PREVALENCE AND PATIENT SELF-AWARENESS OF MALOCCLUSIONS IN AFRICAN AMERICANS

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ABSTRACT

Objectives: To assess prevalence and patient self-awareness of malocclusions in a population of self-identified African Americans from Philadelphia, Pennsylvania and the surrounding area.

Methods: 75 self-identified African American dental patients aged 19 - 35 years from Temple University's dental clinic underwent a clinical exam to assess various types of malocclusions; including molar relationship, canine relationship, overjet, overbite, anterior and posterior crossbite, and dental midline shifts. Patient awareness of the malocclusions was assessed by a visual analog scale (VAS). ANOVA with a stepwise multiple linear regression was applied for the statistical evaluation of means and significance of variables. The level of significance was set at 0.05.

Results: The distributions of Class I, Class II, and Class III molar malocclusion were 75%, 14%, and 7%, respectively, and 75%, 20%, and 5% for canine malocclusion. A midline shift was the most prevalent malocclusion affecting 57%. Regarding vertical malocclusions, the observed deep bite was 17%. Posterior crossbite affected 11% of the subjects, while anterior crossbite affected 10%. With regards to patient awareness, canine classification, overjet and anterior crossbite were predictive variables in a regression model of the VAS score (Adj $R^2 = .668$) and were statistically significant ($P < 0.05$).

Conclusions: Among African Americans patients from Temple University, Angle Class I malocclusion is more prevalent than Class II; the least prevalent is Class III. In the vertical dimension, deep bite is more prevalent than open bite. Posterior crossbite is

more prevalent than anterior. The results indicate that patients have a good perception of canine classification, overjet and anterior crossbite. Additional patient education is required for overbite, posterior crossbite and dental midline shifts.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Dental malocclusions are one of the most prevalent developmental disorders in the world. The impact it can have on a person's quality of life is far reaching and can include; psychosocial distress, speech and chewing impairment, proneness to injury, periodontal defects and temporomandibular disorders (Lindsay, 1983; Ingervall, 1998). Patients with malocclusions are present with decayed, missing and filled teeth more often than patients with normal occlusion (Alhammadi, 2018).

In recent centuries, a secular trend in malocclusions is on the rise and consequently, there is an increased demand for orthodontic treatment. It is crucial to conduct epidemiological studies in order to obtain information on the prevalence of malocclusions and of the social need for orthodontic therapy because this information is useful in the design of public health plans for orthodontic prevention and screening and to organize resources for specific areas (Ingervall, 1978).

There are numerous studies that have been published in the past decade that discuss the prevalence of malocclusions and orthodontic treatment need with regards to specific ethnic groups (Jacobson, 1996). The prevalence of malocclusions varies among different ethnicities based on genetic background, geography, socio-economic status and environmental factors. A universally accepted characterization is Angle's classification. Malocclusions are termed class I, class II and class III depending on the position of the upper first molar to the lower first molar (Profitt, 1998). Canine relationship, overjet, overbite, crossbite, arch perimeter discrepancy, and irregular plane of occlusion and

midline deviations can all contribute to an individual's unique malocclusion. A study conducted to determine the prevalence of malocclusions in a population of orthodontic patients found that 74.8% of the subjects presented with at least one malocclusion (Aikins, 2014).

It is also important to gauge the public's awareness of their malocclusions and the benefit orthodontic treatment may offer. Demand for this treatment results from an individual's desire to seek treatment because of a perceived problem with the dentition or surrounding structures. It is important to understand whether patients are aware of these problems and if more patient education in the dental clinic is necessary. Very little research has been done to measure a patient's self-awareness of his or her own malocclusions.

While Europeans and Asians have been extensively studied, very few studies have evaluated the prevalence of malocclusions and orthodontic treatment need in African American ethnic groups. In particular, the Philadelphia region population has never been investigated. The aim of the present epidemiological study was to assess the prevalence and the patient's self-awareness of malocclusions in a population of self-identified African Americans from Philadelphia, Pennsylvania and the surrounding area.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1: Malocclusions

Malocclusion is defined as, “The misalignment or incorrect relation between the teeth of the two dental arches when the maxillary and mandibular jaws are closed.” Edward Angle, known as the “Father of Modern Orthodontics”, defined and coined the term in the 1880’s and marked an important development in the field of orthodontics. Malocclusions are common; with one study finding that at least one dental anomaly was present among 74.8% of the subjects (Alhmmadi, 2018). The vast majority of occlusions are well functioning and stable even though there are malocclusions present and these are considered to be “normal occlusions”. In some cases, malocclusions can lead to an unfavorable occlusion with deleterious effects if left untreated.

These untreated malocclusions have been associated with decreased oral health and function; increased risks of trauma, caries, and periodontitis; inhibition of normal speech and masticatory development; temporomandibular joint dysfunction; and psychosocial problems (Sanchez-Perez, 2013; Ericson, 2000). Teeth that are misaligned during eruption can cause resorption of the roots of adjacent teeth. The literature shows that ectopic eruption of the maxillary canines causes resorption of the roots of the maxillary lateral incisors in 48% of the cases when viewed with a limited field CBCT (Gallois, 2014). The literature also demonstrates that mispositioned teeth can lead to a higher incidence of trauma, such as when there is excessive overjet and the upper lip does not protect the maxillary anterior teeth (Basha, 2015). A study by Sánchez-Pérez, Leonor

et al in 2013 showed that subjects with untreated malocclusions, such as crossbite and crowding, have a higher incidence of TMD disorders than those who have undergone orthodontic treatment. A major consequence of malocclusions and one of the most common reasons treatment is sought is diminished esthetics and unhappiness with one's own appearance. This can lead to psychological problems and reduced self-esteem (Basha, 2015; Lindsay, 1983).

Coming to a consensus on what qualifies as a malocclusion has been a conversation of much debate. There are many different indices that are used in various countries to determine this but by far one of the most accepted and widely used is the Index of Orthodontic Treatment Need (IOTN). This index is used to evaluate the need and eligibility of children less than 18 years of age for orthodontic treatment on dental and esthetic basis. It became a mandatory part of the NHS dental services in England in April 2006. The first part of the IOTN is the Dental Health Component (DHC) which has 5 Grades. A simplified summary of the IOTN assessment listed on the government website is provided below (British Orthodontic Society, What Is The IOTN):

a. Overjet > 3.5 mm and ≤ 6 mm (with competent lip closing)
b. Reverse overjet between 0 and ≤ 1 mm
c. Anterior or posterior crossbite with 1 mm discrepancy
d. Contact point displacements > 1 mm and ≤ 2 mm
e. Anterior or posterior open bite > 1 mm and ≤ 2 mm
f. Increased overbite of ≥ 3.5 mm (without gingival contact)
g. Class II or class III occlusion without other anomalies (up to half a premolar width)

The second part of the IOTN is the Aesthetic Component (AC). The NHS acknowledges that some children require comprehensive orthodontic treatment due to poor esthetics because it alone can significantly decrease a person's quality of life. The Aesthetic Component of the IOTN provides ten photographs of varying attractiveness which are arranged in ascending order from most attractive to least attractive. The grading is made by the orthodontist who picks the photograph that most resembles the esthetics of the presenting patient. According to the NHS, if a patient in Dental Health category 3 has an Aesthetic Component rating of 6 or more then they qualify for treatment.

