Original Article

The Impact of Playing Wind Musical Instruments on the Dental Arch Dimensions in a Male West African Population

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Abstract

Background: Dental arch dimensions are important considerations in orthodontic treatment planning and monitoring. **Objective:** This study aimed to compare the dental arch dimensions in wind and non-wind instrument players (WIP and non-WIP). **Methods:** This was a cross-sectional study which compared a group of 50 male subjects aged 18–45 years that had been playing wind instruments for a minimum of 2 years with a control group matched for age in the same environment. The arch dimensions were assessed for both groups by measuring their dental casts using a digital caliper. Data was analyzed using statistical Software Package for Social Sciences (SPSS Inc, Chicago, IL) version 17. Statistical significance level was set at $P < 0.05$. **Results:** The mean number of years of playing wind instrument among the WIP was 9.26 ± 6.21 years. All the maxillary arch dimensions were larger in the WIP group except for the palatal depth while the mandibular arch parameters in the non-WIP group were larger than the WIP group except the mandibular arch length. The differences were not statistically significant ($P > 0.05$). The mean maxillary inter-canine width (37.48 ± 1.12 mm), inter-molar width (57.27 ± 1.99 mm), arch length (29.80 ± 2.2.09 mm), and palatal depth (22.21 ± 2.33 mm) for class B instrument (Saxophone and clarinet) players were larger than either the class A instrument (Trumpet and trombone) players or the non-WIP group. These differences were not statistically significant ($P > 0.05$). **Conclusions:** Playing a wind instrument as well as the type of instrument played, duration, and frequency of play did not significantly affect dental arch dimensions.

Keywords: *Arch length, inter-canine width, inter-molar width, palatal depth, wind instruments*

Background

The dental arch is a component of the stomatognathic system which works in harmony with other components such as skeletal (maxilla and mandible), soft tissues (salivary glands, nervous and vascular supplies), temporomandibular joints, and muscles of mastication to perform different functional tasks that are essential and sometimes characteristic to humans, such as speaking, chewing, tasting, swallowing, laughing, smiling, kissing, and socializing.[1,2]

Over the years, orthodontists have been treating an increasing number of individuals who engage in wind musical instrument play; these individuals and their parents often ask if playing a wind musical instrument can adversely affect their dental occlusion and by inference, their dental arch dimensions.[3,4] Dental arch dimension is an important consideration for treatment planning and monitoring in orthodontics, prosthodontics, and maxillofacial surgery. Dental arch dimensions in normal populations show gender,

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racial and ethnic variations.[5] Variations in arch dimensions may occur within a given population as a result of factors that alter the development of the jaws. Researchers have suggested that the dental arch width is governed by several factors such as the size and shape of the jaws and the influence of the oral musculature on the positioning of the teeth.[6] There is also a variation of results of arch dimensions among the different races.[7]

Some of the factors reported to affect arch width include genetics, environment and nutrition.[8,9]

Normal arch dimensions correlated with growth changes include arch circumference, arch length, inter-canine width, and inter molar width.[10]

A Nigerian study[11] showed that all male maxillary and mandibular arch widths were significantly larger than female arch widths. Literature suggests that playing of wind musical instruments will likely lead to a decrease in anterior facial height and creation of wider dental arches.[12,13]

This study was aimed at assessing and comparing the dental arch dimensions in wind and non-wind instrument players.

Subjects, Materials and Methods

Ethical approval and informed consent was obtained before the commencement of this study. Ethical approval was obtained from the Research Ethics committee of Aminu Kano Teaching Hospital, Kano on the 6th July, 2015. The ethical approval number is NHREC/21/08/2008/AKTH/EC/1442.

