MALOCCLUSION PATTERNS AMONG SELECTED WIND INSTRUMENT PLAYER GROUPS IN NAIROBI

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BDS LEVEL 3

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A community dentistry research project report submitted to the University Of Nairobi School Of Dental Sciences in partial fulfillment for the award of the Bachelor of Dental Surgery Degree.

2013
DECLARATION

I, Muyia Robert Mandela Bwire, declare that this is my original work and has not been submitted elsewhere by any other person for research purpose or award of any degree.

Signature........................................ Date..............................
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To my mother, Janet Ombwayo, for her continuous support throughout my entire academic and musical life.
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Special thanks to:

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Mr. Andrew Obaga, deputy principal and music teacher at Nairobi School.

Mr. Moses Watatua, music director, Nairobi School.
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DEFINITION OF TERMS

Brass instrument- a wind instrument in which the player’s lips vibrate onto the mouthpiece, causing the air within the instrument to vibrate.

Embouchure-use of facial muscles and shaping of the lips to the mouthpiece of wind instruments.

Mouthpiece- part of a wind instrument that is placed partly in or against the player’s mouth.

Musical wind instrument- a musical instrument that contains some type of resonator (usually a tube), in which a column of air is set into vibration by the player blowing into (or over) a mouthpiece set at the end of the resonator.

Woodwind instrument- A wind instrument in which a player causes a reed to vibrate or blows against or over the edge of an open hole.
ACRONYMS

**BDS**-Bachelor of Dental Surgery

**TMJ**-Temporomandibular Joint

**SPSS**-Statistical Package for Social Sciences
SUMMARY

Background

Malocclusion is a common form of dental anomalies experienced by musical wind instrument players. Wind instruments have been associated with exertion of high pressure on the dentition causing malocclusion. Malocclusion may result in diminished self esteem and playing proficiency amongst the musicians. Studies have been inconclusive with regards to the relationship between wind instruments and malocclusion. Some have noted that musical wind instruments may act as an adjunct to orthodontic treatment. Others have concluded that they do cause malocclusion whereas others report no significant findings. However, no data exists locally on the relationship between these two fields.

Objective

The main objective of this study was to investigate malocclusion patterns on selected musical wind instrument player groups in Nairobi.

Study Design

This was a cross-sectional descriptive study.

Study Population and Study Area


Methodology

The study comprised of 70 wind and non-wind players from the mentioned groups. A closed ended questionnaire was used and an intraoral examination was carried out. Data was
collected using a clinical examination form. Descriptive statistical tests were carried out using SPSS (17) and data was presented using frequency diagrams, tables and pie charts.

**Results**

The most frequently observed occlusal traits among wind instrument players were: 77.8% had an Overjet of (0<3MM), 82.5% had an Overbite of(0<1/3 overlap), 20.6% had Lower anterior crowding, 17.5% had Upper anterior crowding and 63.5% had a Class I Molar relationship.

There was no difference between malocclusion patterns in the different wind instrument players and there was no difference in malocclusion patterns between wind and non wind players.

**Conclusion**

There were no differences in malocclusion patterns observed within wind instrument player groups or between wind instrument players and non wind instrument players.

**Recommendations**

Wide consultations should be held between members of the dental profession and music educators regarding increasing awareness between these two fields. This would help in bridging the knowledge gap elicited from participants in this study.

A longitudinal study would be recommended to provide more information on the long term effects, if any, of playing a wind instrument on the dentition.
CHAPTER 1 INTRODUCTION AND LITERATURE REVIEW

1.1. INTRODUCTION

The term ‘malocclusion’ refers to a misalignment of teeth or incorrect relation between the teeth of the two dental arches. An appreciable deviation from the ideal occlusal relationship may be considered functionally and aesthetically unsatisfactory. This includes tooth malpositions including: tooth crowding, proclination and retroclination of anterior teeth, scissor bites and cross bites, overjets and overbites among others.

Most incidences of malocclusion are attributed to a complex and poorly understood combination of inherited and environmental factors. A small minority could be attributed to a specific known cause. Graber classified the etiological factors of malocclusion into two categories; General (extrinsic) and local (intrinsic) factors. General factors include: heredity, congenital defects, environment, predisposing metabolic climate and disease, diet, abnormal pressure habits (e.g. thumb sucking, wind instruments), posture and trauma. It has been proposed that playing a musical wind instrument affects the position of teeth as it exerts abnormal pressure, contributes to abnormal posture in the oral cavity and trauma to the dentition.

Musical wind instruments are generally classified into woodwind and brass instruments. Examples of woodwind instruments include clarinets, saxophones, flutes, oboes and bassoons. Brass instruments include trumpets, trombones, tubas, euphoniums and horns. A musical wind instrument consists of a mouthpiece and a barrel which contains holes or valves that vary the pitch produced. The mouthpiece is manipulated by a player’s lips to form an embouchure. Formation of an embouchure involves use of the lips, tongue and teeth to form a seal around the mouthpiece to permit passage of air and sound production.

According to Proffit, teeth are in a state of equilibrium. They are subjected to a variety of balanced opposing forces which ensure that they remain stable on the dental arch. The primary
factors in the maintenance of this state of equilibrium are the resting pressures on the tongue and lips and forces created within the periodontal membrane. A change in any of these factors results in tooth movement and may cause malocclusion.\(^3\)

The orofacial musculature and the dentition are largely involved in the formation of an embouchure during the playing of a musical wind instrument. Studies have shown that brass musical wind instruments exert a high force (higher than thumb sucking) on the dentition. As a result of this, individuals who play brass instruments with large cup-shaped mouthpieces are more predisposed to developing lingual cross bites.\(^5\) Career musicians have been known to experience a number of orofacial problems. This includes malocclusion such as: retroclination and proclination of maxillary incisors, retroclination of mandibular incisors, deep anterior open bite and posterior cross bites. Other dental-facial problems include: focal dystonia, herpes labialis, TMJ problems and xerostomia.\(^6\)

It has been shown that the forces produced during the playing of musical wind instruments are higher than average muscle movements and may reach sufficient levels to correct or cause a malocclusion.\(^6\)