2.2: Prevalence of Malocclusions

The etiology of malocclusions is multifactorial and has many contributing genetic and environmental factors. While the normal development and growth of the teeth and face are governed by genetics, these environmental factors can play a significant role (Basha, 2015). Oral habits such as digit sucking or prolonged pacifier use can displace the teeth. These external factors begin when the first deciduous teeth erupt into the oral cavity at 6-8 months of age and continue throughout lifetime. While the occlusion is developing, the jaw is growing to create space and the face translates in a forward and downward direction as it lengthens. Occlusal development continues well after the facial bones have matured and completed growth. When normal arch development is interrupted due to ectopic eruption or early loss of teeth, force distribution is not equal on both sides and this can lead to the development of malocclusions such as mesial drifting of teeth, midline deviation, rotations and the development of crowding (Sanchez-Perez, 2013). Because of its importance, the prevalence of malocclusions has become the subject of much study.

The most comprehensive overview of malocclusions present in the United States was recently conducted and presented in the third National Health and Nutrition Examination Survey (NHANES III). They found that malocclusions are a regular finding and considered part of the norm, with the most common being incisor crowding. They reported that only 35% of adults have well aligned anterior teeth and that was consistent in all ethnicities. Incisor irregularity fell along a spectrum. At one extreme, they found that enough crowding was present in 15% of the group that it could have an impact on social lives, function, and necessitate expansion, extraction or both. In terms of sagittal

occlusion, only 20% of the population presented an ideal bite. The study then continued on to present trends that appeared among different ethnic groups, which is similar to the purpose of this study but with a focus on African Americans from the Philadelphia area. Mexican Americans presented with the highest prevalence of incisor irregularity, severe Class II malocclusion and severe Class III malocclusion and lowest prevalence of deep bite and open bite. When the IOTN was applied, they discovered that malocclusions were prevalent enough in ethnic groups that 57-59% of the population had at least some degree of orthodontic treatment need. The number of people who actually reported receiving orthodontic treatment was much lower; 30%, 11% and 8% for white youths, Mexican-Americans and African-Americans respectively. The data did show that severe malocclusions were more prevalent in African-Americans and they associated this with a lower level of reported treatment amongst the group.

While many studies focus on either local or national populations, such as the NHANES III, a systematic review by Alhammadi et al, completed in 2018, undertook the task of determining the prevalence of malocclusions worldwide. For the permanent dentition, Class I appeared 74.7% of the time, Class II 19.56% and Class III 5.93%. In the mixed dentition, Class I appeared 73% of the time, Class II 23% and Class III 4%. Posterior crossbites, deep bite and open bite were reported in 9.39%, 21.98% and 4.93% of the population respectively. Class I malocclusions were found most often in Africans, as well as open bites, while Caucasians had the highest prevalence of Class II malocclusion. When looking at the global population, they concluded that there was a tendency for the development of these specific malocclusions and it increases as the dentition transitions from mixed to permanent. This can be seen from many recent

studies. Posterior crossbite was the last malocclusion discussed and it was determined to be more prevalent in Europeans compared to any other group.

2.3: Diagnosis and Classification of Malocclusions

Classification is defined as, “The morphological description of the dental, skeletal and soft tissue deviations from the norm” (Gould, 2001). Diagnosing deviations from the norm is critical for proper treatment planning and patient care. Establishing planes of reference is essential to communicate the malocclusion and in which dimension it exists. Three main planes are used as reference: sagittal, coronal and axial and have been defined by Gould as the following. The sagittal plane is an imaginary plane that passes longitudinally through the middle of the head and divides it into right and left halves and is used to describe anterior-posterior relationships. The coronal plane is an imaginary plane that passes longitudinally through the head perpendicular to the sagittal plane dividing the head into front and back and is used to describe superior-inferior relationships. The axial plane is an imaginary plane that passes through the head at right angles to the sagittal and frontal planes dividing the head into upper and lower halves and is used to describe right to left relationships. The facial midline is determined by constructing a line perpendicular to the interpupillary line from glabella to the tip of the nose. The line passes through the philtrum of the upper lip, and the midline of the chin (Gould, 2001).

There are two other midlines that come up frequently in diagnosis and these are the maxillary and mandibular dental midlines. The maxillary dental midline is a line drawn perpendicular to the maxillary occlusal plane through the proximal contacts of the maxillary central incisors. The mandibular dental midline is a line drawn perpendicular to the mandibular occlusal plane through the proximal contacts of the mandibular central incisors. A facial asymmetry exists when proportions between the left and right sides of

the face are different, and is often associated with syndromes which can greatly complicate treatment. Crowding is present when there is a dental misalignment caused by inadequate arch perimeter for the teeth.

The most common method to diagnose the sagittal dental relationship is the Angle classification. In 1890, Edward H. Angle published his classification of malocclusion, which was the first of its kind. He based it on the relationship of the mesiobuccal cusp of the maxillary first molar and the buccal groove of the mandibular first molar. He determined that if these two anatomical landmarks are aligned then the teeth can come into normal occlusion. The alignment of the teeth, overbite and overjet and coincident maxillary and mandibular midlines were also brought into consideration for normal occlusion. Class I malocclusion is when a normal molar relationship exists but another malocclusion is present, such as crowding or increased overjet. A class II malocclusion exists when the molar relationship shows the buccal groove of the mandibular first molar distally positioned when in occlusion with the mesiobuccal cusp of the maxillary first molar. A class II malocclusion is further broken down into two divisions to describe the position of the anterior teeth. A class II division I is when the maxillary anterior teeth are proclined and a large overjet is present. A class II division II is when the maxillary anterior teeth are retroclined and a deep overbite exists. In contrast to a class II, a class III malocclusion is when the molar relationship shows the buccal groove of the mandibular first molar mesially positioned to the mesiobuccal cusp of the maxillary first molar when the teeth are in occlusion. In addition to molar classification, this study aims to diagnose additional malocclusions defined below by a previous study (Mtaya, 2009).