This comparative cross-sectional study compared subjects in the case group who were professional wind instrument players in Kano state, Nigeria with subjects in the control group who were non-wind instrument players. The case group consisted of 50 male subjects aged 18–45 years that had been playing wind musical instruments for a minimum of 2 years while the control group also consisted of 50 subjects who were matched for age and gender with the case group. Both case and control groups were from the same environment and they were all Nigerians living in Kano state. The wind instrument players were group into players of class A (Trumpet and Trombone) which are instruments that have cup-shaped mouthpieces and class B (Clarinet and Saxophone) which are instruments that have single reed, wedge-shaped mouthpieces according to the classification by Strayer.[12] Strayer's classification was recently modified by Clemente *et al*.[14] The inclusion criteria was the presence of a full complement of the permanent dentition. However, individuals who had periodontal disease with associated mobility, tooth extraction, orthodontic treatment, fracture of the jaws, surgery to their temporomandibular joints and oral habits were excluded from the study.

In order to determine the intra-examiner reliability, 10 subjects were re-assessed after 2 weeks. A very high intra-examiner reliability was recorded (Cronbach alpha - 0.997). The proforma for data collection was coded and used to record measurements of the dental arch dimensions. This was in addition to using it to obtain information on sociodemographic characteristics and other information related to the play of wind instruments.

In order to be able to measure the arch dimensions of the subjects, alginate impressions of the maxillary and mandibular dentition were taken under good illumination on a dental chair after which dental casts were fabricated using dental stone. The casts were coded to correspond with the coding on the proforma for individual subjects. They were then stored in individually labeled airtight plastic bags after they were based and trimmed.

A digital caliper (Mitutoyo Corporation, Tokyo, Japan) with accuracy set at 0.05 mm was used to measure the arch dimensions viz: Inter-molar width, inter-canine width, arch length, palatal depth in both upper and lower arches; except palatal depth that was measured in upper arch only.

The inter-molar width was the distance between the mesiobuccal cusps tips of the first permanent molars for upper and lower casts.[15]

The inter-canine distance was the distance between the cusp tip of the right canine to the cusp tip of the left canine.[15]

Arch length was the shortest distance from the mesial contact points of the central incisors and the midpoint of the line (ruler) joining the mesial anatomic contact points of the right and left first permanent molars.[16]

Palatal height/depth was taken as the vertical distance from a point on the palatal width line (the linear distance between the mesiolingual cusp tips of the right and left first molars) to the palatal vault in the midline. This was determined by securing a piece of stainless steel ruler of known diameter (0.5 mm) between the mesiolingual cusps of the right and left first permanent molars. This ruler served as support for the digital caliper for measuring the depth. The depth was taken as the perpendicular distance between the palate at the mid-palatal raphe and the piece of stainless steel ruler, less 0.5 mm, corresponding to the diameter of the wire.[15]

The average of two measurements carried out at 24 hours interval was recorded. In situations where the two measurements differed by more than 0.5 mm, a third measurement was carried out and the average of the two closest measurements then recorded.

Statistical analysis

Data was processed and analyzed using Statistical Software Package for Social Sciences (SPSS Inc, Chicago, IL) version 17.

Measures of central tendencies (mean), dispersion (standard deviation), independent *t*-tests and analysis of variance (ANOVA) to compare means and standard deviations of the different variables were carried out and presented in tables. Statistical significance level was set at $P < 0.05$.

Results

The mean age of participants in the WIP and non-WIP groups were 28.00 ± 7.64 and 28.10 ± 7.55 years, respectively ($P > 0.05$). The mean number of years of playing wind musical instrument among participants in the experimental (WIP) group was 9.26 ± 6.21 years. Most of the WIP group played Trumpet (72.0%) while saxophone, clarinet, and trombone was played by 12.0%, 8.0%, and 8.0% of the WIP, respectively.

