in specific, designated areas (Holtshousen, 1997; So & Tang, 1993).

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As public attentiveness in oral health care increases, the demand for orthodontic treatment will also increase; it is therefore important to have epidemiological data to estimate the total need for orthodontic care services in specific areas (Jenny, 1975). The data on orthodontic treatment need is of interest to dental public health programs for clinical treatment, screening for treatment priority, resource planning, and third-party funding (Foster, 1979).

The study of orthodontic treatment need is important for structuring public health needs and determining the need for training programmes for specialists. Problems with occlusion, especially when it is in anterior teeth, has more of a social impact in terms of perceived appearance, employability and scholastic achievements (Zreaqat *et al*, 2013). It is therefore essential to determine the level of need for orthodontic treatment and the demand thereof, before treatment commences.

2.3.1   Orthodontic treatment need studies within South Africa

It can be seen from the reported findings that a large percentage of South African children do present with a notable malocclusion, needing some type of orthodontic intervention.

One of the first studies was performed by Zietsman in 1979, the study was to examine the occlusion and treatment needs of 14-year-old children living in Pretoria. The sample consisted of 490 white children. He found that 23.3 % of the sample group had a normal occlusion, but 76.7% per cent needed orthodontic treatment.

Zietsman further did another study in 1979 where he undertook three further pilot studies. A sample of 119 Black subjects was drawn from the Tswana ethnic group of Bophuthatswana and two samples, each of 51, 14-year-olds were drawn from a school for Asians and a school for Coloured children. Using Angle standards (Angle 1899) the results showed that 54.6% of Black, 39.2 per cent of Coloured and 23.3 per cent of Asian children had a normal occlusion. Treatment was essential or necessary for 25 per cent of Blacks, 47 per cent of Coloureds and 49 per cent of Asians. In table 2.4 these values were added and a mean value was calculated for the three study samples he did.

A 1981 study by Hirschowitz, Rashid, Cleaton - Jones measured oral health in 402 urban black school children from Soweto in Johannesburg, South Africa. Malocclusion was recorded, also using a simplified Angles method (Angle 1899). As only the three main groups of malocclusions,

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Class 1, Class 2 and Class 3, were recorded as positive, the data has been included as a definite need when compared to other studies. Class 1 malocclusion was seen the most with a value of 8.8% of the group, Class 2 was 1.3% and Class 3 was found in 1%. Major Malocclusion was therefore concluded as rare, as it was only present in 11.1% of the study group. De Mûelenaere and Viljoen (1987) continued with these studies, using dental age to divide the rural study population. The age categories were determined according to the stage of dentition and ranged between the late primary dentition to the permanent dentition stage. In their subsequent study on the urban population, they measured chronological age, finding the mean to be 14.4 years with a deviation of 1.2 years either way (De Mûelenaere *et al,* 1992).

The orthodontic treatment need as determined by Kotze, Mizrahi & Zietsman, (1982) in the White 11-12-year-old population was 78%. They used the Occlusal Index of Summers (Summers, 1966) and examined the need for orthodontic treatment of White children aged 11-12 years in families of members of the South African Defence Force. They found that 22 % of the subjects had good occlusions or slight malocclusions which needed no treatment and that 78 % presented with malocclusions which needed minor or definite Orthodontic treatment.

In 1985 Swanepoel studied a group of Black children from Ga-Rankuwa, north of Pretoria. He used the modified Federation Dentaire Internationale (FDI) to measure of occlusal traits to classify occlusal problems. The study showed that 70 % needed no Orthodontic treatment, but 30% presented with major malocclusion problems, needing definite Orthodontic treatment.

Van Wyk, du Plessis and Snyman, used the Occlusal Index of Summer in 1985 and their study proved that 56 % of urban Colored children from the Eersterust township of Pretoria had good occlusions or slight malocclusions and that 44 % required minor to definite orthodontic treatment.
In another study using the Occlusal Index of Summers (Summers, 1971), the majority of the South African 12-year-olds (53.6%) presented with a good occlusion, whereas 17.5% had slight malocclusion but needed no treatment, and 15.7% needed minor treatment for small deviations in occlusion. Definite treatment was needed in 11.5% of the subjects studied, while 1.8% fell into the category where urgent treatment was necessary to correct the occlusal problems (Briedenhann *et al,* 1991).

In a published study by Hlongwa and du Plessis in 2005, the Malocclusion among 12-year-old school children in Mankweng, Limpopo Province of South Africa was researched.

The study was to undertake an epidemiological survey to determine the occlusal status of a sample of 12-year-old Black school children in the Mankweng area of the Limpopo Province. The study was done using the Dental Aesthetic Index (DAI). The results showed that 47% of the subjects required orthodontic treatment. There was a proven need for orthodontic treatment among 12-year-old Black school children in Mankweng area. Since there is no government hospital or clinic to provide such treatment, it was recommended that a center should be established.

Ackerman and Wiltshire conducted a study in 1994, among 511 disabled children in the greater Pretoria area. The Occlusal Index was used to examine the participants and a questionnaire was filled out regarding the children's treatment needs, habits, as well as swallowing and breathing patterns. From the study group 16.4 % had previously received orthodontic treatment and were thus excluded from the study. That left 381 children whom needed orthodontic treatment, but only 0.5% indicated that they were planning to seek orthodontic treatment. The results of this study indicated that the frequency of malocclusion in disabled children was not much higher than in normal Caucasoid children. The study concluded that the need for orthodontic treatment was as great for disabled children as for normal children and it was recommended that their malocclusion problems should be taken into consideration in future oral health care planning in South Africa.

In 2003, Drummond undertook a national research project in the form of a thesis. The study was conducted in seven of the nine provinces in South Africa. His results were later summarised in an article in 2005. In the National Oral Health survey and the studies by Hlongwa, Du Plessis (2005) and Drummond (2003), the DAI were used to assess malocclusion. There was a shift from the Occlusal Index of Summers. DAI scores over 26 were used to calculate total treatment need, of which definite treatment need was those with scores above 36.

Drummond (2003) reported that 31% of South African children surveyed, presented with a severe orthodontic treatment need. He also observed that malocclusion was significantly related to the different provinces of South Africa, different population groups, different dentition stages and gender, but not with location type or the socio-economic status of parents. There is limited data available about perceived need for orthodontic treatment in South Africa.

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His results showed that 47.7 % of the children in the sample presented with good occlusion or minor malocclusion, just over 52.3 % presented with identifiable malocclusion, a DAI score larger than 26. Of these, 21.2 % had definite malocclusion, 14.1 % had severe malocclusion and 16.9 % had very severe or handicapping malocclusion, thus 31% with severe malocclusion. Malocclusion as defined in this study was found to be significantly associated with the different population groups in South Africa, with gender and with dentition stage, but not with the location type or the employment status of parents.

A National Oral Health survey in 2004 described the oral health status of the population of, and reflects on possible trends in oral diseases in South Africa. During the past 20 years, three national oral health surveys were conducted in South Africa, the most recent, a national Children's Oral Health Survey, was conducted between 1999 and 2002. The importance to take from this study is the part where the Dental Aesthetic Index was used and they found that to 32.3% of 12-year-old children needed definitive orthodontic treatment in South Africa.
 (Van Wyk, P. & Van Wyk, C., 2004).

A study done in Limpopo province in 2011 by Sehowa focused on the perception of occlusal appearance among schoolchildren of the rural and urban community in Limpopo province of South Africa. The participants for this study were school pupils aged 13-18 years old. Sehowa reported that the perceived needs of orthodontic treatment for children, was 9%, of which 5.5% fell into the definite need for treatment category of AC grade 8 to 10. The most commonly selected AC grade chosen by the children to reflect their own dental aesthetics was AC grade 1 with more than 50% of children choosing this grade, followed by grades 2, 3 and 4. The children were asked to reorder the randomised AC pictures and rank them according to attractiveness. It was found that the agreement between the ranking established and the original ordering was very good with almost 100% agreement. The perception of schoolchildren matched exactly with that of the IOTN which is the professional ranking established by orthodontic specialists. This confirms that the children are good judges as far as occlusion is concerned.

Table 2.4 – Studies Results for the Need for Orthodontic treatment in South Africa

Researcher	Age	Good Occlusion Slight malocclusion (mean % within al ethnic groups)	Minor comprehensive Orthodontic treatment need (mean % within al ethnic groups)	Index
Zietsman, 1979	14	37	63	ANGLE CLASSIFICATION AND OTHER VAROIUS TRAITS
Zietsman, 1979	14	39	60.96	ANGLE CLASSIFICATION
Hirscholwitz, Rashid & Cleaton- Jones, 1981	12	89	11	MALOCCLUSION SCORED AS PRESENT OR ABSENT
Kotze, Mizrahi & Zietsman, 1982	11-12	22	78	OCCLISAL INDEX OF SUMMERS
Swanepoel, 1985	14	70	30	MODIFIED FDI METHOD
Van Wyk, Du Plessis & Snyman, 1985	14	56	44	OCCLISAL INDEX OF SUMMERS
De Muelenaere & Viljoen,1987		83	17	OCCLISAL INDEX OF SUMMERS
De Muelenaere, Witshire & Viljoen, 1992	14	72	28	OCCLISAL INDEX OF SUMMERS
Briedenhann , Van Wyk, Rossouw & Wolmarans,	12	75.1	24.9	OCCLISAL INDEX OF SUMMERS

1991				
Hlongwa & Du Plessis, 2005	12	47	20	DENTAL AESTHETIC INDEX
Ackerman & Wiltshire, 1994		25.5	74.5	OCCLISAL INDEX OF SUMMERS
Drummond, 2003/2005	12	47.7	53.2	DENTAL AESTHETIC INDEX
Van Wyk, P. & Van Wyk, C., 2004	12	-	32.3	DENTAL AESTHETIC INDEX
Showa,2011	13-16	91	9	IOTN

In conclusion from these studies it can be determined that South African children present with malocclusion and need Orthodontic treatment even though there are considerable differences in the reported findings.
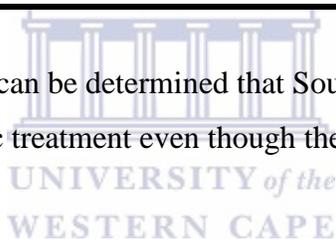
2.3.2 Other studies in the world using the IOTN to determine orthodontic treatment need

Wang, Hagg and Ling did a study in 1999 to determine the orthodontic treatment need and demand of Hong Kong children**.** Their data collection method consisted of study models and questionnaires collected from 765 randomly selected 12-year-old school children in Hong Kong. The need for orthodontic treatment was assessed by the Index of Orthodontic Treatment Need, and questionnaires were used in assessing demand for orthodontic treatment.