Malocclusion on the other hand has been shown to influence the holding position of the instrument and embouchure.\(^7\) There is an interface between orthodontics and wind instrument playing. Studies involving these two fields have proposed that wind instrument playing may have a positive or negative effect on orthodontic treatment; or may be an etiological factor in malocclusion. It has been shown that some musicians have dental and facial features that permit easy embouchure formation. Those with deformities are forced to adapt compensatory maneuvers involving orofacial musculature and skeletal constituents to achieve the required embouchure for optimum results. In addition, it has been demonstrated that musical wind instrument players experience embouchure difficulties during fixed orthodontic treatment.\(^8\)

The diagnostic stage of treatment is very crucial and the dentist should ensure that he/she fully understands the manner in which the musical instrument is manipulated. This is useful in pointing out the specific problem experienced by the player and also aids in treatment planning.
Patients who play these instruments require preventive and supportive treatment from dental practitioners who understand the relationship between musical wind instruments and orofacial structures. Individuals with malocclusion have been found to have certain psychosocial effects including lack of self esteem as a result of their appearance. Addressing this problem would therefore lead to improved dental aesthetics, masticatory function and psychological well being of wind instrument players.
1.2. LITERATURE REVIEW

It is a common belief amongst musicians that playing a musical wind instrument may be an etiological factor in the development of malocclusion. As a result, parents with young children are often discouraged by music teachers from allowing their children to play these instruments at an early age. Brass instruments are especially discouraged due to the nature of the mouthpiece and the higher pressure they exert on the dentofacial complex in comparison with other wind instruments.\(^5\)

Brattsrom et al. studied the effects of playing musical wind instruments on the dentofacial morphology in children at the ages of 6, 9, 12 and 15 years. It revealed a reduced anterior facial height and wider dental arches in the study participants. This was attributed to increased orofacial muscle activity and intraoral pressure as a contributing factor.\(^10\) This was in contrast to a cross sectional study in Switzerland among adult professional musicians by Rindisbacher et al. The latter found that the overbite and upper dental arch width was smaller in the musicians than in the control group. The width at the maxillary and mandibular molars was smaller in reed instrument and flute players than in the control group.\(^13\)

In New York, Herman et al. demonstrated significant anterior tooth movements among a majority of junior high school instrumentalists.\(^11\) This is in contrast to Pang et al who found that it was impossible to predict the effect of playing a musical instrument on the anterior teeth on an individual basis. However, it was suggested that on a group basis a class of wind instruments can be theorized to have a certain effect on the anterior teeth.\(^12\)

Among professional adult musicians in the UK, Grammatopoulos et al. found that there was no significant difference in occlusion between wind instrument players and a control group. It however, found that brass instrument players whose instruments had a large cup shaped mouthpiece had a high prevalence of lingual crossbites.\(^5\) He alluded this to the high pressure exerted by brass instruments. In comparison, Fuhrimann et al. studied natural lip function in wind instrument players and confirmed the presence of higher pressures on the teeth from soft tissues during the playing of a wind instrument. They however did not detect any effect on the bite morphology of the players.
Strayer classified wind instruments according to the embouchure used and the muscle groups. He also provided indications and contraindications. Grammatopoulos applied Strayer’s classification and theorized the distribution of forces around the dentition by observing the embouchure as follows:

Class A instruments—with a cup shaped mouthpiece (e.g. trumpets, tuba, trombones) are indicated for Class II Division I and class I cases with protruding upper incisors. These instruments can exert a horizontal force on the maxillary and mandibular incisors that might result in retroclination of these teeth and result in reduction in overjet and an increase in overbite.

Figure 1 Class A Instruments with a cup shaped mouthpiece
Class B instruments with a single reed mouthpiece (e.g. clarinets and saxophones) are indicated for Class III cases and contraindicated in Class II Divisions I and II; and class I cases with protruding upper incisors.\textsuperscript{14} These instruments can exert horizontal and vertical forces in maxillary and mandibular incisors that might result in maxillary incisor proclination, mandibular incisor retroclination, intrusion of maxillary and mandibular incisors, and therefore an increase in overjet and a reduction in overbite.\textsuperscript{5}

\textbf{Figure 2 Class B Instruments with a single reed mouthpiece}
Class C instruments with a double reed mouthpiece (e.g. oboes, bassoons) are indicated in all cases presenting hypotonicity and contraindicated in complicated Class I. These instruments can exert horizontal and vertical forces on the maxillary and mandibular incisors that might result in retroclination and intrusion of maxillary and mandibular incisors and therefore a reduction in overjet and overbite.

Class D instruments contain an aperture through which air is blown (e.g. flutes) are indicated in class I and III with shorter upper lips and unruly mentalis action. They are contraindicated in class II and complicated class I cases. These instruments can exert a horizontal force on the mandibular incisors that might result in retroclination of mandibular incisors and an increase in overjet.
Studies by Porter\textsuperscript{15} and Parker\textsuperscript{16} seem to arrive at a similar conclusion to Strayer. They both propose the use of musical wind instruments as an adjunct to orthodontic treatment. However, this requires careful selection of the instrument designated for a particular malocclusion and proper guidance from qualified music teachers.

Herman et al. also proposed that dentists should recommend instruments that aid in the correction of overjet and overbite as an adjunct to orthodontic treatment.\textsuperscript{11} Strayer not only recommended the use of wind instruments in orthodontic treatment; but also theorized that they could aid in management of orofacial muscular defects.

From the mentioned studies, it is clear that there is a lack of consensus regarding the role of musical wind instruments in dentistry, especially in orthodontics. Some implicate musical wind instruments in the causation of malocclusion while others show little association between these two factors. It has also been recommended that they could act as an adjunct to orthodontic treatment and in the management of facial muscle defects. It is therefore necessary to conduct a local based study using a different study method to add knowledge to this growing field.
CHAPTER 2 RESEARCH PROBLEM, JUSTIFICATION, HYPOTHESIS, OBJECTIVES AND VARIABLES

2.1. PROBLEM STATEMENT

In recent years in Nairobi, there has been an increase in the number of young people taking up musical wind instruments as part of a school program. Most of these players end up becoming professional musicians or regular amateur performers. In this regard, there has been an increase of musical wind instrument players who experience orofacial problems as a result of their chosen career. In addition, others already have orofacial deformities that do not permit them from achieving optimum results in their musical endeavors.

With this increasing number, it is important to equip dentists and wind instrumentalists with the knowledge on the musical wind instrument-orthodontic interface based on local studies. Dentists and parents need to be aware on the possible effects of wind instruments on the occlusion so that they are aware of potential effects, if any, of exposing their children to these instruments at an early age and the need for initiation of preventive measures.