Table 1 shows the comparison of the arch dimensions in both the WIP and non-WIP groups. All the maxillary

Table 1: Comparison of the arch dimensions in wind and non-wind instrument players

Arch dimensions (mm)	WIP			Non-WIP			*t*-test	
	Mean±SD	Min.	Max.	Mean±SD	Min.	Max.	T	*P*
Maxillary arch								
Inter-canine	36.80±2.10	31.70	41.30	36.54±5.41	31.30	42.70	0.32	0.75
Inter-molar	55.87±2.98	49.40	62.10	55.73±2.76	50.30	64.00	0.25	0.80
Arch length	28.30±3.01	18.20	36.40	28.27±2.20	22.20	33.40	0.05	0.96
Palatal depth	20.86±2.64	15.20	25.60	21.42±2.37	15.50	26.00	-1.11	0.27
Mandibular arch								
Inter-canine	27.36±2.04	21.30	32.80	27.51±1.70	23.50	31.50	-0.38	0.70
Inter-molar	47.52±2.73	41.50	51.80	47.74±2.35	41.90	54.20	-0.43	0.67
Arch length	24.00±2.40	15.80	28.40	23.78±1.88	19.40	28.30	0.51	0.61

P<0.05 - * statistically significant; *p*>0.05-not statistically significant

Table 2: Comparison of the maxillary arch dimensions according to the type of instrument played, number of years and frequency of playing wind instrument

Characteristics of the wind instrument players	Maxillary arch dimensions											
	Inter-canine width				Inter-molar width				Arch length			
	Mean±SD	F	Df	*p*	Mean±SD	F	df	*p*	Mean±SD	F	df	*P*
Type of instrument played												
Non-WIP	36.54±5.41				55.73±2.76				28.27±2.20			
Class A (Trumpet and Trombone)	36.63±2.26	0.22	2	0.803	55.52±3.10	1.55	2	0.218	27.93±3.11	2.09	2	0.130
Class B (Clarinet and Saxophone)	37.48±1.12				57.27±1.99				29.80±2.09			
Duration of playing instrument												
Non-WIP	36.54±5.41				55.73±2.76				28.27±2.20			
2-4 years	36.53±2.06				55.68±3.42				28.16±2.49			
5-10 years	36.55±2.36	0.13	3	0.944	54.86±2.85	1.10	3	0.353	28.79±3.18	0.20	3	0.895
Above 10 years	37.17±2.01				56.64±2.61				28.11±3.56			
Frequency of playing instrument												
Non-WIP	36.54±5.41				55.73±2.76				28.27±2.20			
Regularly (Daily/weekly)	36.78±2.21	0.06	2	0.947	56.43±2.53	0.21	2	0.813	28.33±2.72	0.01	2	0.988
Occasionally (Monthly/3 monthly)	36.93±1.48				55.77±3.08				28.18±4.49			

P<0.05 - * statistically significant; *p*>0.05-not statistically significant; test – one-way ANOVA

Table 3: Comparison of the palatal depth according to the type of instrument played, number of years and frequency of playing wind instrument

Characteristics of the wind instrument players	Palatal depth			
	Mean±SD	F	df	*P*
Type of instrument played				
None	21.42±2.37			
Class A (Trumpet and Trombone)	20.53±2.64	2.48	2	0.089
Class B (Clarinet and Saxophone)	22.21±2.33			
Duration of playing instrument				
None	21.42±2.37			
2-4 years	20.55±2.35	0.99	3	0.401
5-10 years	21.65±3.02			
Above 10 years	20.61±2.64			
Frequency of playing instrument				
None	21.42±2.37			
Regularly (Daily/weekly)	20.82±2.54	0.65	2	0.525
Occasionally (Monthly/3 monthly)	21.09±3.35			

$p<0.05$ - * statistically significant; $p>0.05$-not statistically significant; test: One-way ANOVA

Table 4: Comparison of the mandibular arch dimensions according to the type of instrument played, number of years and frequency of playing wind instrument