They found that 12% of the 12-year-old school children had no need of orthodontic treatment, 18% had little need, 33% moderate need, 33% great need, and only 4% of children had definite need for orthodontic treatment. Approximately 66% of the children were not satisfied with their dental appearance, but only 40% of these would like to have orthodontic treatment. A definite relationship was found between negative self-appraisal of dental appearance and demand for orthodontic treatment. Their study demonstrated that the need of orthodontic treatment among

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Chinese children is similar to that of Caucasian children; the attitude and demand toward treatment were also similar.

Abu Alhaija, Al-Nimri and Al-Khateeb did a study in 2004 to determine the Orthodontic treatment need and demand in 12-14-year-old North Jordanian school children. 1002 students were randomly selected to represent five geographical areas of Irbid. The examinations were carried out twice, first on the pupils in the school premises and then using study models taken from each student. The Dental Health Component (DHC) and Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN) were used as an assessment measure of the need for orthodontic treatment. The demand for orthodontic treatment was measured by a questionnaire asking, 'if it was necessary, would they like to have their teeth straightened by an orthodontist'. The results showed that 34% had a definite need for orthodontic treatment. Within this group, 73.5% needed orthodontic treatment according to the DHC, 23.5% had both DHC and AC great need scores, and 3% were in need according to the AC only. The demand for orthodontic treatment among the students was 49%. About 54% had a definite need for orthodontic treatment. This study provided a baseline for data on the need and demand for orthodontic treatment among a Jordanian population, which is important for planning public orthodontic and dental services.
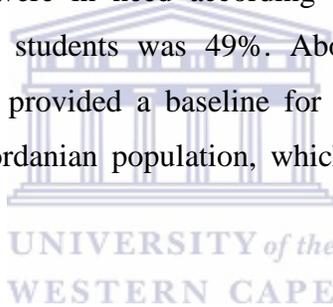
A published study by Zreaqat, Hassan, Ismail, A., Ismail, N., and Aziz in 2013, researched the orthodontic treatment need and demand among 12 and 16-year-old school children in Malaysia. To determine the orthodontic treatment, need and demand helped in planning orthodontic services, and estimating the required resources and manpower required. Their aim was to study the orthodontic treatment need and demand and to assess the association between the orthodontic treatment demand and factors such as ITON, gender, and age. Treatment need was measured using the DHC and AC of IOTN among 12- and 16-year-old Malaysia school children. The treatment demand was also assessed through a modified health questionnaire and its association with IOTN, age, and gender.

A total number of 837 Malaysian school children were randomly selected and then divided into two age groups; 12-year olds; and 16-year olds. They found that 51.4% of 12-year-old school children had definite need for treatment (DHC>4) while 22% of them desired treatment. Among 16-year-old subjects, 56.4% showed definite need for treatment while 47.2% desired treatment.

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The 16-year-old group was more interested in orthodontic treatment than the 12-year-old group. Only age was associated with treatment demand while gender had no effect.

A study was done by Ngom *et al* in 2007 to determine the orthodontic treatment need and demand in Senegalese school children aged 12 to 13 years. They used IOTN and ICON to determine their results. The aim was to assess the normative need, knowledge of, and demand for orthodontic treatment in Senegalese school children aged 12 to 13 years. The sample consisted of 665 Senegalese schoolchildren, randomly selected from different ethnic and socioeconomic backgrounds. Knowledge of and demand for orthodontic treatment were evaluated with a questionnaire. There were no ethnic or gender differences with respect to normative orthodontic treatment need. The mean ICON score ranged from 42.31 to 44.46, according to the ethnic group. Only 10% of the children had some knowledge of orthodontics. However, between 17% and 30% of the children clearly expressed a need for orthodontic treatment, and the distribution between ethnic groups was significant. In contrast, there were no significant gender differences concerning this demand for treatment. This study proved that the need for orthodontic treatment far surpassed the actual available supply.

Zetu did a clinical study in 2014 to determine malocclusion and orthodontic treatment need in adolescent (11-14 year olds) in Romania. The study revealed a dire need for education about prevention, hygiene and disease among the young. The study also showed that recurrent evaluation of the oral-dental status is helpful as an added tool for diagnosis and treatment of dental occlusal anomalies. It was observed that children evaluate themselves based upon what they see, so a photograph example of the ground problems can be beneficial in identifying their own malocclusion problems. 130 randomly selected adolescents were studied from rural and urban areas, but only 69 could be examined in the end. The IOTN was used to determine the Orthodontic treatment need within the group. Oral hygiene was also evaluated and the results showed that most had oral problems in this regard. In the study group, they identified a small number of subjects, 14.38%, who did not need orthodontic treatment, thus 85.62% did require some type of orthodontic intervention.

Volschenk, Briedenhann, Cumber and Rossouw did a study in Swaziland to determine occlusal status of 12-year-old school children. This was published in 1993.

The Occlusal Index of Summers (1966) was used to determine the prevalence of occlusal disorders, various features of malocclusion and to estimate the orthodontic treatment needs of 12-year-old Swazi school children in the Kingdom of Swaziland. The results indicate that the current occlusal status of Swazi school children should be maintained and if possible, improved and that the delivery of highly specialized orthodontic treatment procedures is not required.

Table 2.5 – Other studies over the world using the IOTN to determine Orthodontic treatment need

Researcher	Age	Good Occlusion Slight malocclusion (mean % within al ethnic groups)	Minor comprehensive Orthodontic treatment need (mean % within al ethnic groups)	Index used
Wang *et al* (1999)	12	12	88	IOTN
Abu Alhaija *et al* (2004)	12-14	26.5	73.5	IOTN
Zreaqat *et al,* (2004)	12/16	24.3	75.7	IOTN
Ngom *et al,*(2007)	12-13		42.6	IOTN
Zetu (2014)	11-14	14.38	85.62	IOTN
Volschenk *et al,* 1993	12	82.37	17	OCCLISAL INDEX OF SUMMERS

In conclusion from these studies it can be determined that other adolescents outside of South Africa also present malocclusion and need Orthodontic treatment. There is however considerable differences in the reported findings, but the majority tend to prove a need.

The Need for Orthodontic treatment can thus be a worldwide phenomenon and realising this, deductions can be made that any area especially those without professional specialised Orthodontic service will show a need for Orthodontic treatment.

2.4   Adolescence and Orthodontics

2.4.1   Adolescence

With the eruption of the premolars and canines most dentists start thinking of including orthodontic care in treatment plans (Paul, Casamassimo, Christensen, Fields Jr, & Ganzberg, 2005).

The adolescent patient has unique needs. The term adolescent has no standard definition and can broadly be defined as patients between the ages of 10 to 18 (American Psychological Association, 2002; MacKay & Duran, 2007). The adolescent patient has unique needs that relate to problems that they may have, like a potentially high caries rate, increased risk for traumatic injury and periodontal disease, a predisposition for poor eating habits, an in-creased aesthetic need and awareness, difficulty of combined orthodontic and restorative care fear for dental treatment, possible chemical abuse like tobacco, alcohol, and other drugs, pregnancy, eating disorders, and other unique social and psychological need (Paul *et al,* 2005; National Institute of Health, 2001).

Treatment of the adolescent patient can be difficult. Precise, complete, and up-to-date medical and social histories are essential for the right diagnosis and correct treatment planning. Knowledge of the patient's medical history is vital for reducing the risk of provoking a medical illness while giving dental care. If the parent is not capable of providing acceptable details regarding the adolescent's medical history, consultation with the general practitioner may be indicated. The practitioner may also need to get extra information privately from the adolescent (Ford, English, & Sigman, 2004).

Adolescents are furthermore more concerned with their health and appearance than anything else in society. The challenges they start to face at this age may also result in them not caring as much about dental care. It is also a period where they are at higher risk in their own health and education (Paul *et al,* 2005). Some of these risks may include pregnancy, peer pressure, drugs, neglect, abuse, depression, suicide and then this age is also known to show a rise in criminal activities.

Dental health and needed orthodontic treatment is put on the back burner when these risks affect an adolescent. It is important to have good systems in place to help improve the oral health of

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these students. Good Oral Health Programs implemented by the Health department is necessary to educate these students. Oral Health screenings and even offering more than just extractions at the government clinics must be looked at (Paul *et al,* 2005).

2.4.2   Adolescence and Orthodontic treatment

Some orthodontists prefer to start treatment from the ages of 9 to 10 years, while the child is still in the growth phase. However, most patients will not feel the need as yet, as they do not care about their appearance as much as adolescents do (Dippenaar, 1995).

There is a shift to adult dentistry with the eruption of the premolars and canines. For most dentists, this is the time they start thinking about including Orthodontic Care in treatment plans (Paul *et al*, 2005). The problems dentists associate with the growth spurt of adolescence, include the rapid and uncontrolled rate of skeletal and growth. Up to 35% of the facial height growth of the total facial height will occur during this time. Primary teeth exfoliate and permanent teeth all erupt in this short space of time. Over twelve teeth are lost and gained during this period. Immunologic, hormonal, changes and developments physically, will change the oral cavity. At the age of fourteen, the peak should have been reached and stabilized (Casamassimo, 1991).