A posterior crossbite is present when posterior teeth are positioned in an abnormal buccal or palatal relation with the opposing teeth. It is important to diagnose whether the etiology of a crossbite is dental and/or skeletal. Overjet is defined as the distance from the midway point of the incisal edge of a maxillary incisor to the most labial surface of the opposing mandibular incisor. This distance is measured to the nearest millimeter and it parallels the occlusal plane. It is recorded as a positive value when the maxillary incisor is in its normal position, labial to the mandibular incisor. A negative value is recorded when the maxillary incisor is lingual to the mandibular incisor. This is also referred to as an anterior crossbite. Overbite is recorded in a similar fashion to overjet and is defined as the amount the maxillary incisor vertically overlaps the opposing mandibular incisor. It is measured from the incisal edge of the maxillary incisor to the incisal edge of the corresponding mandibular incisor. As with overjet, the largest value is the number that gets recorded. An open bite can be diagnosed in both the anterior and posterior segments. It occurs when there is no vertical overlap of the maxillary and mandibular anterior teeth or no contact between the maxillary and mandibular posterior teeth (Mtaya, 2009).

2.4: Applications of Visual Analog Scale (VAS)

A Visual Analog Scale (VAS) has previously been defined as an, “Instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured” (Dauphin, 1999). It is often used in epidemiologic and clinical research to measure the intensity of symptoms or attitudes of patients which are often difficult for a patient to quantity of express (Swedish Council on Health Technology Assessment, Report #176). For example, the amount of pain that a patient experiences can range across a continuum from none to an extreme amount of pain. From the patient's perspective, this spectrum appears continuous and it is not easy for them to categorize their pain as mild, moderate or severe. The VAS helps to bridge this gap in studies and provides a simple tool for patients which helps facilitate the expression of their specific state or feeling in that moment.

There are many forms and orientations of a VAS, but the simplest VAS is a straight horizontal line of fixed length, usually 100 mm for simplicity, as depicted in Figure 1. The ends are defined as the extreme limits of the parameter to be measured, orientated from the left (best) to the right (worst) (Aun, 1986).

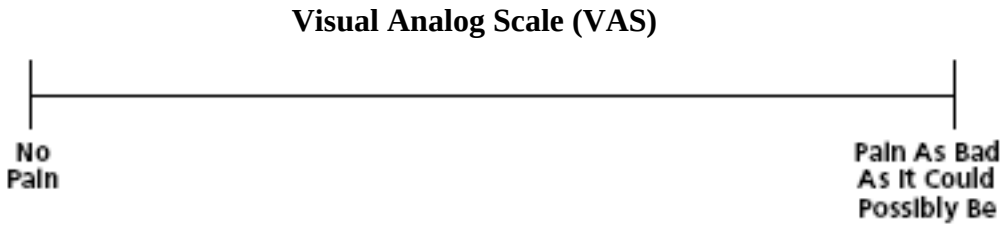

Figure 1. Example Visual Analog Scale

While many studies disagree on whether different orientations of the VAS have an impact on patient results, there is a consensus amongst researchers that the choice of terms to define the left- and right-handed sides plays a critical role (Sriwatanakul, 1983). At this point in time, there are no universal recommendations for constructing the ideal VAS but it is important to understand the different variations and presentations and to acknowledge there may be an inherent impact on a study's results and conclusions. This was confirmed by a randomized controlled trial, performed by Dauphin et al in 1999, which studied the bias and precision of different visual analog scales. If different studies are to be compared, then it is important for the creation of a standard set of guidelines.

A visual analog scale is completed by the patients or subjects of a study. The subject simply marks on the line, between the two anchor terms, the point that they feel accurately expresses their current state or feeling. The VAS score is then calculated by measuring in millimeters from the left-hand end of the line to the point that the patient marks using a ruler, which provides a range of scores from 0–100. A higher score indicates greater intensity, perception or awareness. Based on the distribution of VAS scores in recent studies, the following cut off points on the perception VAS have been recommended: no perception (0–4 mm), mild perception

(5-44 mm), moderate perception (45–74 mm), and severe perception (75–100 mm) (McCormack, 1988). When conducting a study that is comparing means and averages such as in this present study, a visual analog scale was chosen over a Likert scale because it provides nominal data rather than ordinal.

The VAS is great tool for studies because it requires very little training to implement and score. In terms of subject and patients, it has been found to be easy to understand and widely accepted by various studies (Aun, 1986). However, it is important to note that older patients with cognitive impairment may have difficulty understanding the concept and thus a hard time marking the scale. Supervision during instructions and completion may minimize these errors. The test–retest reliability has been shown to be good by a recent study, but they highlighted that it proved to be more reliable for literate than illiterate patients (Dauphin, 1999).

2.5: Patient Self-Awareness

As stated before, it is crucial to conduct epidemiological studies in order to obtain information on the prevalence of malocclusions and of the social need for orthodontic therapy. This information can be used to create public health plans for orthodontic prevention and screening and to organize resources in this area. It is also important to gauge the public's awareness of their malocclusions and the benefit orthodontic treatment may offer. Demand for orthodontic care stems from an individual's desire to seek treatment because of a perceived problem with the dentition or surround structures. It is important to understand whether patients are aware of these problems and if more patient education in the dental clinic is necessary.

Many factors influence a desire to seek out orthodontic treatment but one of the main factors is a parent's awareness and ability to recognize a malocclusion. It has been shown that a layperson may not accurately estimate the severity of a malocclusion and may use different criteria from orthodontists to evaluate a smile. A study by Lindsay et al. conducted in 1983 sought to examine the reliability of parents' and children's' perceptions of a child's own malocclusions with a visual analog scale under two anchoring terms and to compare the difference between the parent's and child's estimates and those of a panel of orthodontists (Lindsay, 1983). They determined that parents and children consistently underestimated the prevalence and severity of malocclusions.

Awareness of malocclusion and the demand for orthodontic treatment was studied in 421 Swiss army recruits by Ingervall et al (Ingervall, 1988). A questionnaire was utilized with the aid of visual analogue scales to gauge patient awareness and the IOTN was used to evaluate the prevalence of malocclusions. The data indicated that of the men

who presented with crowding or spacing of their dentition, only half were aware of it and the majority did not show interest in seeking treatment. Even less of the men who presented with increased overjets and/or overbites (about 30%) were aware of it and 70% of these men said it was of no concern to them.