Characteristics of the wind instrument players	Mandibular arch dimensions											
	Inter-canine width				Inter-molar width				Arch length			
	Mean±SD	F	df	*p*	Mean±SD	F	df	*p*	Mean±SD	F	df	*P*
Type of instrument played												
None	27.51±1.70				47.74±2.35				23.78±1.88			
Class A (Trumpet and Trombone)	27.16±2.09	1.33	2	0.270	47.36±2.88	0.51	2	0.604	23.71±2.40	2.02	2	0.138
Class B (Clarinet and Saxophone)	28.20±1.70				48.18±2.07				25.17±2.08			
Duration of playing instrument												
None	27.51±1.70				47.74±2.35				23.78±1.88			
2-4 years	27.31±2.36				47.34±3.13				23.72±1.86			
5-10 years	27.46±1.62	0.06	3	0.979	46.87±3.04	0.69	3	0.559	24.46±2.42	0.38	3	0.77
Above 10 years	27.34±2.11				48.07±2.20				23.93±2.78			
Frequency of playing instrument												
None	27.51±1.70				47.74±2.35				23.78±1.88			
Regularly (Daily/weekly)	27.35±1.96	0.08	2	0.921	47.41±2.82	0.36	2	0.701	24.04±2.19	0.19	2	0.831
Occasionally (Monthly/3 monthly)	27.45±2.59				48.13±2.32				23.76±3.45			

$P < 0.05$ - * statistically significant; $P > 0.05$-not statistically significant; test: One-way ANOVA

arch dimensions were larger in the WIP group except for the palatal depth. On the contrary, the mandibular arch parameters in the non-WIP group were larger than the WIP group except the mandibular arch length. However, the differences between the two groups were not statistically significant ($P > 0.05$) across all the arch dimensions assessed.

Tables 2-4 show the comparison of maxillary and mandibular arch dimensions of WIP according to the type of instrument played, number of years and frequency of playing.

The means maxillary inter-canine width (37.48 ± 1.12 mm), inter-molar width (57.27 ± 1.99 mm), arch length (29.80 ± 2.09 mm), and palatal depth (22.21 ± 2.33 mm) for class B instrument players were larger than either the class A instrument players (36.63 ± 2.26 mm; 55.52 ± 3.10 mm; 27.93 ± 3.11 mm and 20.53 + 2.64 mm respectively) or the non-WIP group (36.54 ± 5.41 mm; 55.73 ± 2.76 mm; 28.27 ± 2.20 mm and 21.42 ± 2.37, respectively). These differences were not statistically significant ($P > 0.05$). Similarly, the mean mandibular inter-canine width (28.20 ± 1.70 mm), inter-molar width (48.18 ± 2.07 mm), and arch length (25.17 ± 2.08 mm) for the class B instrument players were also larger than that of class A instrument players (27.16 ± 2.09 mm; 47.36 ± 2.88 mm, and 23.71 ± 2.40 mm, respectively) and non-WIP group (27.51 ± 1.70 mm; 47.74 ± 2.35 mm, and 23.78 ± 1.88 mm respectively). The differences between the groups were also not statistically significant ($P > 0.05$). The maxillary and mandibular arch dimensions in the WIP were not significantly influenced by the number of years

or the frequency of play when compared with the control subjects ($P > 0.05$).

Discussion

No previous study of the arch dimensions in wind musical instrument players exists in our population. This study provided an insight into the effect of playing wind instruments on the arch dimensions which may play an important role in the etiology of malocclusion.

This study involved the comparison of two groups of participants who exhibited similar characteristic features in terms of age, sex, and environment. The group matching was necessary in order to eliminate possible confounders of arch form changes that tend to occur with advancing age.[17-19]

In this present study, only male participants were recruited because females do not usually engage in professional wind instrument play in Nigeria and in particular, the northern part of Nigeria which is largely due to cultural reasons and this could be seen as a limitation in gender comparison.

The average age of participants in this study was similar to the report of Grammatopoulos *et al*.[20] in the United Kingdom on 170 professional musicians.

There were no significant changes in dental arch dimensions following the playing of wind instrument in this study. This was reflected in the inter-canine, inter-molar, and arch length measurements of both arches including palatal depth across the different types of wind instrument played, duration, and frequency of play. This shows that the dental arch dimensions in this study population are rarely affected by playing wind musical and that any changes may likely be due to chance occurrence as observed by Lundstrom[21] who reported that changes in arch form of an individual occurs twice during dental development stages; first is during the deciduous dentition and then unpredictably during the permanent dentition. This is also in agreement with the study by Olav *et al*.[22] which suggested that changes in dental arch dimensions are generally not significant in adulthood. Therefore, the wind instrument play may not be enough to cause significant changes in the arch dimensions in adulthood.