Secondly, the environmental challenges and changes adolescence face have an effect in the oral health cases dentists see for this age group. Accidental death is the leading cause for mortality at this age. They take more risks, play more extreme sports and experiment more. They bend under peer pressure and dentists see this orally as well. Dental trauma, oral signs of sexual activities, hormonal gingivitis, and lack of oral care in certain groups, even the effects of drug experimentation can be noted. This time where adolescence become more independent, has shown poor compliance to oral hygiene regimes and the lack of demand to seek treatment for dental and orthodontic problems (Casamassimo, 1991).

Proper oral care is important when wearing orthodontics. Some of the main reasons include the following: It will look clean, eliminating teasing of the adolescent about dirty orthodontics. Good oral hygiene practices when wearing orthodontic appliances is also crucial to avoid common dental problems like gingivitis, calculus, and demineralization. Because thorough oral hygiene is more difficult with fixed orthodontics, orthodontic patients are more disposed to these issues than other individuals. These dental problems are unpleasant enough on their own, but if left

untreated, they can also turn into more serious oral health issues. Bad oral hygiene prolongs treatment time and increases costs associated with orthodontics. In severe cases, the orthodontist may decide to stop the treatment and deband the patient's orthodontics (Casamassimo, 1991).

It can be a challenge for young adults to keep up with good oral hygiene regimes. Patient selection is crucial, as more harm will be done if the oral hygiene is not immaculate during orthodontic treatment. How will straight teeth benefit the patient, if they have, for example, gingivitis which may cause loss of teeth, or caries that may lead to fillings, crowns, root canals and even extractions. (Casamassimo, 1991).

Chapter 3: Research design and methodology

3.1   Introduction

A few studies have been done in South Africa to determine the orthodontic treatment needs of children. Some of these where restricted to a certain area, while Drummonds (2003) crossed over

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the entire population of South Africa. In 1997, the national Department of Health took the initiative to conduct a national oral health survey amongst 4-5-, 6-, 12- and 15-year-old children in South Africa, to determine the oral health status and treatment needs of these children.

3.1. Aims and Objectives

Aim

To estimate the prevalence of malocclusion amongst adolescents in the Upington area of the Northern Cape Province.

Objectives
- To determine the need for orthodontic treatment in the area using the Index for Orthodontic Treatment Need (IOTN).
- To determine the demand for Orthodontic treatment will also be determined with the participant questionnaires.
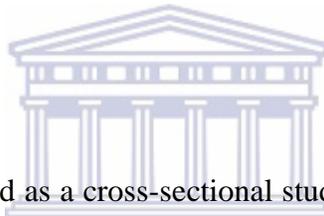
3.2. Study design

This research project was conducted as a cross-sectional study. It included a questionnaire to be completed by the participant, a quick interview with assessment of the participant's view using the AC, and an intra-oral photograph of the occlusions (Appendices 2). The participants were asked to swallow and bite to make sure the correct bite was used. A photograph was taken of the number allocated to them, and then an anterior occlusion photograph of the teeth was taken. This was done to use the Aesthetic Component and Dental Health Component of the Index of Orthodontic Treatment Need for analysis later. The photographs were taken with Canon EOS 60D, on Manuel focus mode. The questionnaire was aimed at participants and their parent or legal guardian. It included questions such as whether they thought there was a need for orthodontics treatment and whether they would consider treatment if a dentist recommended it. The questionnaire also included an open space where participants could choose a photograph, colour coded for the Aesthetic Component self-assessment, during the day of the data collection

3.3 Sampling technique

A multi-stage cluster sampling technique was used as described by the World Health Organisation (1997) in their manual on basic methods in oral health surveys. Upington was

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selected as the primary sampling unit. It was chosen because there is currently no permanent access to orthodontic specialist services in this area, and therefore it is of significance to establish whether the need for orthodontic treatment in this area would warrant motivation for an orthodontist to be employed in the Upington Area.

The secondary sampling unit was the schools, which were selected from the predetermined sample population. Schools were selected based on the ethnic majorities primarily found in those schools. Grades 8 and 9 were chosen as the tertiary sampling unit, as this was the age group targeted for this study. All children in those grades were invited to participate; however the study sample included only those who consented.

3.4 Sample population

The sample population included school children entering adolescence stages and their parents or legal guardians in the Upington area of the Khara Hais local municipality in the Northern Cape Province.

3.5. Sample size

The sample size minimum was calculated as 160. Upington was said to have a total population of 93,494 (Stats SA, 2011). The stats couldn't be used to determine the sample size minimum as the stats SA have two groups 10-14 and 15-19 where the adolescents lie within. The group used in this study is much smaller than 10-19 year olds as only 13, 14 and 15 year olds where targeted and used for the study.

According to all the high schools in Upington, the number of 13-15-year olds is 1838. Although a number of these schools are in the rural areas and not representative of the population of Upington. To get a proper representation of the population the two main high schools with all the races in the area where chosen. The sample size was 639 students, using a total population size of 639 and a Confidence Interval (CI) of 5%, the sample size minimum was 160 students if a confidence level of 95% was sought. However, only 103 students participated, decreasing the confidence level to little less than 75%.

It was however calculated that the sample size was big enough to support a hypothesis theory.

For the hypothesis test, the results pertained from the study done by Drummond in 2003/2005 indicated orthodontic treatment need of 53.2%, was used. The examiner suspected that this figure of Drummond for orthodontic treatment need is too low for the Upington area, thus the research proposal was conducted. From that statement the following was tested:

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☐ Null hypothesis – H0: p = 0.532 (53.2%)

☐ Alternative hypothesis – Hα: p ≠ 0.532 (53.2%)

3.6. Exclusion criteria

Any student who did not receive consent was excluded.

Any student who declined to participate on the day of data collection was excluded.

3.7. Ethics approval and consent

The proposal for the study was presented in April 2015. The Ethics and the Research Board approved the study on the 7th May 2015 and the project registration number of 15/3/28 was given. (Appendix 1.1)

A folder with information on the research and the Research Protocol was handed in at the Department of Education for the Khara Hais district in the Northern Cape end of May 2015. Permission was given first by the head of the Education department, of the Khara Hais District in the Northern Cape on the 13/04/15 to conduct the study at the schools proposed. (Appendix 1.2) The schools selected where contacted and gave permission after a formal visit and explanation of the proposed study in June 2015. They gave permission to come and address the students and give the informed consent forms out during mass. (Appendix 1.3)

Detailed consent and questionnaire forms in the language/s of their preference (English/Afrikaans) were sent to each parent or guardian marked with a unique research participant number (Appendices 1.4, 1.5 & 2.1)

 We returned the next week during exam times to collect the forms, ask the questions and take the photographs (Appendices 2.1, 2.2 & 2.3).

Only students whose parents consent was obtained were invited to participate in the study and approached on the day of data collection.

Students requiring dental treatment for any condition diagnosed during the examination parents where sent referral letters to go visit their dentists.

3.8. Research instruments

3.8.1. Parents or Legal Guardian Questionnaire

The legal guardians of the participants had to sign the consent form and complete the questionnaire attached. The aim was to obtain a perceived need for orthodontic treatment from the guardian's point of view, as they will be paying the bills and needed to be included in the process. A demand for treatment, or lack thereof, was also obtained from the questionnaire. (Appendix 2.1)

3.8.2. Student's Questionnaire

All participants had to complete their own set of questions which was part of the legal guardian's questionnaire before the data collection could commence. The aim was to obtain participants' perceived need for orthodontic treatment, as well as to compare their responses to the Aesthetic Component of the Index of Orthodontic Treatment Need. A demand for treatment was retrieved from their responses, and a reason for no demand was also included during the data collection process. (Appendix 2.1)

Statistically, the grades from the Aesthetic Component of the Index of Orthodontic Treatment Need were translated back into percentages. Photograph 1, for example, received a 0% score, which was further increased with increments of 10% per grade. If a participant chose photograph 4, as an example, they will have had a 30% personal belief that they needed orthodontic treatment. (Table 3.1)

The Aesthetic Component was also used by the examiner to compare it to the Aesthetic Component the participant chose. The Dental Health Component was used to determine the need for orthodontic treatment. It was then considered that any value more than 0% of the Aesthetic Component, combined with a yes answer from the Modified Dental Health Component, had some degree of need for orthodontics treatment.

Table 3.1 AC grades shown as percentages

1	0%	6	50%

2	10%	7	60%
3	20%	8	70%
4	30%	9	80%
5	40%	10	90%

3.8.2.1 The AC of the IOTN

The AC of the IOTN consists of a ten-point scale illustrated by a series of photographs, rated for attractiveness by a lay panel, and which were selected as being equidistantly spaced through the range of grades.

In their questionnaire, the children were asked to rate their own dentition according to the AC pictures, which were re-ordered, to attain the subjective perceived need for orthodontic treatment The examiner, using the AC as pictured in Figure 3.1 & Appendix 3, also rated the dental aesthetics of the student during the analysis phase to attain the objective perceived need for treatment. This was assessed after using the photographs taken with the DHC.

The Aesthetic Component was used as a guide to pick a grade, which most closely resembled the overall level of aesthetic impairment of the dentition, as opposed to the specific character traits represented by the picture.

The Aesthetic Component pictures where scrambled and colour coded to ensure that students did not choose picture number one as most Aesthetic, just because it is number one in the list. They were also not placed from most attractive to least attractive to ensure that students did not just choose the most attractive. Participants had to look at the pictures and choose one that they thought resembled their teeth. It was thoroughly explained that they had to show the dentist how bad they thought their own malocclusion was. The form that was used is included below. The numbers were added later for analysing purposes. The students did not see these numbers during the interview process.

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Figure 3.1. The Scrambled up AC used in the thesis.
Numbering was added later on during calculations in
the result stage.