A previous study performed by Ingervall in 1978 studied the awareness of malocclusion, the demand for orthodontic treatment and the prevalence of malocclusion in 389 Swedish men, aged 21-54 years (Ingervall, 1978). The data collection showed that 57% present with some type of malocclusion, with rotation being the most common. 43% and 18% of the subjects presented with crowding and spacing respectively. While 75% of the men needed some form of orthodontic treatment, only 25% of the men were aware of their malocclusions affecting the anterior dentition and 1% were aware of malocclusions affecting the posterior teeth. Only a small percentage of the men believed they needed orthodontic treatment.

In 1996, Jacobson et al. conducted a study to determine the subjective and objective need for a patient's orthodontic treatment. A VAS was utilized and the subjects were asked to place a mark on the scale to express how they felt about their own teeth. The data showed a large spread but most of the adolescents were happy with their teeth. The researchers determined that the main factors that influenced opinion were spacing, overjet and upper incisor proclination. The data was then broken down by gender and it revealed that boys and girls have a similar awareness of their teeth but that girls are more interested in seeking orthodontic treatment.

In recent centuries, a secular trend in malocclusions is on the rise and consequently, there is an increased demand for orthodontic treatment. Yamashita et al. conducted a study to determine if parental awareness of malocclusion is on the rise as well (Yamashita, 2008). An identical study was conducted back in 1998 and the results were compared to determine the change of parental awareness. The results showed that awareness increased from 37.7% to 47.8% and the conclusion was drawn that awareness of malocclusion is on the rise.

CHAPTER 3

AIMS OF THE INVESTIGATION

The aim of this study is to investigate the prevalence of malocclusions in self-identified African Americans from the Philadelphia region, as well as to determine which specific malocclusions patients have a greater awareness of. In recent centuries, a secular trend in malocclusions is on the rise and consequently, there is an increased demand for orthodontic treatment. It is crucial to conduct epidemiological studies in order to obtain information on the prevalence of malocclusions and of the social need for orthodontic therapy because this information is useful in the design of public health plans for orthodontic prevention and screening and to organize resources for specific areas.

It is also equally important to gauge the public's awareness of their malocclusions and the benefit orthodontic treatment may offer. Demand for this treatment results from an individual's desire to seek treatment because of a perceived problem with the dentition or surrounding structures. It is important to understand whether patients are aware of these problems and if more patient education in the dental clinic is necessary. Very little research has been done to measure a patient's self-awareness of his or her own malocclusions.

While Europeans and Asians have been extensively studied, very few studies have evaluated the prevalence of malocclusions and orthodontic treatment need in African American ethnic groups and the studies that have been conducted are difficult to compare due to unique methods. In particular, the Philadelphia region population has never been investigated. By way of clinical exam and visual analog scales, we will measure the

prevalence of malocclusions and compare patient's awareness for different malocclusions.

Our null hypothesis is that there will be no difference in the following: **1)** the prevalence of malocclusions compared to the current literature and **2)** there will be no difference of patient's awareness for different malocclusions.

CHAPTER 4

MATERIALS AND METHODS

This study protocol was reviewed and approved by the institutional review board of Temple University (Protocol Number 25889). Self-identified African Americans of varying age presenting to the dental clinic for comprehensive care will be eligible for participation. Patients will be recruited when they present for their scheduled appointments in the dental clinics and while their student doctor is waiting for the attending faculty to check their procedure. Inclusion and exclusion criteria were defined as the following:

Inclusion:

1. Patients presenting to the Maurice H. Kornberg School of Dentistry for comprehensive care in the dental clinics
2. Age 18-35
3. Self-identified as African American on the mandatory health questionnaire

Exclusion:

1. Previous orthodontic treatment
2. Missing more than four permanent teeth (excluding 3rd molars)
3. Different molar or canine classification between left and right sides

The present study was carried out at Temple University Kornberg School of Dentistry and recruited patients who self-identify as African American on the mandatory

health questionnaire provided by the school. Patient inclusion based on age ranged from 18-35 to avoid potential issues with consent and mutilated dentitions. When a patient presented to the dental clinic for comprehensive care, they were required to undergo an "Occlusal Assessment" by their assigned dental student (Table 1). The assessment was performed by the assigned dental student and supervised by the attending clinic faculty. The assessment examined the patient for various types of malocclusions; including molar relationship, canine relationship, overjet, overbite, anterior and posterior crossbite, and dental midline shifts. Age and gender were recorded.

Maxillary overjet was categorized as 1, 1–3.0 mm (mild); 2, 3.01–6.0 mm (moderate); and 3, ≥ 6.01 mm (severe). Anterior crossbite was coded as 0, absent; and 1, present. Overbite was recorded and categorized as 0, 0.1–3.5 mm (normal); and 1, >3.51 mm (deep). Open bite was recorded if the overbite was < 0 and the crowns of the maxillary teeth did not overlap the crown of the opposing mandibular teeth. An open bite was coded as 0, absent; 1, present. Midlines were observed and recorded if the maxillary and mandibular midlines were non-coincident when the posterior teeth were in maximum intercuspation. It was coded as 0, absent, when the displacement was <2 mm; and 2, present, when the displacement was more than 2 mm. Overall, crossbite was recorded as 0, absent; 1, anterior crossbite; 2, posterior crossbite; or 3, both anterior and posterior crossbite present. The molar and canine relationship was recorded as 1, Class I; 2, Class II; and 3, Class III (Table 2). Based on the distribution of VAS scores in recent studies, the following cut off points on the perception VAS were utilized as follows: no perception (0–4 mm), mild perception (5-44 mm), moderate perception (45–74 mm), and severe perception (75–100 mm) (Aun, 1986).

The results are recorded electronically on the student's personal computer using the axiUm program. axiUm Dental is marketed and described by the manufacture as a HIPAA-compliant, ONC-ATCB certified system that includes electronic health record (EHR), billing and practice management applications. The software was designed to address the needs of educational institutions, such as dental hygiene schools and dental organizations with multiple locations. axiUm is an on-premise system that includes a patient portal and a faculty portal for teachers. The program allows students to record patient information, chart dental and periodontal treatment and monitor treatment progress and history. It also allows faculty members to evaluate student work and to record grades to monitor student progress.