There have been conflicting studies in the past on whether musical wind instruments play a part on the etiology of malocclusion. It is important therefore establish whether this is true in our local setting.
2.2. JUSTIFICATION OF STUDY

No such study on wind instrument players has been conducted in Kenya before.

As more individuals take up musical instruments, they need advice on possible dental problems encountered. This study will serve to investigate the possible involvement of musical wind instruments in malocclusion so that preventive measures are taken by the musicians and their oral healthcare providers.

2.3. OBJECTIVES OF THE STUDY

GENERAL OBJECTIVE

To investigate malocclusion patterns on selected musical wind instrument players.

SPECIFIC OBJECTIVES

1. To determine the types of wind instruments used in the study population.
2. To determine the prevalence of malocclusion among musical wind instrument players in selected groups in Nairobi.
3. To describe the malocclusion patterns observed in the different instrument categories.
4. To compare malocclusion patterns between wind instrument players and non wind instrument players.

2.4. HYPOTHESIS

There is no difference in occlusion patterns between musical wind instrument players and non-wind instrument players.
### 2.5. VARIABLES

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CHAPTER 3  RESEARCH METHODS AND INSTRUMENTS

3.1 STUDY AREA
The study was carried out at the Nairobi School, The Kenya Conservatoire of music orchestra, The Salvation Army brass band and the Kenya National Youth Orchestra.

Nairobi School is a boys’ national school located along Waiyaki way in Nairobi, Kenya. It has approximately 1200 students studying the 8-4-4 curriculum. The school has a wind band program consisting of about 40 players whose age ranges from 15 to 18 years. It has one of the most active wind band programs in Nairobi.

The Kenya Conservatoire of Music is a music teaching institution located on Harry Thuku road next to the Kenya National Theatre. It has a resident amateur orchestra consisting of students from all over Nairobi of the conservatoire. The orchestra has 60 players of which 20 are wind instrument players, 30 string players and 10 percussionists. The players’ age range is from 16 to 30 years.

The Salvation Army Brass Band is a regularly performing brass band based in Nairobi, Kenya. It comprises of players aged between 20 and 40 years. It consists of approximately 30 players, some of whom are professional players. It conducts rehearsals at the Nairobi Central Seventh Day Adventist Church and performs in churches in Nairobi.

The Kenya National Youth Orchestra is an amateur orchestra based in Nairobi, consisting of 80 players of which 40 are wind instrument players, 35 are string players and 5 are percussionists. It is based at the Art of Music foundation in Hurlingham along Argwings Kodhek road. The players are from Nairobi and its environs and their age ranges from 16 to 25 years.

3.2 STUDY POPULATION
The study population consisted of wind instrument players and a control group of musicians who are non wind instrument players. They were drawn from the four study areas: Nairobi
School, Kenya Conservatoire of Music Orchestra, the Salvation Army Brass Band and the Kenya National Youth Orchestra.

3.3 STUDY DESIGN
The study was a Cross sectional descriptive study.

3.4 SAMPLING
SAMPLE SIZE DETERMINATION
The sample size was calculated using the following formula

\[ N = \frac{Z^2 \cdot p(1-p)}{C^2} \]

Where  
- \( Z \) = Z value corresponding to 95% confidence interval.
- \( C \) = 1-confidence interval
- \( P \) = Prevalence of the problem under investigation

The sample size was calculated based on a study by Grammatopoulos et al. in 2009 which reported the prevalence of Class II(2) incisor relationship to be 8.1%:

\[ N = \frac{1.96^2 \times 0.081(1-0.081)}{(1-0.95)^2} \]

= 114 persons

However, the population of this study was less than 10,000 therefore the following formula was used:
\[ nf = \frac{n}{1 + \frac{n}{N}} \]

Where \( nf \) = desired sample size for a population < 10,000

\( n \) = sample size derived for a population > 10,000

\( N \) = estimated size of the population with the characteristic of interest under investigation.

\( n = 114 \)

\( nf = 180 \) (total number of players in the three groups)

\[ nf = \frac{114}{1 + \frac{114}{180}} \]

\( = 69.9 \) (70 persons)

The study was to comprise 70 wind instrument players and 70 non-wind instrument players.

This study included 103 players (63 wind and 40 non wind). The targeted sample size was not met due to scarcity of participants; failure to meet the inclusion criteria and some participants belonging to more than one study group.

**SAMPLING METHOD**

Convenience sampling was used to obtain the study population.
3.5 INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA

1. Those that played musical wind instruments and non-wind instruments.

2. Study participants who consented to the study.

3. Study participants below 18 years who assented and whose guardians consented to the study.

EXCLUSION CRITERIA

1. Those who were musicians but did not play an instrument.

2. Study participants who did not consent to the study.


4. Study participants who had undergone orthodontic treatment previously.

5. Study participants who had had extractions of permanent teeth.

3.6 DATA COLLECTION INSTRUMENTS AND TECHNIQUES

A closed ended questionnaire (Appendix 1.) was administered by the investigator outlining the basic demographic variables, the type of instrument played, the frequency and the duration of play. The type of wind instrument played was recorded according to type (woodwind or brass) and according to a modification of Strayer’s classification.
Modification of Strayer’s classification of musical wind instruments (1939)

Class A(I)-Instruments with a large cup shaped mouthpiece e.g. tubas, trombones, euphonium.

Class A(II)-Instruments with a small cup shaped mouthpiece e.g. trumpets, French horns

Class B-Instruments with a single reed mouthpiece e.g. clarinets and saxophones.

Class C-Instruments with a single reed mouthpiece e.g. oboes, bassoons.

Class D-Instruments with an aperture through which air is blown e.g. flutes

An intraoral exam was conducted by the investigator under natural light and entered into a data collection form that is a modification of the Dental Aesthetic Index (DAI). Variables were recorded as follows:

Maxillary overjet was measured using a graduated periodontal probe from the labio-incisal edge of the most prominent upper central incisor to the corresponding lower central incisor parallel to the occlusal plane.

Overbite was estimated as the maximum overlap of either upper central incisor in relation to the lower incisor and recorded.

Anterior open bite was assessed for presence or absence. It was recorded only when all four upper incisors did not overlap any lower incisor when viewed in the occlusal plane.