Figure 3.2. The AC of the IOTN (Brook and Shaw, 1989)
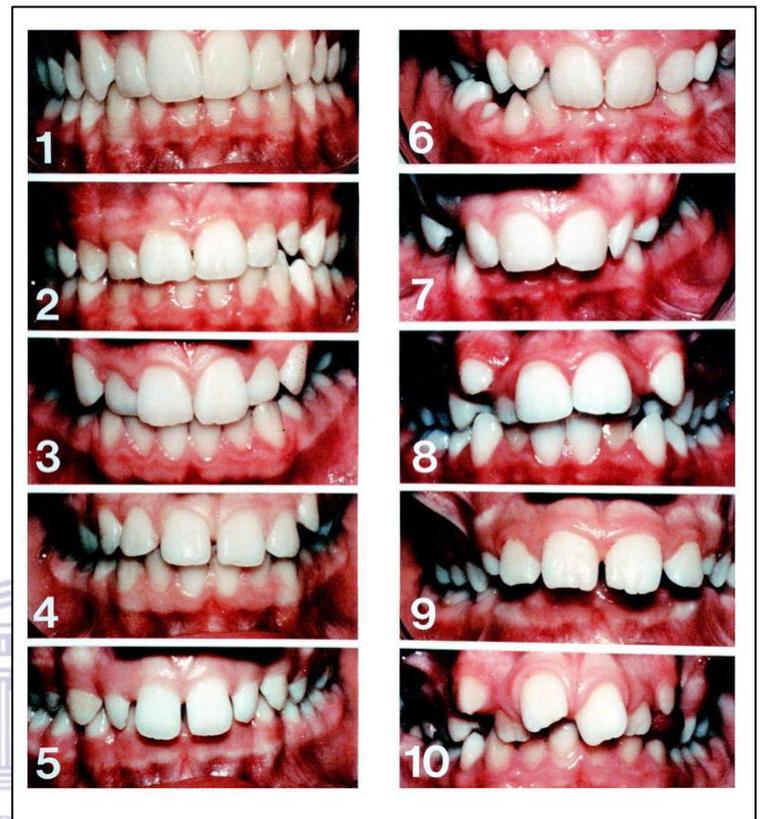
The Aesthetic Component form was also used by the examiner to compare it to the Aesthetic Component the participant chose. The Dental Health Component was then used to determine the need for orthodontic treatment

The images presented to the students were not in order as they appear in the original AC picture scale and the students were asked to state which pictures they felt represented occlusions which in their opinion represented their own teeth most.

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3.8.3 The Occlusal Dental Anterior Photograph

The examiner used a Canon EOS 60D camera to take an occlusal dental photograph of each participant. The camera was set on manual focus as the automatic focus did not focus on the teeth, but rather on the lips. A lip retractor was used to insure better photographs. Once participants chose their Aesthetic Component, the photograph was taken of the questionnaire number and then the anterior dental occlusal photograph was taken to ensure no mix up in the data. These photographs where downloaded and sorted by the assistant who then cropped and numbered them in order of time taken. The photographs were then placed on the photograph page for further analysis by the examiner. The participant's answers were also included on this page to ease data capturing later on. (Figure 3.3 & Appendix 3.2)

*Figure 3.3:   Example of the photo*graph *page with the occlusal dental anterior photographs, observations by the examiner, and answers by participants*

Orthodontic treatment need and demand in the Upington area

Photograph Analysis: NUMBER 1

Photographs:

Dr Jeannette Booysen's observations

Need: YES

Problems: Edge to edge bite, anterior crowding, blocked out 34.

Participants: Need: YES

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3.8.4. The modified DHC of the IOTN

3.8.4.1   Dental Health Component: DHC

The intra-oral examination was conducted according to the modified DHC of the
IOTN as described by Burden *et al* (2001), which is a 2-grade scale.

   0. No definite need for orthodontic treatment

   1. Definite need for orthodontic treatment

Each participant was examined for specific conditions and if one was found, a "1" was recorded
and no further conditions were sought. This was done with the analysis with the occlusal
photograph taken at the school.

Each participant was examined according to the following conditions:

1. Missing teeth

   i. Any teeth missing due to traumatic loss or congenital absence, if orthodontic treatment was
required to open or close the space, were recorded

   ii. Any teeth which were erupting ectopically were recorded

   iii. Any teeth, which were impacted, including any space required for the future eruption of a
tooth that was less than 4mm between teeth present, were recorded.

   iv. The presence of supernumery teeth and retained deciduous teeth was recorded.

2. Overjet

   i. Increased and reverse overjets were measured using the modified DHC ruler.

   ii. Measurement was done to the labial surface of the most prominent incisor.

   iii. Increased overjets exceeding 6mm were recorded

   iv. Reverse overjets in which all 4 maxillary incisors were in lingual occlusion were recorded
if they were greater than 4mm without masticatory or speech difficulties, or greater than 1mm
with masticatory or speech difficulties.

3. Crossbite/s

   i. Any anterior or posterior crossbite with more than 2mm discrepancy between intercuspal

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and retruded contact positions were recorded.

4. Displacement of contact point/s

   i. This was determined according to crowding of permanent teeth only.

   ii. If the measurement between the contact points of the two most crowded teeth was more than 4mm, then it was recorded

5. Overbite

   i. Any deep overbite causing gingival or palatal traumatic injury was recorded.

   ii. Any anterior or lateral open bite greater than 4mm was recorded

3.9   Infection Control

Infection control regimes were closely followed throughout the data collecting procedure. A new set of Medical, non-latex and no powder gloves, and facial loop mask where used with each participant.

The retractors where cleaned with cold sterrilent Caviside™ after every participant's photographs were taken. Three retractors were available, so a sterilized one was always ready for the next participant. The camera and other surfaces were all wiped with Caviside™ wipes after each participant's interview. Used gloves where discarded with the medical waste of the practice upon returning from the visits. All used instruments where placed in the autoclave after the visits.

3.10   Data analysis and Editing

The photograph pages where analysed and printed out. The questionnaires where attached to each numbered photograph page. A database was then created using MS Excel where statistical analysis of the data was then carried out. The quantitative information from the questionnaires and photographic pages was captured in the created Excel Spreadsheet for processing, analysis and interpretation.

From the data collected, the statistician made use of the Wald test for single binomial proportion.

3.11 Data collection

At the end of May 2015, a folder with information on the research project and related protocol was submitted to the Department of Education for the Khara Hais district in the Northern Cape. Permission was granted by the local head of the Education Department, on 13 April 2015, to

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conduct the study at the schools proposed. (Appendix 1.2)

The schools where contacted next. After a formal visit and explanation of the proposed study in June 2015, headmaster of Upington High School, and the assistant headmaster from Duineveld High School, granted permission for the study to take place at both schools. (Appendix 1.3) Both schools gave permission to address the students on the proposed study, after which the informed consent forms was handed to the students. (Appendix 1.4). A week later, the completed informed consent forms were collected from both schools, followed by questioning of students and capturing relevant photographs.

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Chapter 4: The Results

4.1   Composition of the sample in terms of dentition stage

Table 4.1 Composition of the sample in terms of dentition stage

Race	Quantity	Percentile
Upper Canine Erupting	7	6.7 %
Deciduous tooth	4	38.9 %
n	103	

4.2   Demographics

The quantifiable characteristics of the participants were analysed, and include their age, race, which grade and school they are in, and the dental problems they present with.

4.2.1   Age Distribution within the study group.

Table 4.2 The age distribution in the participant group of 103 students, 63 were in grade 8 and 40 were in grade 9.

Age	Quantity	Percentile
14-15	63	61.16 %
15-16	40	37.84 %
n	103	100 %

4.2.2   Study group distribution within the schools visited.

Table 4.3 Study group distribution within the schools visited

Demographics	Quantity	Percentile
Upington High School	78	75.73 %
Duinevel High School	25	24.27 %
n	103	100 %

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4.2.3 Racial distribution within the Study Group. (Table 4.1)

Table 4.4 – Racial distribution within the Study Group

Race	Quantity	Percentile
Caucasian	43	41.75%
Black	20	19.42%
Coloured	40	38.83%

4.2.4 Student participation in the Study. (Table 4.2)

Table 4.5– Student participation in the Study

	Percentage	Percentile
Total students	639	100%
Participants	103	16.12%

4.3 The Need and demand for Orthodontics treatment

Table 4.6 –The table shows the summary of the parents and students perception of need and if they had a need would they seek treatment, the demand. This is compared to the Examiners results for the level of need of the students examined.

	ANSWERS		
QUESTIONS	N=103	N=103	N=103
	Yes	No	50/50
Parent need	73	14	16
Parent demand	89	12	2
Student need	83	10	10
Student demand	98	4	1
Examiner	85	8	10

4.4 The Dental Health Component

Table 4.7 The DHC tabulated in the this study.

	Quantity	Percentile
Missing tooth/ teeth	8	7.7 %
Crowding	39	38.83 %
Spacing	35	34.95 %
Midline Diastema	7	6.08%
Rotations	39	38.83 %
Overjets & Overites	12	11.65 %
Occlusal Problems	47	46.60 %
Open Bites & Open Spaces	48	37.95 %
n	103	

4.5   The Aesthetic Component: The AC (Table 4.4, 4.5 and 4.6)

Table 4.8 – Breakdown of choices made by students related to the Aesthetic Component presented to them

Colour	Percentage need	Students	Examiner
White	0	27	8
Light blue	10	26	25
Dark blue	20	16	5
Green	30	13	11
Yellow	40	6	6
Orange	50	5	9
Pink	60	3	17
Red	70	4	13
Purple	80	2	9
Black	90	1	0

Table 4.9 – Indication of agreeableness to treatment need identified by the examiner

Agree/ Disagree with Examiner	NEED	
	AGREE	DISAGREE
Parent	96	7
Student	95	8
Photographs	60	43

Table 4.10 – Comparison between the levels of need identified vs AC photograph chosen

N= 103	Same level of need	Photograph chosen doesn't correspond to need
LEVEL OF NEED	58	45

Chapter 5: The Discussion

5.1   Composition of the sample in terms of dentition stage.

Malocclusion indices are unreliable over time because it can be affected by developmental stages in the occlusal traits measured (Chi, Johnson, & Harkness, 2000).

Proffit *et al* (2007) suggested that the morphological variation with age may not be related to chronological age, but rather to the stage of dental development. The chronology of tooth development of the permanent dentition shows that all permanent teeth should be erupted by the age of 12, except for the third molars. All deciduous teeth should therefore have exfoliated by this time. This specific study sample was chosen to make sure that the participants are older than 12 years and in full permanent dentition stage, in order to ensure reliable results.

