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Dental and Occlusal anomalies in Paediatric Patients with Endocrine Disorders

Comparison of Alignment Efficiency of Superlastic and Heat activated Niti archwires

Dental Arch Width Dimensions of Orthodontic Patients

Detrimental Effects of Orthodontic Treatment: A Review Article

Management of Severe Spacing with Bimaxillary Proclination: A case report

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Dental Arch Width Dimensions among Pre-treatment Orthodontic Patients In A Nigerian Tertiary Hospital.

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Abstract

Background: Accurate assessment of dental arch width is essential for orthodontic diagnosis and treatment planning, as it influences space availability, occlusal relationships, aesthetics, and long-term stability. Arch width varies by gender, age, ethnicity, and arch form, yet most normative data are derived from non-African populations, limiting their applicability in African clinical settings. This study aimed to determine maxillary and mandibular arch width dimensions among pre-treatment orthodontic patients attending a Nigerian tertiary hospital.

Methods: This descriptive cross-sectional study was conducted at the Orthodontic Clinic of the University of Benin Teaching Hospital. Pre-treatment maxillary and mandibular dental casts of 150 orthodontic patients were analysed. Intercanine and intermolar arch widths were measured using a calibrated digital caliper. Data was analysed using SPSS version 27. Descriptive statistics were computed, and comparisons were made by sex, age group, and anterior arch form, with statistical significance set at $p < 0.05$.

Results: The mean age of participants was 17.92 ± 9.05 years, with females constituting 62.3% of the sample. Males demonstrated higher mean values for all arch width parameters. A statistically significant difference was observed in maxillary intercanine width, which was greater in males than females ($p = 0.041$). No significant age-related differences were found in any arch width parameter. Casts with anterior spacing exhibited significantly greater maxillary ($p = 0.007$) and mandibular ($p = 0.003$) intermolar widths, while crowded arches demonstrated reduced posterior arch widths.

Conclusion: Dental arch width among pre-treatment orthodontic patients varies significantly by sex and anterior arch form but not by age. Posterior arch width plays a key role in the presence of spacing and crowding. These findings highlight the importance of population-specific arch width assessment to support accurate, evidence-based orthodontic treatment planning in African populations.

Keywords: Dental arch width; Orthodontic patients; Pre-treatment asses; Tertiary health facility

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ORIGINAL ARTICLE

Introduction

Orthodontic diagnosis and treatment planning rely heavily on accurate evaluation of dental and skeletal parameters, among which arch width is a critical determinant.[1] Arch width describes the transverse dimension of the dental arches and directly influences space availability, occlusal relationships, facial aesthetics, and long-term treatment stability.[2,3] Decisions regarding arch expansion, extraction therapy, or non-extraction approaches are largely guided by pre-treatment arch width assessment.[4,5]

Malocclusion remains a major public health concern globally, with epidemiological studies reporting prevalence rates ranging from 56% to over 75% in children and adolescents, and approximately 30–45% of these individuals present with moderate to severe malocclusion requiring orthodontic intervention.[6–8] Transverse discrepancies, including reduced arch width and posterior crossbite, account for an estimated 8–23% of orthodontic problems, emphasising the clinical importance of arch width evaluation during treatment planning.[9,10]

Several studies have demonstrated that reduced maxillary or mandibular arch width is strongly associated with dental crowding, while increased arch width may influence post-treatment if not properly managed.[11,12] Differences in arch width have

also been shown to vary by sex, age, ethnicity, and craniofacial pattern, with males generally exhibiting wider arches than females and significant inter-population variations reported across Caucasian, Asian, and African groups.[1,13]

Despite this, most available normative data on arch width are derived from non-African populations, limiting their applicability in African clinical settings. Evidence suggests that African populations tend to have broader dental arches compared with Caucasian populations.[14,15] Yet, orthodontic treatment planning in many tertiary facilities continues to rely on reference values derived from external populations. This mismatch may contribute to suboptimal treatment outcomes, including instability and relapse.

Tertiary health facilities serve as major referral centres and manage a high volume of orthodontic cases, offering a representative pool for evaluating dental arch characteristics. Establishing baseline arch width measurements among pre-treatment orthodontic patients in such settings is essential for developing population-specific reference values, improving diagnostic precision, and guiding evidence-based orthodontic care.