Posterior crossbite was recorded when the buccal cusp of an upper tooth lies lingual to the maximum height of a buccal cusp of an opposing lower tooth.

Scissor-bite was recorded when a lingual cusp of an upper tooth lies buccal to the maximum height of a buccal cusp of an opposing lower tooth.

Crowding was assessed for presence or absence. Both upper and lower incisal segments will be examined for crowding. 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 sufficient alignment.
Molar relationship was recorded according to Angle’s classification as follows:

Class I - Mesiobuccal cusp of the upper first molar occludes in the buccal groove of the lower first molar.

Class II - Mesiobuccal cusp of the upper first molar occludes mesial to the buccal groove of the lower first molar.

Class III - Mesiobuccal cusp of the upper first molar occludes distal to the buccal groove of the lower first molar.

3.7 VALIDITY AND RELIABILITY

The questionnaires were pre-tested on a sample of the study population. The data collection form was a modification of the Dental Aesthetic Index. The principal investigator was calibrated by the supervisors to calculate inter-examiner reliability. A repeat examination procedure was done on every tenth subject. Cohen’s Kappa was used to calculate inter and intra-examiner reliability. 80% Kappa score was acceptable.

3.8 CONTROL OF BIASES

Only the respondents who met the inclusion criteria were enrolled into the study. All data collection tools were pre-tested. All the instruments used were calibrated.

3.9 ETHICAL CONSIDERATIONS

1. The research proposal was submitted to KNH ethics committee for approval.

2. Permission was sought from the Nairobi school administration, The Kenya Conservatoire of Music Director, The Salvation Army Brass Band Director and The Kenya National Youth Orchestra Director to conduct the research.

3. Participants and guardians of minors were required to consent to the study.

4. All information collected was treated with confidentiality and used for research purposes only.
3.10 DATA ANALYSIS AND PRESENTATION

The data collected was coded. The Statistical Package for Social Sciences (SPSS) 17. was used for data analysis. Descriptive statistical tests were carried out to explain the frequency of various variables. The One Way ANOVA was used to test for statistical significance. The results were presented using frequency diagrams, tables and pie charts.

3.11 PERCEIVED BENEFITS

The study results offer an insight into whether playing a musical wind instrument may contribute to development of malocclusion.

It also serves as a benchmark for further research regarding other orofacial problems and systemic diseases that musicians may be predisposed to due to the nature of their occupation.

It will also serve in the partial fulfillment towards the BDS degree.
CHAPTER 4: RESULTS

4.1 Socio-demographic variables

The study involved 103 participants, 23(22.3%) from Nairobi School, 35(34%) from the Kenya Conservatoire of Music Orchestra, 25(24.3%) from the Kenya National Youth Orchestra and 20(19.4%) from the Salvation Army Brass Band.

Figure 5. Distribution of study participants
Their ages ranged from 14 years to 40 years with a mean of 22.38 years and an overall mode of 19 years. Male participants were the majority 73(70.9%) while female participants were 30(29.1%).

Figure 6. Age Group and Gender Distribution
4.2. Players

4.2.1. Wind instrument players versus non wind instrument players

63(61.2\%) of the participants were wind instrument players while 40(38.8\%) formed the control group of non-wind instrument players.

Figure 7. Distribution of wind players and non wind players
4.2.2. Types of wind instruments

Out of the 63 wind players, the majority 36(57%) were in the brass category whilst those in the woodwind category were 27(43%).

Figure 8. Types of wind instruments

According to wind instrument classification, players of the Class A(I) category were 21(33.3%), Class A(II) were 15(23.6%), Class B were 21(33.3%) and Class D were 6(9.5%). Class C players were not found in the study population.
4.2.3. Non wind instrument players

28(70%) of the non wind instrument players were string players, 8(20%) were percussion players and 4(10%) were categorized as ‘others’.

Figure 10. Distribution of Non Wind Players
4.2.4. Duration and frequency of play

Majority of the players from both groups responded that they play for 3 to 5 hours in a day. (Table 1. below) With regards to duration of play, majority in both groups responded that they have played their instruments for 1 to 3 years. (Table 2. below)

Table 1. Frequency of play among wind and non wind players

<table>
<thead>
<tr>
<th>FREQUENCY OF PLAY</th>
<th>WIND PLAYERS (N=63)</th>
<th>NON WIND PLAYERS (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOURS/DAY</td>
<td>N(%)</td>
<td>HOURS/DAY</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>19( 30.2%)</td>
<td>1-2 hours</td>
</tr>
<tr>
<td>3-5 hours</td>
<td>42( 66.7%)</td>
<td>3-5 hours</td>
</tr>
<tr>
<td>6-8 hours</td>
<td>2( 3.2%)</td>
<td>6-8 hours</td>
</tr>
</tbody>
</table>

Table 2. Duration of play among wind and non wind players

<table>
<thead>
<tr>
<th>DURATION OF PLAY</th>
<th>WIND PLAYERS (N=63)</th>
<th>NON WIND PLAYERS (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEARS</td>
<td>N(%)</td>
<td>YEARS</td>
</tr>
<tr>
<td>1-3 years</td>
<td>66.7%(42)</td>
<td>1-3 years</td>
</tr>
<tr>
<td>4-6 years</td>
<td>28.6%(18)</td>
<td>4-6 years</td>
</tr>
<tr>
<td>≥ 7 years</td>
<td>4.8%(3)</td>
<td>≥ 7 years</td>
</tr>
</tbody>
</table>
4.2.5. Perception towards wind instruments and malocclusion

Majority of the participants {49(47.6%)} did not know whether wind instrument playing may result in malocclusion. 26(25.2%) were of the opinion that they do, whilst 27(26.2%) were of the contrary opinion. One participant(1%) did not respond.
4.3. MALOCCLUSION PATTERNS
4.3.1. Overjet

Wind Players

Out of the 63 wind instrument players, 49 (77.8%) had a zero to less than 3mm relationship, 10 (15.9%) had a 3mm to less than 6mm relationship, 2 (3.2%) had a 6mm to less than 9mm relationship and 2 (3.2%) had a 9mm and greater relationship.