In this sample, it was found that 6.7% of the participants where still erupting their upper canines and 3.88% had at least one deciduous tooth still present in the occlusion (Table 4.1). The Aesthetic Component was developed to assess the prevalence of malocclusion in the permanent dentition stage (Otuyemi & Jones, 1995). Some of the occlusal traits measured will improve with the transition from the mixed dentition stage to the permanent dentition stage, resulting in an improvement of the AC Score. (Estioko, Wright, & Morgan, 1994; Summers, 1966; McLain & Proffit, 1985; Tarvit & Freer, 1998; McVay & Latta, 1984). Although this is true, it must also be remembered that the few participants whose canines were still erupting, had no space and impaction may have hindered the eruption. This also applies to deciduous teeth present. If they are still present at this age, there will be problems causing these teeth not to exfoliate, leading to the need for orthodontic intervention.

5.2   Demographics

The quantifiable characteristics of the study group were analysed by age, race, which grade and school they were in, and the dental problems they present with.

In a study done on 12-year-old children in South Africa, it was found that there were no significant differences observed in the prevalence of malocclusion and the different location types, i.e. urban, farm schools and non-urban schools. Thus, the prevalence of malocclusion in the three location types did not differ significantly. The results of this study therefore suggested that the provision of orthodontic services for the rural and urban areas should not be different

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(Drummond, 2003). The two schools chosen for this study was thus representative of the mixed population in the area, and are therefore justified. These schools were also the only institutions with hostels, therefore accommodating rural, urban and non-urban students.

5.2.1 Age Distribution within the study group.

The analysis of the data related to the demographics of the sample group showed that 61.16 % of the total participants were between the ages of 14 and 15 years. The 15-year-old participants represented only 38.84 % of the study group. The participating 14-year group therefore made up two thirds of the entire study group. (Table 4.2)

The morphological discrepancy with age may not be associated to chronological age, but to the stage of dental development (Proffit, *et al* 2007). Most 12-year-old children will present with a dentition in the early permanent dentition stage, and the rest will still be in the late mixed dentition stage (Moyers, 1972). Some of the occlusal traits recorded will improve with the transition from the mixed dentition stage to the permanent dentition stage, resulting in an improvement of the AC score (Estioko *et al.,* 1994; Ansai, Miyazaki, Katoh, Yamashita, Takehara, & Jenny, 1993; Summers, 1966; McLain & Proffit*.,* 1985; Tarvit & Freer*,* 1998).

In the other studies done in South Africa, it was seen that most researchers chose 14 year olds on which to conduct their research (Zietsman, 1979; Swanepoel, 1985; Van Wyk *et al.,* 1985; De Muelenaere & Viljoen, 1987).Adoloscents are known to be more docile, more eager to learn and more concerned with their health and appearance. The challenges they face at this age, may also have a negative effect on importance they place on dental care. It is a period where they are at higher risk in their own health and education (Paul *et al.,* 2005). Some of these risks may include pregnancy, peer pressure, drugs, neglect, abuse, depression, suicide and criminal activities. The younger group was more willing to participate in the study, showing more interest and asking more questions related to the study. It might be argued that adolescents experience a social shift from the age 14 to 15 years, which makes the 15 year olds less willing to participate.

5.2.2 Study group distribution within the schools visited.

Upington High School had the highest participation rate of 48.55 % of the total study group, followed by the practice group with 27.18% participation, and Duineveld High School coming in at 24.27%. Duineveld High School would have had more students participate, but most forgot to

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bring their signed consent forms to partake in the study. (Table 4.3)

5.2.3 Sample Group

The sample size minimum was 160 students if a confidence level of 95% was sought. However only 103 students participated decreasing the confidence level to little less than 75% .Thus the treatment need percentage from the sample group can only give a 75% certainty that the results are a representation of the whole population in the Upington area.

However, the sample size was big enough to support a hypothesis theory. From the results the H0 could be rejected and a conclusion could be made that the orthodontic treatment is not 53.2% for the Upington area in adolescents; in fact, it could be deduced that the orthodontic treatment need exceeds 50%. (Table 4.5)

From the data collected the Wald test for a single binomial proportion was used. Firstly, the points estimate for the proportion of patients identified to have orthodontic treatment need was determined, as identified by the researcher. That point estimate is $\hat{p} = 85/103 = 0.8252$ (82.52%), with sample size n = 103.

The confidence interval for the proportion of patients identified to have orthodontic treatment need with a 95% confidence interval; it can thus be assumed the researcher is 95% confident that the true population parameter (true orthodontic treatment need for adolescents in Upington area) will lie in the confidence interval. The confidence interval is determined by using the point estimate for the data and an estimate of the standard error of the point estimate. The calculated confidence limits are as follows:

Lower limit = 0.7519 (75.19%)

Upper limit = 0.8986 (89.86%)

The margin of error is 7.33%. Thus, the need for orthodontic treatment in Upington possibly lies between 75.19% and 89.86%.

For the hypothesis test the results pertained from the study done by Drummond in 2003/2005 was used that indicated orthodontic treatment need of 53.2%. The examiner suspected that the figure for orthodontic treatment need is too low for the Upington area, thus the research proposal was conducted.

Null hypothesis – H0: p = 0.532 (53.2%)

Alternative hypothesis – Hα: p ≠ 0.532 (53.2%)

A two-sided test is thus used. The test statistic z and the probability P (z) were calculated. The two-sided significance level of α = 0.05 was then specified. The z statistic was calculated using formula,

$$z = \frac{\hat{p} - p}{\sqrt{\dfrac{p * (1 - p)}{n}}}$$

In the formula z is the test statistic, $\hat{p}$ is the sample population, p is the population parameter and n is the sample size. Then z = 5.9644 with P (z) <= 0.0001. Therefore P (z) <(0.00021) < α (0.05). Therefore, the H0 was rejected.

5.2.4 Racial distribution within the Study Group

In this study group, it was found that 43 out of the 103 students where Caucasian, thus representing 41.75% of the study group. 40 Students were coloured and represented 38.83% of the study group. (Table 4.4). The black participants made up 19, 42% of the study group with just 20 participants. According to the 2011 Census data (Table 5.1), the study group is good representation of the Upington population. Upington has a higher population of coloured individuals, compared to black individuals (Census, 2011):

Table 5.1 – Population by race for Upington, NC

Racial makeup (2011)	
• Black African	25.6%
• Coloured	62.6%
• Indian/Asian	0.6%
• White	10.1%
• Other	1.1%

It was also interesting to see that Afrikaans was the main language of choice in the Upington area. It is therefore important to source a specialist in Orthodontics that is fluent in Afrikaans in order to serve the community better. (Table 5.2)

Table 5.2 – Language breakdown in Upington, according to the 2011 Census data

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First languages (2011)	
• **Afrikaans**	85.5%
• **Xhosa**	6.1%
• **Tswana**	3.2%
• **English**	2.1%
• **Other**	3.1%

5.3.1   Dental Health Component (DHC) (Table4.7)

5.3.1   Missing incisor, canine and premolar teeth-maxillary and mandibular teeth

Drummond's study in 2003, found that missing incisors, canines and premolars are more common in the maxilla (9.72%), than in the mandible (8.57%). Thus, a total 8 to 10 % of his study group presented with missing teeth (either upper or lower teeth). In this study, however, only 7.77% of the participants presented with missing teeth. Although this is slightly less than the results from Drummond's study, it is still regarded as in line with his findings (Drummond, 2003).

5.3.2   Crowding in the incisal segments

Crowding in the incisal segment is the condition in which the available space between the right and left canine teeth is insufficient to accommodate all four incisors in normal alignment. Teeth may be rotated or displaced out of alignment in the arch. Crowding of the incisors are the most common form of Angle Class I malocclusion and is by far the most prevalent form of malocclusion (Proffit *et al*., 2007).

5.3.3   Spacing in the incisal segments

Spacing is the condition in which the amount of space available between the right and left canine teeth exceeds that which is required to accommodate all four incisors in normal alignment. If one or more incisor teeth have proximal surfaces without any interdental contact, the area was recorded as having space (World Health Organisation, 1997).

One of the characteristic features of normal occlusion is arch continuity, as expressed by proximal contact between all teeth in each dental arch. Factors such as mesial drift, transeptal fibres, the slope of the occluding cusp, and the direction of occlusal forces, contribute to the

maintenance of this continuity (Moyers, 1972). The loss of contact as through loss of proximal tooth material is viewed as detrimental to arch integrity and normal function (Steigman and Weissberg, 1985).

On the other hand, Henley (1971) claimed that spacing is an acceptable variation in the normal occlusion pattern and therefore not a malocclusion. A considerable number of individuals show spaces between some, or even all, of their teeth. These are known as "spaced dentition" (Steigman & Weissberg, 1985). Spacing in the incisal area is indicative of space excess in these segments. Spacing can be a symptom of missing or undersized lateral incisors, para-function habits such as thumb sucking, mouth-breathing and tongue-thrusting, flared or rotated central incisors, anodontia, macroglossia, dento-alveolar disproportions, and true tooth size/jaw size discrepancies (Nainar & Gnanasundaram, 1988).

In the current study 18.44% of participants had open spaces. Drummond (2003)'s study showed the prevalence 27 % per cent of the children presented with spacing related problems.
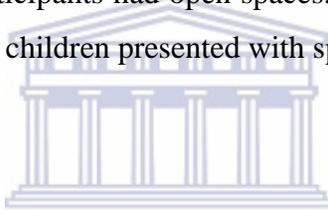
5.3.4 Midline diastema

A diastema is an open space greater than 0.5 millimetres between adjacent teeth (Keene, 1963). A midline diastema therefore, is a space between the central incisors (Moyers, 1972). Of the 103 adolescents examined, 7 or 6.08% presented with maxillary midline diastema. Drummond (2003) found 16.66 % of his study group to present with diastema. The different results from these two studies can be contributed to the fact that this study group was younger, and that some diastemas do close with age. In the developing dentition at the age of 12 years old, the presence of a diastema is viewed as a normal occurrence. In the absence of a deep overbite, these spaces normally close spontaneously (Moyers, 1972). It must also be noted that there is a proven racial link to Midline Diastemas. Black individuals had a higher prevalence for this anomaly (Drummond, 2003; Horowitz, 1970; Richardson, Malhotra, Henry, Little, & Coleman, 1973). The current study had a very low representation of the Black race (19.42% of the study group), compared to the other races represented.