A second-year orthodontic resident performed the malocclusions assessment that was initially performed by a dental student in the clinical environment, under the supervision of the dental faculty. The examination was performed in a dental chair under artificial illumination and the malocclusion was recorded with a periodontal probe and plane mouth mirror. Each subject was examined for the types of malocclusion listed above and as defined in Table 2. At the conclusion of the exam, the patient was asked to record their potential benefit from orthodontic treatment on an analog scale ranging from 1 to 10. 1 is defined as "no benefit from braces" and 10 as "extreme benefit from braces". The VAS utilized in this study can be seen in Figure 2.

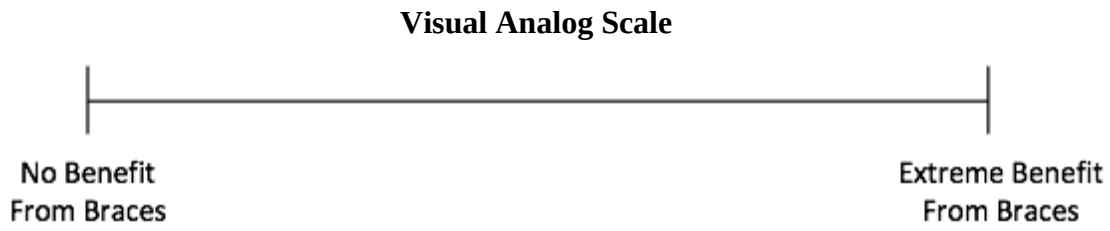

Figure 2. Visual Analog Scale from Study

Statistical analysis included computation of percentages, means and standard deviations. The Chi-square test is used to determine whether malocclusion distributions were due to chance. The relationships of the malocclusion items to patient awareness are assessed by a multiple regression analysis. For all tests, confidence interval and *P* value are set at 95% and ≤ 0.05 respectively.

Table 1. Occlusal Assessment and VAS Categories

Occlusal Assessment	Angle Classification	Class I
		Class II
		Class III
	Canine Relationship	Class I
		Class II
		Class III
	Overjet	Mild (0-3 mm)
		Moderate (3.01-6 mm)
		Severe >6.01 mm)
	Overbite	Normal (<1-3.5 mm)
		Deep (>3.5 mm)
	Anterior Crossbite	Present
		Absent
	Posterior Crossbite	Present
		Absent
	Midline Shift	Absent (>2.0 mm)
		Present (<2.0 mm)
Visual Analog Scale	No Perception	0-4
	Mild Perception	5-44
	Moderate Perception	45-74
	Severe Perception	75-100

CHAPTER 4

RESULTS

5.1 Sample Profile

A total of 75 adults from the surrounding Philadelphia region completed an extensive medical history review and underwent a full-mouth occlusal examination to assess various types of malocclusions; including molar relationship, canine relationship, overjet, overbite, anterior and posterior crossbite, and dental midline shifts. Patient awareness of the malocclusions was assessed by a visual analog scale (VAS). The mean age of the sample was 29 years (SD= 3 years), with ages ranging from 19-35. The sample of respondents was 44.6% male and 55.4% female.

5.2 Prevalence of Malocclusion

From the results of the study, subjects without any recorded malocclusions were found in 24.1% of the time. Thus, 75.9% of the subjects had one or more types of the documented malocclusions. The following sections provide a breakdown of each malocclusion and its prevalence among the participating subjects.

5.2.1 Molar Angle Classification

A Class I occlusion was observed in 74.3% of the total sample, while Class II and Class III were recorded in 14.8% and 6.7%, respectively (Table 5). There were no significant differences in diagnoses between the genders. In three subjects, the molar relationship could not be recorded due to missing first molars but were still included in the overall data analysis.

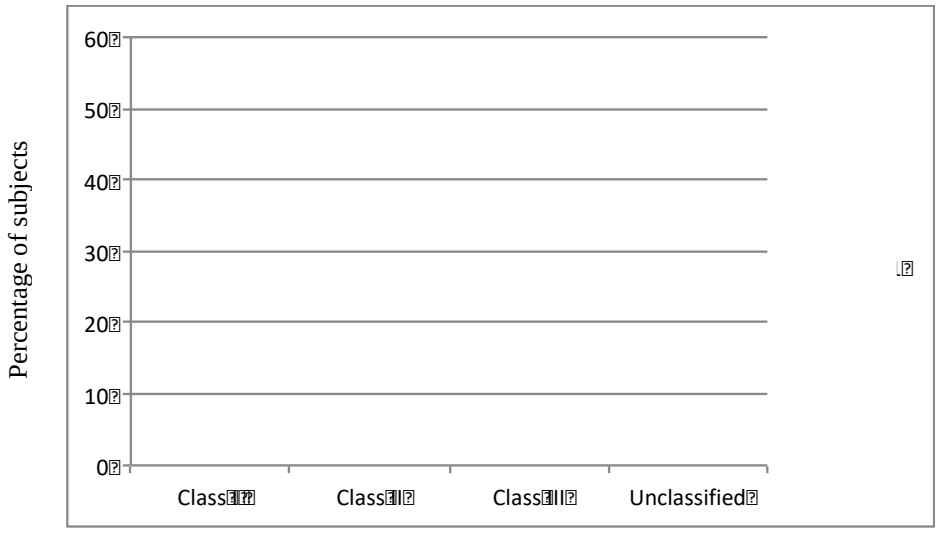

Figure 3. Molar Angle Classification

5.2.2 Canine Classification

A Class I occlusion was observed in 74.3% of the total sample, while Class II and Class III were recorded in 20.3% and 5.4%, respectively (Table 5). When analyzing between genders, there were no significant differences. The canine relationship could be recorded in all subjects, and thus none were excluded from the data analysis.

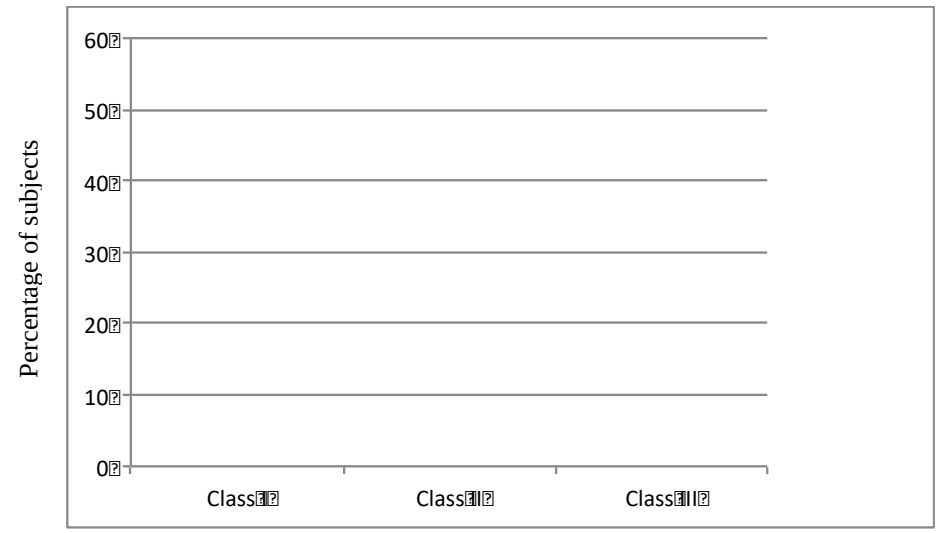

Figure 4. Canine Classification

5.2.3 Overjet

A majority of the subjects (66.2%) in the total sample had a maxillary overjet <3 mm. Overall, an overjet ≥3 mm occurred in 22.9% and a severe increased overjet (≥6 mm) was registered in 2.7%.