Figure 11. Overall overjet pattern in wind players

Among the wind instrument categories, majority of the players in each class: Class A(I)-14 (66.67%), Class A(II)-13 (86.67%), Class B-17 (80.95%) and Class D-5 (83.33%) had an edge to edge to 3mm overjet pattern. The differences in overjet were not statistically significant (F=0.274, p=0.824).
Table 3. Overjet within wind instrument groups

<table>
<thead>
<tr>
<th></th>
<th>MAXILLARY OVERJET</th>
<th></th>
<th></th>
<th></th>
<th>TEST (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0&lt;3 MM</td>
<td>3MM &lt;6MM</td>
<td>6MM &lt;9MM</td>
<td>9MM &gt;</td>
<td></td>
</tr>
<tr>
<td>CLASS A(I)</td>
<td>14(66.67%)</td>
<td>6(28.57%)</td>
<td>1(4.76%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F=0.274</td>
</tr>
<tr>
<td>CLASS A(II)</td>
<td>13(86.67%)</td>
<td>1(6.67%)</td>
<td>0(0%)</td>
<td>1(6.67%)</td>
<td>p=0.824</td>
</tr>
<tr>
<td>N=15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS B</td>
<td>17(80.95%)</td>
<td>3(14.29%)</td>
<td>1(4.76%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS C</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS D</td>
<td>5(83.33%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>1(16.67%)</td>
<td></td>
</tr>
<tr>
<td>N=6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Wind Players</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Majority of the non wind players 30(75%) had an edge to edge to <3mm relationship. 10(25%) had a 3 to 6mm relationship. This was not statistically significant(F=0.641,p=0.533).

Figure 12. Overjet in non wind players
Comparison of Overjet among Wind Vs Non Wind Players

Figure 13. Overjet among Wind Players vs Non Wind Players

Majority of both wind and non wind players had an overjet of zero to 3mm. None of the non wind players had an overjet greater than 6mm. (Figure 13 above).

Differences in maxillary overjet between wind players and non wind players were not statistically significant.(F=0.303,p=0.583)
4.3.2. Overbite

Wind Players

52 (82.5%) of the wind instrument players had an edge to edge to one thirds overlap pattern, 9 (14.3%) had a one third to < two thirds overlap, 1 (1.6%) had a two thirds to three thirds overlap and 1 (1.6%) had a three thirds overlap and over.

Figure 14. Overall Overbite distribution in wind players

In the individual wind instrument categories, the most frequently observed overbite pattern was edge to edge < one thirds overlap followed by the one thirds to < two thirds overlap. The differences in overbite among the players in the different instrument categories was not statistically significant. (F = 0.298, p = 0.826)
Table 4. Overbite within wind instrument groups

<table>
<thead>
<tr>
<th>Overbite</th>
<th>0&lt;1/3</th>
<th>1/3&lt;2/3</th>
<th>2/3&lt;3/3</th>
<th>3/3 AND &gt;</th>
<th>Test (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS A(I)</td>
<td>15(71.42%)</td>
<td>6(28.57%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F=0.298</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p=0.826</td>
</tr>
<tr>
<td>CLASS A(II)</td>
<td>13(86.67%)</td>
<td>2(13.33%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS B</td>
<td>19(90.48%)</td>
<td>1(4.76%)</td>
<td>0(0%)</td>
<td>1(4.76%)</td>
<td></td>
</tr>
<tr>
<td>N=21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS C</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS D</td>
<td>5(83.33%)</td>
<td>0(0%)</td>
<td>1(16.67%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>N=6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Non Wind Players

31(77.5%) of the players had an edge to edge to <one thirds overlap. 9(22.5%) had a one thirds to <two thirds overlap. This was not statistically significant(F=1.158,p=0.326).

Figure 15. Overbite in non wind players
Comparison of Overbite among Wind Vs Non wind Players

Figure 16. Overbite among Wind vs Non Wind players

Majority of both wind and non wind players had an edge to edge to less than one thirds overlap. None of the non wind players had an overlap greater than two thirds.

Differences in overbite between wind players and non wind players was not statistically significant. (F=0.001, p=0.978)
4.3.3. Anterior Openbite

Wind players

Anterior open bite was present in 5(8%) of the wind instrument players and absent in 58(92%) players.

Figure 17. Anterior openbite in wind players

In the individual wind instrument categories, 1(4.76%) player in Class A(I), 2(13.33%) players in Class A(II) and 2(9.52%) players in Class B had an anterior open bite respectively. None of the six players in Class D featured an anterior open bite. The differences in anterior open bite in the individual wind instrument categories was not statistically significant. (F=0.565, p=0.640)
Table 5. Anterior openbite according to wind instrument class.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>PRESENT</th>
<th>ABSENT</th>
<th>TEST (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A(I) N=21</td>
<td>1(4.76%)</td>
<td>20(95.23%)</td>
<td>F=0.565</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>p=0.640</td>
</tr>
<tr>
<td>A(II) N=15</td>
<td>2(13.33%)</td>
<td>13(86.67%)</td>
<td></td>
</tr>
<tr>
<td>B N=21</td>
<td>2(9.52%)</td>
<td>19(90.48%)</td>
<td></td>
</tr>
<tr>
<td>C N=0</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>D N=6</td>
<td>0(0%)</td>
<td>6(100%)</td>
<td></td>
</tr>
</tbody>
</table>

Non Wind players

Only 1(2.5%) player in the non wind category had an anterior openbite. This was statistically significant.(F=5.385,p=0.009).

Figure 18. Anterior Openbite in non wind players
Comparison of Anterior openbite among Wind vs non wind players.

Figure 19. Anterior Openbite among Wind players vs Non Wind players

There was a higher prevalence of anterior openbites in the wind players compared to the non wind players(Figure 19 above). This was however, not statistically significant.(F=1.309,p=0.255)
4.3.4. Posterior Crossbites

Wind Players

Left posterior crossbite

7(11.1%) of the wind instrument players had a left posterior crossbite.

Left posterior crossbite was present in 3(14.29%) of Class A(I) players; present in 1(6.67%) Class A(II) players; present in 3(14.29%) of the Class B players. None of the 6(100%) Class D players exhibited this feature. The differences in left posterior crossbites was not statistically significant. (F=0.495, p=0.687)

Right Posterior Crossbite

7(11.1%) players had a right posterior crossbite while 56(88.9%) lacked this feature.