5.3.5 Rotations

Rotations can be defined as tooth movements around the long axis of the tooth. Rotations can be Mesiolinguel and Distolabial where the crown is labially placed compared to its mesial aspect; it can be Distolingual and Meisolabial where the mesial aspect of the crown is labially placed, compared to its distal aspect, and lastly, transposition rotation is when two teeth change places (Singh, 2015).

Any type of rotation noted was recorded as a rotation either in the upper or lower segments. The results of the study showed that 38.8% of participants represented some type of rotation irregularity, and 9.71% represented with displacements. This totalled to 48.51% representation for some form of irregularity. Based on evidence from previous studies on the topic, this finding is in line with results recorded between 53 – 59% ranges (Drummond, 2003; Brunelle, Bhat & Lipton, 1996).

5.3.6 Overjets & Overbites

According to Moyers (1972), an overjet between 1mm and 3mm is regarded as normal. An overjet larger than 3mm but smaller than 6mm indicates a moderate problem and overjets more than 6mm indicates a severe problem. (Brook & Shaw, 1989)

It this study, 11.65% of the group presented with an overjet larger than 3mm. Any value over 3mm was recorded as a need and the severity was therefore not recorded. These results are in line with Drummond's study, where 9.28% of his study group presented with a maxillary overjet of more than 3mm (Drummond, 2003). Certain occlusal traits, including overjets, will improve with age due to normal changes in development and growth present during this development stage. A lesser value of overjets will therefore be seen in adolescents, than in a younger group of participants (Brunelle *et al*, 1996).

5.3.7   Occlusal Problems; Dental Class II or Class III Malocclusions

Overjets and overbites can also be seen as trademarks of these malocclusions. An increased overjet may indicate dental class II, whereas a reversed overjet can be that of a dental class III (Singh, 2015). Drummond found that in 12-year-old South African children, there were occlusion irregularities of 53.06% mandibular overjet or Class III, and 59.52% maxillary overjet or Class II

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(Drummond, 2003).

The results of the current study gave a value of 46.60% of the study group, who presented with either a dental class II or III. The difference can also be explained by growth, as certain occlusal traits, including over jets, will improve with age. A lesser value of overjet's will therefore be seen in adolescents, compared to a group of 12 year old participants, for example (Brunelle *et al*, 1996). Drummond (2003) found a link between overjet and dentition stages. In the late mixed dentition stage, percentage distribution was at 12.43% (+/- 12 year olds), and with early permanent dentition stage (+/- 14 year olds), the percentage was 9.77 %. This gave a p-value of 0.0045, which was quite significant. It proved that a higher value of overjet malocclusion will be seen in the late mixed dentition stage, than in the early permanent dentition stage, proving the results of the current study. A study by Proffit, Fields and Moray in 1998 found the prevalence of Angle class III malocclusion ranged from 0 to 26.7% in different populations which is slightly less than our sample group. Their results suggested that the prevalence of Angle class III malocclusion varies greatly within different races and geographic regions.

Our group however was too small to make definitive conclusions thus further study is recommended to determine the exact prevalence of Malocclusions type II and III in the Upington area. Also note that Proffit *et al,* 1998 study only measured class III's where our study measured both.
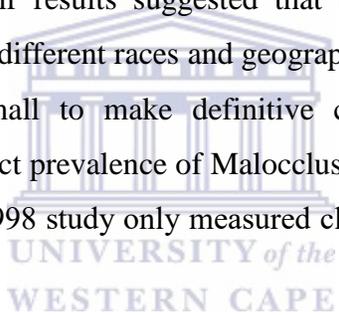
5.3.8   Open bites and open spaces

There is no vertical overlap between maxillary and mandibular teeth. When the individual bites in centric occlusion and a space exists between the maxillary and mandibular teeth. Open bites can be anterior or posterior. Usually they are accompanied by tongue trust on closing to aid in swallowing (Singh, 2015). It must be remembered that as a child grows, it has been seen that a malocclusion in the vertical plane is related to skeletal jaw relationship, and not just indicative of malocclusions of the teeth alone (Proffit *et al*., 2007).

In this study, 37.95% of the sample presented with some type of open bite. When only anterior open bites where looked at, the value recorded came in at 16.50%, a little above the range of other studies done on anterior open bites. The values found in these studies, varied between 3.5%, 7.7% to 10.2% (Burnelle *et al*, 1985; Drummond, 2003, Otuyemi, Ogunyinka, Dosumu,

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Cons & Jenny, 1999).

5.4 The Aesthetic Component of the Index of Orthodontic Treatment Need

At this stage in the study, it was noticed that there was a direct decline from "no need" or most aesthetic appearance to "definite need" or least aesthetic appearance, even though the photographs were scrambled up and colour coded. Even when students knew they had a need for treatment, they tended to choose less severe levels when picking a picture resembling their own teeth. Most of the participants chose the more aesthetic pictures (64%), whereas the dentist's observations are more objective, spread widely over the all levels. (Table 4.8)

The participating students were asked to choose a picture from the Aesthetic Component form, which they thought most resembled their teeth. They were free to make a decision on their own and no guidance was given. When they were uncertain, they were told that there was no right or wrong answer, and they should just choose a picture that they thought looked like their teeth.

- Firstly, those participants with "no need", chose the white bordered picture, adding up to 27 votes (26.21% of the study group).
- This was closely followed by the "borderline need" indicated by the light blue bordered picture, with 26 votes (or 25.24% of the study group).
- The dark blue bordered picture indicating "slight need", received 16 votes (15.53%), whereas the green bordered picture, indicating a "30% need", had 13 votes (12,62%).
- The yellow and orange bordered pictures, which indicated a "40-50% need", had 6 and 5 votes respectively, with a corresponding percentage score of 5.83% and 4.85%.
- Moving towards a "definite need", as seen in the pink bordered picture, 3 votes were received, constituting only 3.88% of the total study group.
- The red bordered picture received 4 votes and made up 1.94% of the study group.
- The purple bordered picture, indicating a "most definite need", received 2 votes (1.94%), whereas the black bordered picture only received one vote, totalling only 0.97% of the total study group.

The Aesthetic Component of the Index of Orthodontic Treatment Need and the Dental Health

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Component was combined to determine a definite need for orthodontic treatment in 85 of the 103 students, totalling 82.52% of the total study group. From the group only 8 participants, or 7.77%, did not need orthodontic treatment. The borderline cases are made up of 10 students, 9.71% of the study group, where treatment need was uncertain. (Table 4.6, Examiner results)

There was direct difference in the need for treatment expressed by these students and their perception of the level of need they had. A high percentage of 79.61% (82 out of 103 participants) chose the more aesthetic photographs, whereas the examiner's decisions where more widely spread.(Table 4.9 & 4.10) The difference in the examiners ratings and the student's AC choice can be explained by other studies that showed the same pattern. A few studies found a statistically significant, although minor, association between the two ratings of the AC, even though participants consistently rated themselves more favourably, than the examiner rated them (Kerosuo H, Al Enezi, Kerosuo E, & Abdulkarim, 2004; Abu Alhaija, Al-Nimri, & Al-Khateeb, 2005).
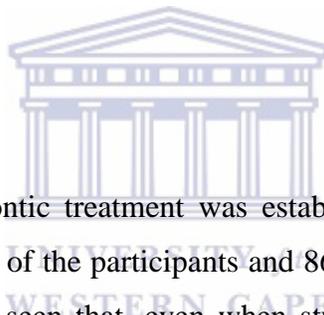
5.5 Need and Demand

At least 82.52% need for orthodontic treatment was established in this study group. Of this 82.52% who had the need, 95.15% of the participants and 86.41% of the legal guardians wanted treatment for the problem. It was seen that, even when students knew they had a need, they tended to choose less severe levels of AC when choosing a picture resembling their own teeth. Most of them chose the more aesthetic pictures (64%), whereas the dentists observations are more objective a widely spread over all the levels. (Table 4.6)

5.5.1. The Parents or Legal Guardians Need and Demand for Orthodontic treatment for their Child

In analysing the parents' or legal guardians' perception of need of orthodontic treatment for their children, a total of 73 participants agreed that their child required treatment, constituting almost 71% of the total study group. Only 14 participants said that they did not believe their child needed orthodontic treatment, whereas 16 participants (15.53%) were uncertain. Whether parents or legal guardians would consider treatment if it was indicated by the dentist, 89 participants (86.41%) indicated that they had a demand. Those with no demand came in at 11.59% (or 12 participants) and 2 participants (1.94%) were uncertain. (Table 4.3)

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Parents or legal guardians who were initially uncertain about whether orthodontic treatment for their children were necessary, dropped from 15.53% to only 1.94%, once a professional indicated that their children might require orthodontic treatment. This indicated that the public still has some degree of confidence in professionals. (Table 4.6)

5.5.2   The Participating Students Need and Demand for Orthodontic treatment

In a similar study by McLain and Proffit (1985), it was found that 11.0% of 12- to 17-year-old children in America had normal occlusion. Results further found that 35% had minor manifestations of malocclusion, 25% had a definite malocclusion for which orthodontic treatment was 'elective', 13% were judged to have conditions for which orthodontic treatment was 'highly desirable', and 16% were judged as having a condition for which orthodontic treatment was 'mandatory'.