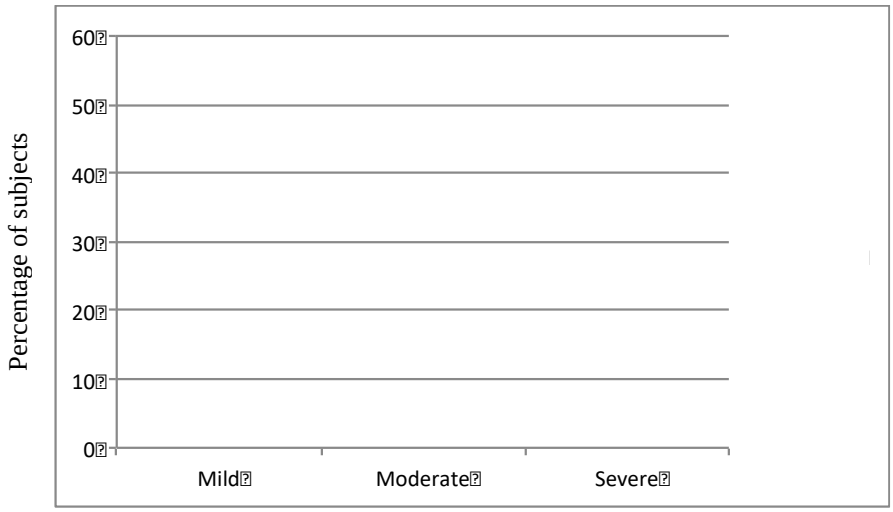

Figure 5. Maxillary Overjet

5.2.4 Overbite and Anterior Open Bite

A normal overbite (0.1–3.5 mm) was recorded in 77% of the total sample, while a deep bite (≥3.5 mm) were registered in 17.6%. An anterior open bite (AOB) was recorded in 4.5% of the entire sample (Table 5).

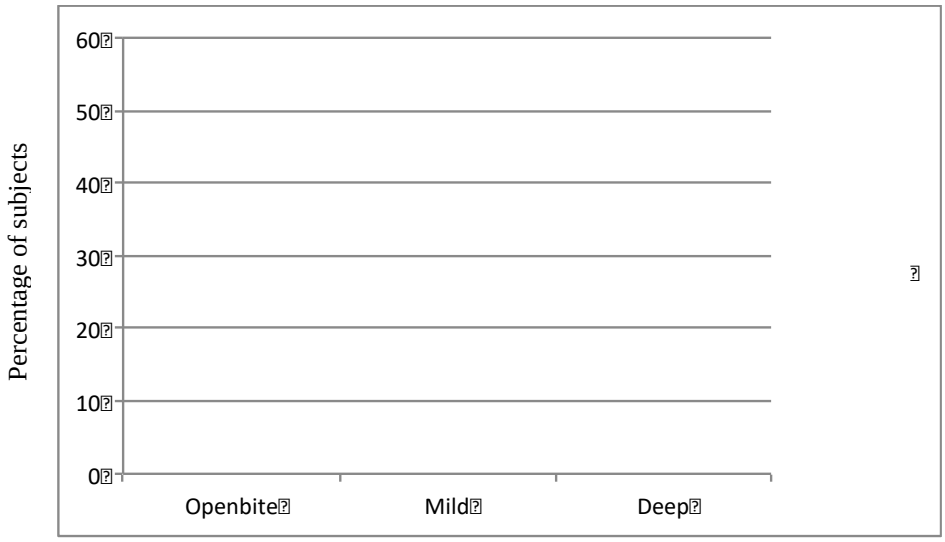

Figure 6. Overbite and Anterior Open Bite

5.2.5 Posterior and Anterior Crossbites

When considering transverse malocclusions, the majority of the subjects (74.3%) in the total sample presented with no posterior or anterior crossbites. A posterior crossbite was found in 13.5%, while an anterior crossbite or edge-to-edge bite was found in 8.1%. A posterior and anterior crossbite existed simultaneously in 4% of the subjects.

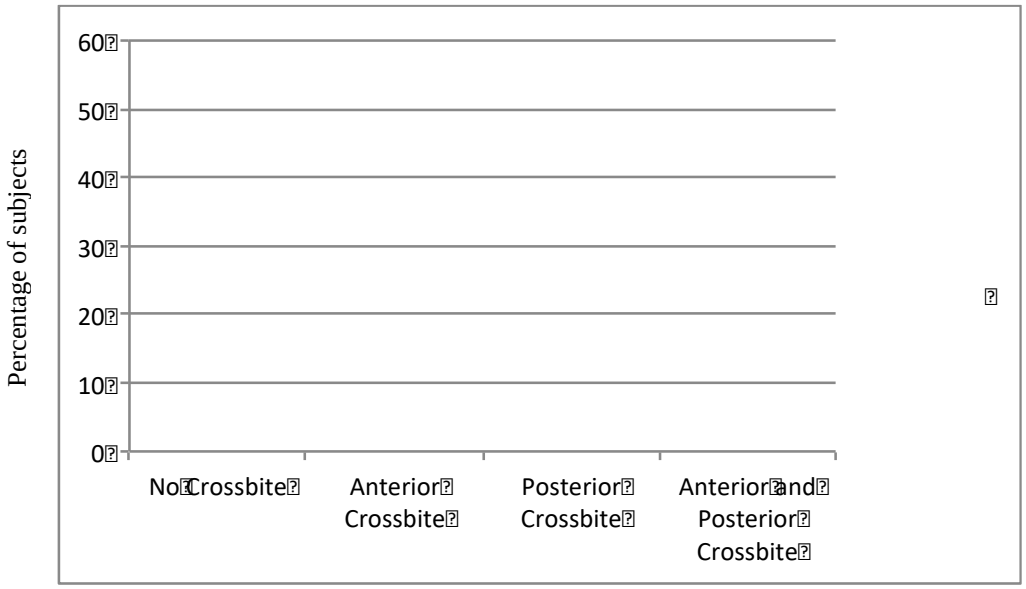

Figure 7. Anterior and Posterior Crossbites

5.2.6 Midline Shift

A midline shift (≥2 mm) was recorded in 41.2% of the whole sample (Table 5), while 58% of the sample presented with no midline shift (<2 mm).