Right posterior crossbite was present in 1(6.67%) the Class A(II) players, present in 4(19.05%) of the Class B players and present in 2(33.33%) of the Class D players. The differences in right posterior crossbite was not statistically significant. (F=2.628 p=0.059)

Table 6. Posterior Crossbites according to wind instrument class

<table>
<thead>
<tr>
<th>Class</th>
<th>N</th>
<th>Present (%)</th>
<th>Absent (%)</th>
<th>Test</th>
<th>Present (%)</th>
<th>Absent (%)</th>
<th>Test (ANOVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A(I)</td>
<td>21</td>
<td>3(14.29%)</td>
<td>18(85.71%)</td>
<td>F=0.495</td>
<td>0(0%)</td>
<td>21(100%)</td>
<td>F=2.628</td>
</tr>
<tr>
<td>Class A(II)</td>
<td>15</td>
<td>1(6.67%)</td>
<td>14(93.33%)</td>
<td>P=0.687</td>
<td>1(6.67%)</td>
<td>14(93.33%)</td>
<td>P=0.059</td>
</tr>
<tr>
<td>Class B</td>
<td>21</td>
<td>3(14.29%)</td>
<td>18(85.71%)</td>
<td></td>
<td>4(19.05%)</td>
<td>17(80.95%)</td>
<td></td>
</tr>
<tr>
<td>Class D</td>
<td>6</td>
<td>0(0%)</td>
<td>6(100%)</td>
<td></td>
<td>2(33.33%)</td>
<td>4(66.67%)</td>
<td></td>
</tr>
</tbody>
</table>
Non Wind Players

None of the non-wind players had a left posterior crossbite whilst only 2(5%) had a right posterior crossbite. This was not statistically significant(F=0.582,p=0.564).

Figure 20. Posterior crossbites among Non Wind Players

Comparison of Posterior Crossbites among Wind vs Non wind Players

Left posterior crossbites were only present in wind players. This was statistically significant.(F=4.903,p=0.029)

Figure 21. Left Crossbites among Wind vs Non Wind players
Right posterior crossbites were more prevalent in the wind players compared to non wind players. This was also not statistically significant. (\(F=1.136, p=0.289\))

Figure 22. Right Posterior Crossbites among Wind vs Non Wind players
4.3.5. Scissorbites

Wind Players

Left Scissorbite

3(4.8%) of the players had a left scissorbite.

1(4.8%) player belonged to the Class A(I) and 2(9.52%) to Class B. Differences in left scissorbites were not statistically significant.(F=0.720, p=0.544)

Right Scissorbite

3(4.8%) of the players had a right scissorbite. Of these players 1(4.8%) each belonged to Class A and B and 1(16.67%) to Class D groups of wind instruments respectively.

Differences in right scissorbites were not statistically significant.(F=0.842, p=0.477)

Table 7. Scissorbites according to wind instrument class

<table>
<thead>
<tr>
<th>POSTERIOR SCISSORBITES</th>
<th>LEFT</th>
<th></th>
<th></th>
<th>RIGHT</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRESENT</td>
<td>ABSENT</td>
<td>TEST</td>
<td>PRESENT</td>
<td>ABSENT</td>
<td>TEST(ANOVA)</td>
</tr>
<tr>
<td>Class A(I) N=21</td>
<td>1(4.8%)</td>
<td>20(95.2%)</td>
<td>F=0.720 p=0.544</td>
<td>1(4.8%)</td>
<td>20(95.2%)</td>
<td>F=0.842 p=0.477</td>
</tr>
<tr>
<td>Class A(II) N=15</td>
<td>0(0%)</td>
<td>15(100%)</td>
<td></td>
<td>0(0%)</td>
<td>15(100%)</td>
<td></td>
</tr>
<tr>
<td>Class B N=21</td>
<td>2(9.52%)</td>
<td>19(90.48%)</td>
<td></td>
<td>1(4.8%)</td>
<td>20(95.2%)</td>
<td></td>
</tr>
<tr>
<td>Class D N=6</td>
<td>0(0%)</td>
<td>6(100%)</td>
<td>1(16.67%)</td>
<td>5(83.33%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Non Wind Players

Amongst the non-wind players, left scissorbite was present in 5(12.5%) players. However, this was not statistically significant(F=0.244,p=0.785). Right scissorbite was present in 4(10%) players and this was also not statistically significant(F=0.692,p=0.507)
Figure 23. Scissor bites in Non wind players

Comparison of scissor bite among Wind vs Non wind players

Left scissor bite was more prevalent in non wind compared to wind players. This was not statistically significant. (F=2.046, p=0.156).

Figure 24. Left Scissor bite: Wind Players vs Non Wind Players
Right scissorbite was also more prevalent in non wind compared to wind players. This was also not statistically significant. (F=1.050, p=0.308).
4.3.6. Lower and Upper Anterior Crowding

Wind Players

Lower anterior crowding

Lower anterior crowding was present in 13(20.6%) and absent in 50(79.4%) of the wind players. In the Class A(I) group, it was present in 5(23.8%), in Class(II) it was present in 1(6.67%), in Class B it was present in 7(28.57%) and in Class D, it was absent in all the players. Differences in lower anterior crowding within the wind instrument groups were not statistically significant.(F=2.042,p=0.118)

Figure 25. Lower anterior crowding among different wind instrument classes
**Upper Anterior Crowding**

Upper anterior crowding was present in 11 (17.5%) and absent in 52 (82.5%) of the wind instrument players. It was present in 3 (14.28%) of Class A(I), present in 1 (6.67%) of Class A(II), present in 6 (28.57%) of Class B and present in 1 (16.67%) Class D player. Differences in upper anterior crowding within the wind instrument groups were not statistically significant. \( F=1.155, p=0.335 \)

**Figure 26.** Upper anterior crowding among different wind instrument categories

![Diagram showing upper anterior crowding percentage for different wind instrument classes.]

- **Class D:** Absent 16.67%, Present 83.33%
- **Class B:** Absent 28.57%, Present 71.43%
- **Class A(II):** Absent 6.67%, Present 93.33%
- **Class A(I):** Absent 14.28%, Present 85.72%
Non Wind Players

Lower Anterior Crowding

Lower anterior crowding was present in 13 (32.5%) players and absent in 27 (67.5%) of the players. Differences in lower anterior crowding within the non wind instrument player groups were not statistically significant. (F=0.353, p=0.705).

Upper Anterior Crowding

7 (17.5%) of the players had upper anterior crowding while 33 (82.5%) did not have this feature. Differences in upper anterior crowding within the non wind instrument player groups were not statistically significant. (F=1.582, p=0.219).