A study using the Occlusal Index of Summers (Summers, 1971), the majority of the South African 12-year-olds (53.6%) presented with a good occlusion, whereas 17.5% had slight malocclusion but needed no treatment, and 15.7% needed minor treatment for small deviations in occlusion. Definite treatment was needed in 11.5% of the subjects studied, while 1.8% fell into the category where urgent treatment was necessary to correct the occlusal problems (Briedenhann *et al.,* 1991).

In this study it was found that, even when students knew they had a treatment need, they tended to choose less severe AC levels when they had to choose a photograph resembling their own teeth. Most of them chose the more aesthetic pictures (64%), whereas the dentists observations are more objective a widely spread over the levels. Some of the reasons for this phenomenon include the fact that they are scared that they will get the answers wrong, or they could have felt shy to the truth of how severe their dental problem really is. It could also be due to them really not realizing how severe the problem is. (Table 4.6)

5.5.3   The reason for no demand where a need was found

The main reason participants did not seek out treatment, although a need may be identified, related to the costs involved. More than 40% of the group was under the impression that orthodontics is more expensive than what it is.

Costs related to Orthodontic treatment do not only include the placement of the braces, but it also entailed traveling fees, if needed, to other towns where the Orthodontist resides. Because of the remoteness of a town such as Upington, Orthodontists can only visit patients every 4-6 weeks, if at all possible. It must also be remembered that for most of these students, the costs related to orthodontic treatment also include traveling fees to see a specialist in a town/city 600km away, especially if a local specialist is not available or a traveling Orthodontist has a long waiting list.

Social and cultural circumstances also have a direct effect on the demand for orthodontic treatment. It is found that individuals from a higher income group are more likely seek out treatment, than those who cannot afford it. Thus, people with higher income levels will have better looks and are more likely to have better jobs. The more a child wants to achieve in life, the more likely the adults will have a demand for Orthodontic treatment, if needed (Proffit *et al,* 2007).

78.87% of the parents in this study thought that braces where much more expensive than they really are, if a dentist asked medical aid rates. Rates are on medical aids from a Class I mild (both arches) round about R 9000 to more severe cases that can go up to R20 000 (Medical Aid rates, 2017).
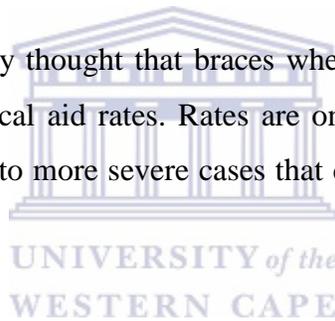
5.7   Problems and limitations of the study

Many more students wanted to participate in the study, but either forgot or lost their parents' consent forms. It was debated at one point whether we could have included these students in the study without their consent forms, as it is possible for a child at the age of 12 to seek out medical treatment on their own, without adult permission (Marais, 2015). As the model for the study was already drawn up, it was decided not to deviate from already chosen methods.

The degrees of need varied from student to reality, as the students where either shy, afraid of being wrong or didn't really realize the degree of their problem. Maybe a longer discussion would have cleared things up. The school only allowed a few minutes to speak during mass. Measuring the psychological effect malocclusion has on these students, would have been a valuable in future planning in implementations of possible treatment options.
The AC of the IOTN does not represent all forms of malocclusion. In a study in 1996 by

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Trottman and Elsbach, white children were found to have Class II malocclusion more frequently than black children who, in comparison, commonly presented with Class III malocclusion. Furthermore, they found that black children were twice as likely to suffer from anterior crossbites as white children. De Mûelenaere *et al* (1998) suggested that minor adjustments to the index used, such as representing bi-maxillary protrusion, would better suit the index used, such as representing bi-maxillary protrusion, would better suit the black South African population.

The total number for the sample group was too small to draw definite conclusion on the exact treatment need percentage and should be considered as suggestive with further investigation being required.

5.6 Results comparison of various studies related to malocclusions in South Africa children in their adolescent stage (Table 5.3)

According to Drummond (2003/2005) there are considerable differences in the reported findings, for studies done is South Africa, but it is clear that a large percentage of South African children presents with malocclusion and need orthodontic treatment. This study findings of an Orthodontic Treatment Need of 50% or more in the Upington area of the Northern Cape in inline with his findings of an Orthodontic Treatment Need of 53% in his study.

Table 5.3 – Results comparison of various studies related to malocclusions in South Africa Children in their Adolescent stage.

Researcher	Age	Good Occlusion Slight malocclusion (mean % within al ethnic groups)	Minor comprehensive Orthodontic treatment need (mean % within al ethnic groups)	Index
Zietsman, 1979	14	37	63	ANGLE CLASSIFICATION AND OTHER VAROIUS TRAITS

Zietsman, 1979	14	39	60.96	ANGLE CLASSIFICATION
Swanepoel, 1985	14	70	30	MODIFIED FDI METHOD
Van Wyk, *et al,*, 1985	14	56	44	OCCLISAL INDEX OF SUMMERS
De Muelenaere *et al,*, 1992	14	72	28	OCCLISAL INDEX OF SUMMERS
Current study, 2017	14-16	-	>50	IOTN

5.8   Result Summary

In the study 46.60% of the participating presented with malocclusions in the form of Class I, Class II and Class III malocclusions. The main orthodontic problems measured were rotations, crowding, open bites and or open spaces.

The Aesthetic Component of the Index of Orthodontic Treatment Need and the Dental Health Component was combined to determine a definite need for treatment in 85 of the 103 students, constituting 82.52% of the total study group. The parents' perception of treatment need for their children was at 70.87% certain, 13.59% said they did not believe their child needed orthodontic treatment and 15.53% where uncertain. Parents' need for treatment substantially increased on recommendation for treatment from a specialist. Based on dentists' recommendations, 86.41% of the parents had a demand for treatment for their children. Those with no demand where 11.59% of the group, and only 1.94 % where uncertain.

The reason mostly indicated for not wanting to seek treatment was the costs involved. More than 40% of the group was under the impression that orthodontics are way more expensive than what they really are, if the dentists are contracted in under medical aid fees. The students' demand where higher than that of the parents. Their demand was quite high at 95, 14 % of the participating student group.

It was further found that 82.52% of the total study group needed orthodontic treatment, whereas 9.71% where borderline cases, and those not needing treatment totalled to only 7.77% of the

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group. Participants tended to choose the prettier pictures in the Aesthetic Component, compared to severity of their actual dental problem. 45 of the participants' decisions did not match the examiner's decision correctly, adding up to a high prevalence of 68% of the group having a more favourable view of their dental problem, compared to reality.

Though the results could only been seen as a recommendation due to the sample group size, it was determined with the hypothesis test results that the orthodontic treatment need for the Upington area in adolescents; exceeds 50%.

Chapter 6: Recommendations and Conclusion

The aim of the study was to investigate the need for orthodontic treatment amongst adolescents in the Upington area of the Northern Cape. The demographics showed that only a fifth of the sample group participated in the study. More Grade 8's students participated in the study than Grade 9's – This might have been due to the age difference and peer pressure. Upington High School showed the greatest participation number in the total sample group.

Ethnic divide reflected the Census of 2011 within the study, as Coloured and White participants far exceeded the black students. The main language of choice among the total study group was Afrikaans. As a new dentist in town, one would start to speak English with non-white patients, and they would immediately stop you and ask to speak Afrikaans. This was quite an adjustment to the norm in South Africa. It must also be noted that many of these participants do not even understand English. It creates a real language barrier for someone who might not be fluent in Afrikaans. This should therefore be an important consideration in finding a specialist to train to work in the Upington area. They must be able to communicate properly with the community.

The main dental problem in the study group, was Class II and III malocclusion which presented in almost half of the study group. This was closely followed by rotations, open bites, open spaces and crowding. These dental problems require orthodontic intervention to correct it

A definite need of more than 50% for orthodontic treatment was established by the examiner, with a corresponding demand from the guardians and participating students. Comparing this to Drummond (2003) which reported that 52.3 % presented of his study group with identifiable malocclusion it could be concluded that there is a need in the Upington area for Orthodontics of at least 50% and even more.

The demand and need was weighed against each other, and it was found that almost all of those with a treatment need, had a demand for treatment as well. The main reasons why those with need did not seek treatment, was related to the perceived costs involved with orthodontic treatment.

Orthodontics can improve a person's quality of life by creating confident smiles and a functional occlusion (Sheiham, 1993). Thus, the perceived benefits of Orthodontic treatment in a population group is Improvement of Oral Health and enhancement of psychosocial welfare

The results of this study will be brought to the attention of the Public Health sector of the Northern Cape for the need of a Specialist in Orthodontics in the Upington area.

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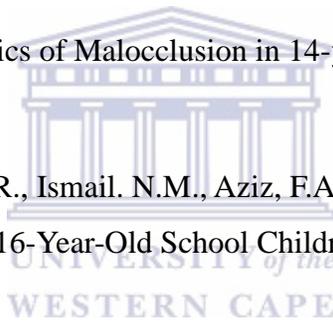
Appendices

Appendices 1: Consent forms and information pages

Appendix 1.1 Project registration

**Office of the Deputy Dean
Research**

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE
Private Bag X1, Tygerberg 7505
Cape Town
SOUTH AFRICA

Date: 7th May 2015

For Attention: Dr Booysen
Faculty of Dentistry
Department of Orthodontics
Tygerberg Campus

Dear Dr Booysen

STUDY PROJECT: Orthodontic treatment need and demand in the area of Upington in the Northern Cape Province

PROJECT REGISTRATION NUMBER: 15/3/28

ETHICS: **Approved**

At a meeting of the Senate Research Committee held on Friday 17th April 2015 the above-mentioned project was approved. This project is therefore now registered and you can proceed with the study. Please quote the above-mentioned project title and registration number in all further correspondence. Please carefully read the Standards and Guidance for Researchers below before carrying out your study.

Patients participating in a research project at the Tygerberg and Mitchells Plain Oral Health Centres will not be treated free of charge as the Provincial Administration of the Western Cape does not support research financially.

Due to the heavy workload auxiliary staff of the Oral Health Centres cannot offer assistance with research projects.