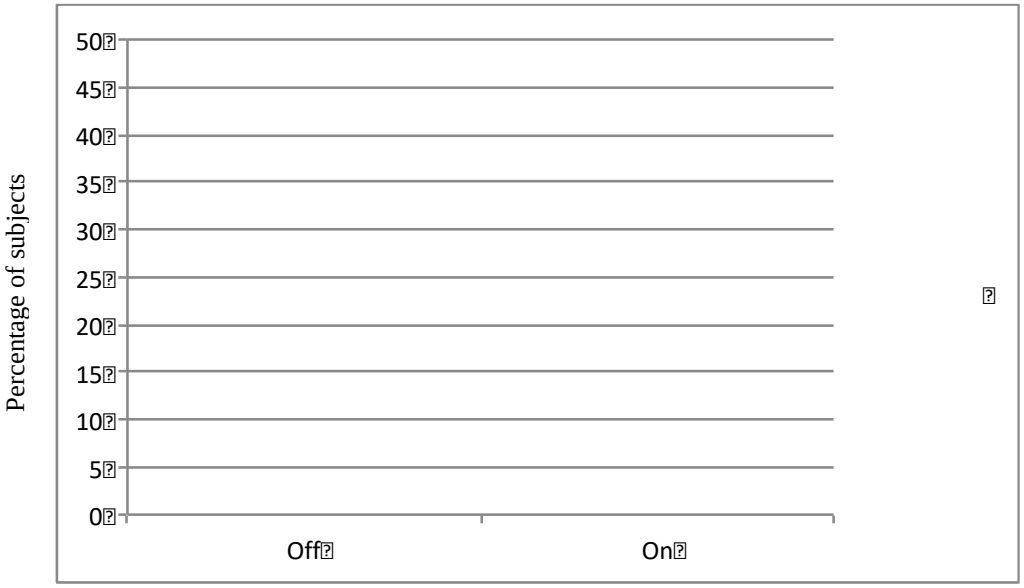

Figure 7. Midline Discrepancy

5.3 Patient Awareness and Treatment Need

As shown in Table 3, 48 of the subjects (64.9%) had a mild perception of their present malocclusion, 12 (16.2%) had a moderate perception and 14 (19%) had a severe perception of their malocclusions. Furthermore, of the 14 patients who did have a severe perception, 33.3% were males and 66.6% were females. The average VAS scores for males and females were 39.2 and 41.9 respectively. The association between the genders was not found to be statistically significant ($p = 0.602$).

Table 3. VAS Distribution

Perception	Range	Total (n)	Percentage (%)
None	0-4	0	0%
Mild	5-44	48	64.9%
Moderate	45-74	12	16.2%
Severe	75-100	14	19%

5.3.1 Patient Awareness and Malocclusions

With regards to specific malocclusions and the effect on patient awareness, statistical analysis showed that canine classification, overjet and anterior crossbite were predictive variables in a regression model of the VAS score and were statistically significant ($P < 0.05$), as seen in Table 4. Statistically the model explains about 67% of VAS score (Adj R2 = .668). Overall the model is significant, which means the variables do predict the VAS well (F (10,6) =15.102 (p<.000). When taking all of the recorded variables into account, canine classification, overjet and anterior crossbite were found to be significant indicators for a patient's desire to seek orthodontic treatment. These finding can be found in Table 4.

Table 4. Significance of Variables on VAS Score

		Coefficients	Standardized Coefficients		
Model	Unstandardized B	Std. Error	Beta	t	Sig.
Gender	2.07	3.94	0.04	0.52	0.602
Age	0.09	0.42	0.02	0.22	0.825
Molar	5.74	4.76	0.12	1.21	0.233
Canine	14.64	5.14	0.31	2.85	0.006
Overjet	7.51	2.60	0.35	2.89	0.005
Overbite	5.08	3.12	0.20	1.63	0.109
Anterior Crossbite	51.76	7.05	0.57	7.34	0.00
Posterior Crossbite	0.72	6.36	0.01	0.11	0.91
Both Crossbites	60.28	12.20	0.37	4.94	0.00
Midlines	-3.42	4.11	-0.06	-0.83	0.409

Table 5. Prevalence and Significance of Variables

Malocclusion	N (%)	P-value
Molar Angle		
Class I	55 (74.3%)	
Class II	11 (14.8%)	
Class III	5 (6.7%)	
Canine Angle		
Class I	55 (74.3%)	<.05
Class II	12 (20.3%)	
Class III	4 (5.4%)	
Overjet		
Mild	49 (66.2%)	<.05
Moderate	17 (22.9%)	
Severe	2 (2.7%)	
Overbite		
Normal	57 (77%)	
Deep	13 (17.6%)	
Anterior Open Bite		
Present	4 (4.5%)	
Absent	70 (94.5%)	
Anterior Crossbite		
Present	6 (8.1%)	<.05
Absent	66 (89.2%)	
Posterior Crossbite		
Present	10 (13.5%)	
Absent	64 (86.5%)	
Midline Shift		
Present	31 (41.2%)	
Absent	43 (58%)	

CHAPTER 6

DISCUSSION

This is the first study to provide knowledge about the prevalence of malocclusion in self-identified African Americans from the Philadelphia region. Numerous studies have been reported in the literature from various countries describing the prevalence and types of malocclusion in differing ethnicities. Despite all of this information, it is sometimes difficult to compare the data because of differences in subject age and study methodology and caution must be used. Many studies report that malocclusion incidence varies by age, gender and country but there are no studies that assess the prevalence of malocclusions on African Americans from the northeast United States (Mtaya, 2009). The method used in this study was to determine the frequency of specific malocclusions, identify trends and discover which malocclusions affect a person's self-perception of their own dentition the most. It was important to make sure that none of the subjects had previously undergone orthodontic treatment at any point in their lives, including both interceptive and comprehensive treatments. When conducting a study to determine prevalence of malocclusions, it is important that the data is derived from a well-defined population who have not received orthodontic treatment (Thilander, 2001). The sample presented in this study fulfills these requirements.