Figure 27. Anterior Crowding in Non Wind players
Comparison of crowding in wind vs non wind players

Lower anterior crowding was more prevalent in non wind players compared to wind players. This was not statistically significant (F=1.822, p=0.180).

Upper anterior crowding was equally prevalent between the wind and non wind players. This was also not statistically significant. (F=0.000, p=0.996)
4.3.7. Angle’s First Molar Relationship

Wind Players

40 (63.5%) of the players had an Angles Class I relationship, 12 (19%) had an Angle’s Class II relationship and 11 (17.5%) had an Angle’s Class III relationship. This was not statistically significant. (F = 1.873, p = 0.144)

Figure 28. Angle’s first molar relationship in wind players

Figure 29. First molar relationship in individual wind instrument categories
Non Wind Players

20(50%) had a Class I relationship, 12(30%) had a Class II relationship and 8(20%) had a Class III relationship. The differences between the wind players and non wind players were not statistically significant. (F=1.024, p=0.314)

Figure 30. First molar relationship in non wind players

Comparison of wind players vs non wind players

The most frequently observed molar relationship was Angles Class I followed by Class II and Class III for both groups(Figure 31 below). The differences observed were not statistically significant. (F=1.024, p=0.314)

Figure 31. First Molar Relationship: Wind vs Non Wind
CHAPTER 5  DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The main objective of this study was to investigate patterns of malocclusion among wind instrument players among selected musical wind instrument players in Nairobi. Study participants were sampled from the Kenya Conservatoire of Music Orchestra, Kenya National Youth Orchestra, Nairobi School and the Salvation Army Brass Band. This represented musicians of varying ages and different backgrounds.

5.1 Socio-demographics

The overall gender distribution was uneven. Male to female ratio was 2.4:1; with males forming 70.9% and females forming 29.1% of the study population. The gender ratio obtained in this study is however, not in line with the Kenyan population, which has a Male to Female ratio of 1:1.01 according to the 2009 census report by the Kenya National Bureau of Statistics.\textsuperscript{19} The reason behind this disparity could be attributed to the study group selection which included an all male high school (Nairobi School). In addition it can also be deduced from previous studies that males generally prefer wind instruments. This was in line with a similar study conducted in the UK whose gender distribution was 71.8%(Males) and 28.2%(Females).

Age distribution ranged from 14 to 40 years with a mean of 22.38 years(SD±5.68). This was not in line with the Kenyan population whose median age is 18.80 years. This is significant lower when compared to a similar study conducted in the UK\textsuperscript{5} whose age range was 18 to 57 years with an average of 33.37 years. This difference can be attributed to majority of the participants in this study being amateur players who have played instruments for a shorter duration of time.

5.2 Duration and frequency of play

Majority of the players responded that they played for 3 to 5 hours a day. They also reported having played their instruments for a period of 1 to 3 years. This was in contrast to a study by Grammatopoulos where majority of the players were professional players who played for longer hours.\textsuperscript{5}
5.3 Perception on wind instruments and malocclusion

The study participants were asked whether they thought musical wind instruments affect the position of their teeth. Majority (47.6%) did not know the answer to this. This can be attributed to lack of locally available formation regarding these two fields.

5.4 Overjet

On examination, majority of the players, both wind and non wind had an overjet of between zero and 3mm. This was similar to a study conducted by Rindisbacher et al.\textsuperscript{13} which found a median overjet of 2.5mm; and a study by Grammatopoulos et al. which found a mean overjet of 2.96mm in all instrument groups.\textsuperscript{5} Strayer et al. suggested that Class B single reed instruments playing may result in an increased overjet and a reduced overbite. He also suggested that Class A instruments may result in a reduction on overjet and a reduced overbite.\textsuperscript{14} This study refutes that suggestion since majority of Class A and B players had an overjet of between zero to 3mm; and an edge to edge to less than one thirds overlap. However, this is in agreement with a study conducted by Pang et al. which found that there was a reduced overjet in children who played brass and single reed instruments.\textsuperscript{12} This disparity may be due to age differences. The study by Pang involved children. It can be postulated that greater overjet dimensions can be observed in adults who have played for a longer duration.

5.5 Overbite and Anterior Openbite

Majority of the players wind (82.5%) and non wind (77.5%) had an overbite of an edge to edge to less than one thirds overlap. This is in agreement with a study conducted in Switzerland which found a smaller overbite in wind instrument players compared with a control group\textsuperscript{13}.

Majority of wind and non wind players in this study did not feature an anterior open bite. This study investigated the presence or absence of anterior openbite; with a prevalence of 5% in wind players and 2.5% in non wind players. It was present in 3 brass players and 2 single reed players. Rindisbacher et al. recoded negative overbite values in the brass category only.\textsuperscript{13} Grammatopoulos et al. recorded negative overbite values in all instrument categories.\textsuperscript{5} There seems to be a great variation in the prevalence of anterior openbite. In this study, there were
no statistically significant differences in anterior openbite within the wind instrument player groups and between the wind players and non wind players. It is unlikely that playing a wind instrument may result in an anterior openbite since the forces generated as postulated by Strayer et al., do not permit the formation of an openbite.¹⁴

5.6 Posterior Crossbites

Posterior Crossbites were found to be present in 11.1% and absent in 88.9% of wind players. This was similar to a study by Grammatopoulos et al found that the percentage of players who did not exhibit a crossbite or crossbite tendencies ranged from 59% to 88% in different instrument categories⁵.

In this study, there were statistically significant differences in left posterior crossbites between the wind and non wind players. There were also statistically significant differences in right posterior crossbites within the four wind instrument categories. A study conducted in the UK found that individuals who played brass instruments with large cup shaped mouthpieces are more likely to develop lingual crossbites.⁵

5.7 Scissorsbites

Majority of the players from the wind and non wind player groups did not exhibit scissorsbites. However, this variable has not featured in previous studies and therefore no comparison can be made.