Yours sincerely

Professor Sudeshni Naidoo

Tel -27-21-937 3148 (w); Fax -27-21-931 2287 e-mail: suenaidoo@uwc.ac.za

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Appendix 1.2 Department of Education Khara Hais District; Consent page

Inligting oor navorsing:

Onderwerp: Die nood en aanvraag vir Ortodontiese behandeling in die Upington area

Ek is 'n plaaslike tandarts en is besig met my
Meestersgraad aan die Universiteit van die Wes-Kaap. My toesighouer by die
Universiteit se Ortodontiese Departement is Prof Harris. Ek poog om 'n behoefte
en aanvraag vir Ortodonsie in Upington te bevestig.
Dit is 'n uitnodiging vir die studente en skole om deel te neem in die
Meestersgraad navorsingstesis in Ortodonsie.
Alle deelname is op vrye wil en studente of ouers kan onttrek op enige stadium
van die insameings proses.
Studente sal 'n nr toegeken word en slegs tande foto's sal gebruik. Geen
persoonlike inligting sal gebruik word nie. Ouers en studente sal gevra word om
'n eenvoudige vraelys in te vul.
Tydlyn waar die skole betrek sal word:

1. Vraelyste en toestemming vorms word aand studente gegee in Mei- April
   2015
2. Die daaropvolgende dae sal die vorms ingevorder word en vinnige foto's
   geneem word.

Data invordering sal so ver as moontlik gedoen word buite klas tye.
Die tesis is voor die etiese en tesis raad van die Universiteit Wes-Kaap gebring
vir goedkeuring.
Die skole sal in kennis gestel word van moontlike publikasies in gesondheid
tydskrifte.

U tyd en deelname sal baie waardeer word.

Kontak my gerus vir verdere inligting
Dr Jeannette Booysen
(BcHD)(PDD in Ingrypende Orthodonsie)
Student nr: 2381893
Practice nr 0384011
Contact 054 332 3030
2A Schroder Street
Upington
www.drbooysen.co.za/ www.facebook.com/DrBooysenDentist

Toesighouer: Prof A Harris
Hoof van Ortodonsie
Univiersiteit van die Wes Kaap

(Trek asb dood waar nie van toepasing)
Hiermee gee ek, *George Berends*..., toestemming dat die skole in Upington/
~~die skool waarvan ek hoof is~~, kan deelneem aan die bogenoemde studie.

Handtekening: .... Datum: 13/04/2015

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Appendix 1.3 Study Schools Consent pages

Hoërskool Upington

Information on proposed research:

Topic: Orthodontic treatment need and demand of in the Upington area

UNIVERSITY *of the* WESTERN CAPE

I am a local dentist doing my Master's Degree at the University of the Western Cape. My supervisor at the University Dental Orthodontic Department is Prof Harris.

This is an invitation for the students and schools to participate in a Masters Research Thesis in Orthodontics. All participation is of free will and students or parents can withdraw at any stage during the data collecting if they feel the need to do so. Students will be allocated numbers and only dental photos will be used. No personal identification will be used. Parents and students will be asked to fill out a simple a quick questionnaire.

Time line for school participation:

1. Questionnaires and consent forms will be handed to the participating students. This will be during April and May 2015
2. After this the data collecting will commence. Forms will be collected and a quick photo will be taken of each participant.
3. Each Participating student will receive a gift pack from GSK dental products. And from a random draw a student will receive their Orthodontic treatment free (+/- R15 000)

Data Collecting will be done as far as possible out of education times as not to interfere with education.

The proposal will have been brought before the ethical and thesis board of the University Western Cape for approval.

The schools will be notified of possible publications in health journals of the thesis.

I aim to establish a need and demand for Orthodontics in the Northern Cape.

Your time and participation will be greatly appreciated.

Please contact me for more information
Dr Jeannette Booysen
(BChD)(PDD in Interceptive Orthodontics)
Student nr: 2381893
Practice nr 0384011
Contact 054 332 3030
2A Schroder Street
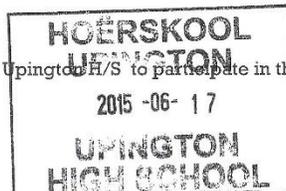Upington
www.drbooysen.co.za/ www.facebook.com/DrBooysenDentist

Supervisor: Prof Angela Harris
Head of Orthodontics
Dental Department
University of the Western Cape

I,......W. A Kotze..........., give consent for Upington H/S to participate in the study.

Signature................

Date:.....17. 6. 2015

HOËRSKOOL
UPINGTON
2015 -06- 1 7
UPINGTON
HIGH SCHOOL

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Hoof/Adjunkhoof e teken asb.

Information on proposed research:

Topic: Orthodontic treatment need and demand of in the Upington area

UNIVERSITY *of the*
WESTERN CAPE

I am a local dentist doing my Master's Degree at the University of the Western Cape. My supervisor at the University Dental Orthodontic Department is Prof Harris.

This is an invitation for the students and schools to participate in a Masters Research Thesis in Orthodontics. All participation is of free will and students or parents can withdraw at any stage during the data collecting if they feel the need to do so.
Students will be allocated numbers and only dental photos will be used. No personal identification will be used. Parents and students will be asked to fill out a simple a quick questionnaire.
Time line for school participation:
1. Questionnaires and consent forms will be handed to the participating students. This will be during April and May 2015
2. After this the data collecting will commence. Forms will be collected and a quick photo will be taken of each participant.
3. Each Participating student will receive a gift pack from GSK dental products. And from a random draw a student will receive their Orthodontic treatment free (+/- R15 000)

Data Collecting will be done as far as possible out of education times as not to interfere with education.
The proposal will have been brought before the ethical and thesis board of the University Western Cape for approval.
The schools will be notified of possible publications in health journals of the thesis.
I aim to establish a need and demand for Orthodontics in the Northern Cape.
Your time and participation will be greatly appreciated.

Please contact me for more information
Dr Jeannette Booysen
(BChD)(PDD in Interceptive Orthodontics)
Student nr: 2381893
Practice nr 0384011
Contact 054 332 3030
2A Schroder Street
Upington
www.drbooysen.co.za/ www.facebook.com/DrBooysenDentist

Supervisor: Prof Angela Harris
Head of Orthodontics
Dental Department
University of the Western Cape

I,......du Plessis............, give consent for Duineveld H/s to participate in the study.

Signature......du Plessis......

Date: ...2015 – 06 – 02

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Informed consent form **to participate in Dr Jeannette Booysen's thesis on:**

Orthodontic treatment need and demand in the Upington area

The parents/ guardians and students only need to fill in a short questionnaire and we will take dental photos when collecting these forms. At no time will there be interfered with scholastic activities. This thesis will have been approved by the ethical and thesis board of the University of the Western Cape. It will have been approved by the Head of the Education Department in the Northern Cape and finally will have been approved by the Head Master of the School.

Notable: No names or recognisable photos will be used in the study and children will remain anonymous.

I………………………….., the parent or legal guardian of, ………………………… give permission that he/she may participate in the study.

I understand that this is of free will and I give permission for the examiner to use the dental photos in the study. U have the right to with draw at any stage.

The schools will be notified of possible publications in health journals of the thesis.

No students may participate without a signed consent forms from their parents or legal guardians.

Date:………………

 Sign …………………………………………

Example of photo we will use.

Please feel free to contact me for the final results or any other questions:

2A Schröder Str.   PO Box: 2546
Upington   Upington
8801   8800

Tel: 054 332 3030
Fax: 054 332 3040
Emergencies: 054 332 3030
Email: drbooysen@gmail.com
www.drbooysen.co.za

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Information on proposed research**:**

Topic: Orthodontic treatment need and demand of in the Upington area

I am a local dentist doing my Master's Degree at the University of the Western Cape. My supervisor at the University Dental Orthodontic Department is Prof Harris.

This is an invitation for the students and schools to participate in a Masters Research Thesis in Orthodontics. All participation is of free will and students or parents can withdraw at any stage during the data collecting if they feel the need to do so.

Students will be allocated numbers and only dental photos will be used. No personal identification will be used. Parents and students will be asked to fill out a simple a quick questionnaire.

Time line for school participation:

1. Questionnaires and consent forms will be handed to the participating students. This will be during April and May 2015

2. After this the data collecting will commence. Forms will be collected and a quick photo will be taken of each participant.

3. Each Participating student will receive a gift pack from GSK dental products. And from a random draw a student will receive their Orthodontic treatment free (+/- R15 000)

Data Collecting will be done as far as possible out of education times as not to interfere with education.

The proposal will have been brought before the ethical and thesis board of the University Western Cape for approval.

The schools will be notified of possible publications in health journals of the thesis.

I aim to establish a need and demand for Orthodontics in the Northern Cape.

Your time and participation will be greatly appreciated.

Please contact me for more information

Dr Jeannette Booysen

(BChD)(PDD in Interceptive Orthodontics)

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Supervisor: Prof Angela Harris

Head of Orthodontics

Dental Department

University of the Western Cape

I,………………………………, give consent for Upington H/S to participate in the study.

Signature…………………………

Date: ………………………

Appendices 2: Data Capture forms for analysis

Appendix 2.1 Questionnaire: Parents and Participants

Dr Jeannette Booysen
DENTIST/TANDARTS
B.ChD(UWC) | 0540000384011

Nr: ………

UNIVERSITY *of the*
WESTERN CAPE

Questionnaire: Parents and Participants

Orthodontic (Braces) treatment need and demand in the Upington area

Parents:

Do you think your child needs braces? :……………..

Would you let your child get braces if needed? :……..

What do you think are the costs involved in braces? :……….

…………………………………………………………………

…………………………………………………………………

Participants

Do you think you need braces? :………………

Please chooses a photo mostly resembling your teeth : ………….

(this will be shown to you on the day the photos are taken)

Would you wear braces if you need them? : …………………..

If not, why? : …………………………………………………

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Orthodontic treatment need and demand in the Upington area

Photograph Analysis:

Photographs:

Dr Jeannette Booysen's observations

Need:

Problems:

Participants:

Need:

Demand:

Watter kleur is jy? / Which colour is you ?