In the current study, it was observed that 74.3% of subjects had Angle's Class I occlusion, 14.8% had Class II and 6.7% had Class III. The findings of our results confirmed previous studies that the most prevalent malocclusion was Angle's Class I followed by Angle's Class II, while the least prevalent malocclusion was Class III. These

results are in line with previously conducted studies, including the first epidemiological study focusing on malocclusions conducted on an African American population by Altemus in 1960. He found that 83% had Class I occlusion, 12% had Class II occlusions and 5% Class III occlusion. Although the study methods are not reported and the patient population was significantly younger, comparisons can still be drawn between the two studies. A similar study, conducted in 1965 by Enrich, Bodie and Blayney, reported that a group of African Americans from Illinois had a significantly lower incidence of Class II occlusion at 7%, while Class I and Class III occlusions were more in line with previous reports.

While literature is lacking on the prevalence of overjet in African Americans, a study performed by Hassanli et al compared a similar subject pool and found that a normal overjet (1-3 mm) occurred in 77.4% of the sample with an average overjet of 2.96 mm (Hassanli, 1993). These results are very similar to the current study's findings of 66.2% of the total sample had a maxillary overjet <3 mm. Overall, an overjet ≥3 mm occurred in 22.9% and a severe increased overjet (≥6 mm) was registered in 2.7%. The average overjet of 2.9 mm is supported by the study as well.

Recent literature has compared the prevalence of anterior open bite between ethnic groups and has found that it is more common in African Americans. In a study performed Kelly et al, anterior open bite occurred in the United States 3.5% for the white population and 6.5% for the African American population (Agbaje, 2012). The current study reported a lower prevalence, only 4.5%. This difference may be due to the average age difference between the studies, as they were 18 years and 30 years of age respectively.

In the current study, a normal overbite (0.1–3.5 mm) was recorded in 77% of the total sample, a deep bite (≥3.5 mm) were registered in 17.6% and an overall average overbite of 2.6 mm. Many studies have been conducted regarding vertical malocclusions, with recorded deep bites and open bites of 21.98% and 4.93%, respectively (Alhamaddi, 2018). Another study performed by Hassanli et al reported an average overbite of 3.83 mm which is slightly greater than this study's reported average of 2.6 mm but still comparable.

When considering transverse malocclusions, the majority of the subjects (74.3%) in the total sample presented with no posterior or anterior crossbites. A posterior crossbite was found in 13.5%, while an anterior crossbite or edge-to-edge bite was found in 8.1%. A study by Alhmaddi et al reported similar results. In this study, posterior crossbite affected 9.39% of the sample, while 5.5% of the group had an edge-to-edge bite (Alhamaddi, 2018).

Overall, the prevalence of malocclusion results presented in this study are supported well by recent studies found in the literature but some limitations are important to note. There is an inherent probability of underestimating and overestimating the prevalence of specific malocclusions when performing a clinical examination without the aid of dental casts. This difference that exists between examination techniques was demonstrated in a study by Heikinheimo et al in 1978 in which they showed that there was a higher prevalence of malocclusions when records were taken from a dental cast compared to a direct examination. The sample size and patient selection of the current study were specific enough to overcome these limitations and provide an accurate representation of the target population's malocclusions.

As shown in Table 3, 48 of the subjects (64.9%) had a mild perception of their present malocclusion, 12 (16.2%) had a moderate perception and 14 (19%) had a severe perception of their malocclusions. Furthermore, of the 14 patients (19%) who did have a severe perception, 33.3% were males and 66.6% were females. The average VAS scores for males and females were 39.2 and 41.9 respectively. A similar study was performed on college students and compared different tools to assess patient perception of their own dentition, one tool being a visual analog scale. Subjects undergoing orthodontic treatment at the time of examination were excluded and the average VAS score was 40.16 (+/- 18.16) was almost identical to the current study's average of 40.5. The study concluded that the visual analogue scale was the easiest tool for the student to use and that it also presented the strongest correlation to the two other techniques used (Flores-Mir, 2004). This supports the VAS as a simple tool that is easy for the lay person to understand and to use so that their perception can be recorded, but it is important to know if a patient's perception if associated when their demand for treatment. This can be confounded by many factors, such as religion, economic status, culture and geographic location.

A recent study looked at this association between patient perception and demand for treatment and found it to be significant. Interestingly, they found that age, gender and educational level were not statistically significant factors in a patient's perception. The study concluded that a patient's own perception is equally important as the orthodontist's and should be included in orthodontic treatment planning. A key difference between this study and the current study was the tool used to assess perception. The study used a series of color photographs ranked from least attractive to most attractive and asked the subjects to judge their own occlusions based off these photos (Singh, 2014).

With regards to specific malocclusions and the effect on patient awareness, statistical analysis showed that canine classification, overjet and anterior crossbite were the most statistically significant variables that influenced the VAS score. These malocclusions are concentrated in the anterior region and often times are present simultaneously. For example, a class II canine is often associated with increased overjet. The specific age limit of the study was selected to avoid mutilated dentitions which may limit the findings applying to larger populations. Another necessary limitation was selecting subjects who had not undergone orthodontic treatment as an adolescent which may bias subject selection towards decreased awareness or decreased desire to seek treatment. The sample of respondents was nearly equal, 44.6% male and 55.4% female, which was due to a larger percentage of females refusing to participate in the study. When interpreting these results, it is important to remember limitations of visual analog scales that have been reported. A study by Paul-Dauphin et al in 1999 conducted a randomized controlled trial to investigate the effects of different variations of a VAS. They determined that orientation in a horizontal or vertical plane can impact subject's measurements as they see more values in a vertical orientation. Although a horizontal VAS was utilized in this study, Paul-Dauphin concluded that the claims required further investigation (Paul-Dauphin, 1999). An important takeaway from the current literature on visual analogue scales is that is paramount that a consensus needs to be reached on a universal scale to be used if future studies are to be comparable.

CHAPTER 7

CONCLUSIONS

1. Among self-identified African Americans in the Philadelphia area, Angle Class I malocclusion was the most prevalent malocclusion. The least prevalent Angle classification is Class III.

2. In the vertical dimension, deep bite is more prevalent than open bite.

3. Posterior crossbite is more prevalent than anterior crossbite.

4. The results indicate that patients have a good perception of canine classification, overjet and anterior crossbite and that these factors play a significant role in perceived benefit from treatment.

5. Patient awareness of overbite, posterior crossbite and midline shifts is insufficient and additional patient education is required.

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