5.8 Crowding

Lower and upper anterior crowding had the highest prevalence amongst single reed players(28.57%) followed by brass players with a large cup shaped mouthpiece. Lower anterior crowding was more prevalent in the control group compared to the wind players. Upper anterior crowding was equally prevalent in both groups. This study only assessed the presence or absence of crowding in contrast to Grammatopoulos et al. that assessed severity in the different wind instrument classes. That study found the greatest severity in brass players with a large cup shaped mouthpiece.⁵
5.9 First Molar Relationship

The most frequently observed Angle’s First molar relationship was Class I for both wind (63.5%) and non wind players (50%). This could be compared to a Kenyan study by Ng’ang’a et al. which found a higher prevalence (93%) of neutral occlusion in children aged 13 to 15 years. Grammatopoulos studied the antero-posterior dimensions by examining the incisor relationship. He found a more prevalent Class I incisor relationship.

5.10 Malocclusion: Wind Players vs Non Wind players

Despite variations in socio-demographic characteristics, there doesn’t seem to be a difference in malocclusion traits observed in Kenyan wind instrument players compared with those in previous studies. It has been postulated that the nature of muscle and soft tissue interaction with the dentition in the course of embouchure formation may result in a specific type of malocclusion. The results obtained in this study refute that suggestion. Majority of the participants in this study play for less than three hours a day. Forces required to produce a given amount of orthodontic movements need to be continuous. In removable orthodontic appliances the amount of forces applied need to be active for 4 to 6 hours for orthodontic movement to occur. Below this duration threshold, no movement would occur.

A study conducted by Fuhrimann et al. assessed lip strength, lip muscle activity pressure from the lips and morphology of the face and dentition in wind players. Although pressure from the soft tissues on the teeth during playing was greater than during natural lip function, effects of this on bite morphology could not be detected. This could provide an explanation as to why there are no statistically significant differences in malocclusion patterns observed in wind instrument players in Nairobi.
CONCLUSIONS

Based on the findings of this study, we can conclude that:

1. The most frequently observed occlusal traits among wind instrument players were:
   77.8% had an Overjet of (0<3MM), 82.5% had an Overbite of (0<1/3 overlap), 20.6% had Lower anterior crowding, 17.5% had Upper anterior crowding and 63.5% had a Class I Molar relationship.
2. Majority of the wind instrument players were brass players (57%).
3. There was no difference between malocclusion patterns in the different wind instrument players and there was no difference in malocclusion patterns between wind and non wind players.
4. Differences in malocclusion patterns observed between wind and non wind players were not statistically significant.
RECOMMENDATIONS.

Wide consultations should be held between members of the dental profession and music educators regarding increasing awareness between these two fields. This would help in bridging the knowledge gap elicited from participants in this study.

A longitudinal study would be recommended to provide more information on the long term effects, if any, of playing a wind instrument on the dentition.
REFERENCES


19) Kenya Demographic and Health Survey 2009.
APPENDICES

APPENDIX 1: DATA COLLECTION FORM

PART I

1. Date of birth ……/…../……..

2. Gender
   Male ☐ Female ☐

3. Location
   Nairobi School ☐
   Kenya ☐
   Conservatoire of Music Orchestra ☐
   Kenya National Youth Orchestra ☐
   Leidzen Brass Band ☐

4. Are you a wind instrument player?
   (If ‘Yes’ answer Question 4, If ‘No’ skip Question 5 and answer question 6)
   Yes ☐ No ☐

5. Type of wind instrument
   Woodwind ☐ Brass ☐

6. Type of non wind instrument
   String ☐ Percussion ☐ Other ☐

7. Duration of play(in months or years)

55
8. Frequency of play (hours per day)

9. Do you think playing a musical wind instrument affects the position of your teeth?

Yes ☐ No ☐ I don’t know ☐
PART II

1. Maxillary overjet (mm)
   - Edge to edge < 3mm
   - 3mm to < 6mm
   - 6mm to < 9mm
   - 9mm and >

2. Overbite
   - Edge to edge < one thirds overlap
   - One thirds to < two thirds overlap
   - Two thirds to < three thirds overlap
   - Three thirds overlap and over

3. Anterior openbite
   - Present
   - Absent

4. Posterior crossbite
   - L Present
   - Absent
   - R Present
   - Absent

5. Scissor Bite
   - L Present
   - Absent
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6. **Lower anterior crowding**
   - Present
   - Absent

7. **Upper anterior crowding**
   - Present
   - Absent

8. **1st molar relationship**
   - Angle’s Class I
   - Angle’s Class II
   - Angle’s Class III

9. **Instrument class**
   - Class A(I)
   - Class A(II)
   - Class B
   - Class C
   - Class D
APPENDIX 2: INDICES

Modified Strayer’s classification of musical wind instruments (1939)

Class A(I)-Instruments with a large cup shaped mouthpiece e.g. tubas, trombones.

Class A(II)-Instruments with a small cup shaped mouthpiece e.g. trumpets, French Horns

Class B-Instruments with a single reed mouthpiece e.g. clarinets and saxophones.

Class C-Instruments with a single reed mouthpiece e.g. oboes, bassoons.

Class D-Instruments with an aperture through which air is blown e.g. flutes

Angle’s classification of molar relationship (1899)

Class I-Mesiobuccal cusp of the upper first molar occludes in the buccal groove of the lower first molar.

Class II-Mesiobuccal cusp of the upper first molar occludes mesial to the buccal groove of the lower first molar.

Class III-Mesiobuccal cusp of the upper first molar occludes distal to the buccal groove of the lower first molar.
APPENDIX 3: CONSENT FORM

I am a 3rd year undergraduate student at the University of Nairobi pursuing a Bachelor of Dental Surgery degree. I am currently conducting research on malocclusion among selected musical wind instrument player groups in Nairobi.

I wish to request for your participation in this study that would form part of my degree course. It involves answering some questions and an intraoral exam in which the type of malocclusion will be assessed and recorded in a data collection form. There will be no risks involved because no invasive procedures will be performed and the entire examination will be carried out maintaining absolute hygienic measures.

The study will serve to provide more information regarding the relationship of musical wind instruments and orthodontics. It will also open up avenues for further research regarding orofacial problems experienced by musicians in our local setting. Participation is voluntary and you are free to withdraw from the study at any stage. The study entails no costs on the part of the participants. The participant’s identity and the results of the investigation will be kept confidential. However, appropriate advice shall be given for any urgent treatment required.

I would therefore appreciate your consent by signing here below.

I, **Muyia Robert Mandela Bwire**, confirm that I have explained the relevant parts of the study to the participant.

Signed: ________________________ Date___________

I, **the participant**, confirm that I have understood the relevant parts of the study and do hereby give consent to participate.

Signed: _________________________Date_____________