The maxillary inter-canine and inter-molar widths recorded in this study were comparable with other Nigerian study that was reported during early and late permanent dentition stages by Aluko *et al*.[11] The recorded widths in this study are also comparable with the studies by Mark,[23] Otuyemi and Noar[24] in other Nigerian populations but were relatively higher than those obtained by Al-zubair[15] in a Yemeni population. The difference in the maxillary inter-canine and inter-molar widths recorded in this study was likely due to racial factor, as genetics have been reported as a determinant of arch dimension.[11]

In this present study, the maxillary arch dimensions were larger in the WIP group except the palatal depth but they were not statistically significant. This is consistent with a study by Tircoveluri *et al*.[25] which reported increased growth in the transverse and sagittal dimensions, and decreased growth in the vertical dimensions of arch widths in wind instrument players. This trend was also reported by Brattstrom *et al*.[13] among wind instrument players in Nittedal, Norway. Brattstrom *et al*.[13] reported significant differences in arch dimensions at ages 12 and 15 years while no differences were reported at ages 6 and 9 years between the wind instrument players and control group in their longitudinal study. The significant difference was likely due to an increased intra-oral pressure in combination with reduced pressure from the cheeks when wind instruments are played. The effect of playing wind instruments on the arch dimensions will likely be more pronounced when it occurs during growth spurts usually between ages 12 and 15 years, as only small changes occur in arch dimensions in adulthood.[22] Rindisbacher *et al*.[26] however reported a contrasting finding in which the width of the maxillary and mandibular arch widths in the molar areas were smaller in the flute and reed instrument players than in the control group. The contrasting finding may be due to the fact that the instruments whose effects were studied by Rindisbacher *et al*.[26] belonged to different classes as outlined by Strayer[12] compared to the ones considered in this study.

The maxillary inter-molar widths recorded in this study were similar to those reported by Dung *et al*.[27] but significantly higher than the findings of Mohammad *et al*.[28] and Ribeiro *et al*.[6] This significant difference may probably be due to genetic differences in the study populations. The higher mean maxillary inter-molar width and lower palatal depth recorded in the regular wind instrument players in this study compared with non-WIP and occasional players maybe due to persistent outward pressure exerted on the arch in regular players which could have led to decrease in the depth of the palate as the maxillary inter-molar width increased.[25]

In the present study, the mandibular arch dimensions reported for both WIP and non-WIP group were significantly higher than those reported by Haidi *et al*.[29] in a Saudi Arabian population but were only slightly smaller than those obtained from another Nigerian study by Aluko *et al*.[11]

All the mandibular arch dimensions were smaller in the WIP than non-WIP group except the mandibular arch length but the differences were not significant. This finding is in agreement with the study by Rindisbacher *et al*.[26] but however in contrast with the study by Grammatopoulos *et al*.[20] which showed a significant increase in mandibular intermolar width among trombone and tuba instrument players with large cup-shaped mouthpiece. The contrast may largely be due to differences in instrument designs and other factor like a racial/genetic difference among the study populations.

The slightly larger mandibular arch length, though not significant, recorded in this study among the WIP group and those that play regularly may be due to regular forward posturing of the mandible when playing wind instruments which is likely to have stimulated increase in mandibular growth especially during growth spurts, thus leading to increase in the mandibular arch length. This is in agreement with other previous studies[26,30] which suggested increase in mandibular arch length with forward posturing of the mandible.

The present study has provided a cross-sectional report and comparison of the arch dimensions of male wind and non-wind instrument players in our environment which will enable orthodontists provide informed advice to potential players of wind instruments in this age group concerning the potential impacts of playing wind musical instruments on the arch dimension thus prevent development of malocclusion. A longitudinal study is recommended in order to provide more information on the long term effects of playing wind instrument on arch dimensions in this population.

Conclusion

Playing a wind musical instrument did not significantly affect the dental arch dimensions in the population studied. Furthermore, the type of instrument played, duration of play and the frequency of play did not also significantly affect the arch dimensions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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