This study, therefore, seeks to determine the arch width of pre-treatment orthodontic patients attending a tertiary health facility, providing locally relevant data that may enhance treatment planning, optimise clinical outcomes, and contribute to the existing body of orthodontic literature.

Materials and methods

Study Design

This descriptive cross-sectional study was conducted at the Orthodontic Clinic of the University of Benin Teaching Hospital (UBTH). This tertiary health facility provides specialised orthodontic care and serves as a major referral centre to the Benin Metropolis and neigbouring states such as Ondo and Delta.

Study Population

The study population consisted of pre-treatment orthodontic patients attending the Orthodontic clinic of the University of Benin Teaching Hospital (UBTH). A total of 150 patients were included in the study. Pre-treatment maxillary and mandibular dental casts obtained before the commencement of any orthodontic treatment were used for analysis.

Inclusion and Exclusion Criteria

Patients with complete permanent dentition up to the first molars and well-preserved pre-treatment dental casts were included. Dental casts that were fractured, or had missing teeth affecting the measurement landmarks were excluded.

Data Collection

Maxillary and mandibular dental arch widths were measured on the pre-treatment dental casts using a digital fibre composite caliper calibrated to the nearest 0.01 mm. The following parameters were assessed:

- Intercanine arch width, defined as the linear distance between the cusp tips of the right and left permanent canines.
- Intermolar arch width, defined as the linear distance between the mesiobuccal cusp tips of the right and left permanent first molars.

All measurements were taken under standardised conditions to reduce measurement error.

Figure 1: Measurement of maxillary intermolar width using digital caliper

Figure 2: Measurement of mandibular intercanine width using digital caliper

Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 27. Descriptive statistics were used to compute the means, standard deviations, and ranges of maxillary and mandibular intercanine and intermolar arch widths. Statistical significance was set at a p-value of < 0.05.

Ethical Considerations

Ethical approval for the study was obtained from the Health Research and Ethics Committee of the University of Benin Teaching Hospital. Patient confidentiality was strictly maintained.

Results

Table 1: Sociodemographic Characteristics of the Study Population

Variables	Frequency (n=150)	Percentage (%)
Sex		
Male	56	37.3
Female	94	62.3
Age group(years)		
≤13	76	50.8
>13	74	49.2
Mean ± SD	17.92 ± 9.05	

A total of 150 pairs of maxillary and mandibular dental casts were included in the study. The mean age of the participants was 17.92 ± 9.05 years. Participants aged 13 years or younger were 76 (50.8%), while those older than 13 years were 74 (49.2%). Females constituted the majority of the study population, accounting for 94 participants (62.3%), whereas males were 56 (37.3%

Table 2: Arch Width Distribution According to Gender (N = 150)

Arch width (mm)	Male (Mean ± SD)	Female (Mean ± SD)	p-value
Maxillary			
Inter-canine width	35.65 ± 4.05	33.61 ± 3.50	0.041*
Inter-molar width	40.83 ± 3.58	39.37 ± 3.66	0.134
Mandibular			
Inter-canine width	27.87 ± 2.32	26.50 ± 3.32	0.088
Inter-molar width	34.43 ± 3.42	33.95 ± 3.71	0.610

Statistically significant (p < 0.05).

Male dental casts demonstrated higher mean values for all maxillary and mandibular arch width parameters compared with females. The mean maxillary inter-canine width among males was 35.65 ± 4.05 mm, which was significantly higher than the corresponding value of 33.61 ± 3.50 mm observed among females (p = 0.041). The mean maxillary inter-molar width was 40.83 ± 3.58 mm in males and 39.37 ± 3.66 mm in females, although this difference was not statistically significant (p = 0.134).

For the mandibular arch, the mean inter-canine width was 27.87 ± 2.32 mm in males compared with 26.50 ± 3.32 mm in females (p = 0.088), while the mean inter-molar width was 34.43 ± 3.42 mm among males and 33.95 ± 3.71 mm among females (p = 0.610). These differences were not statistically significant.

Table 3: Arch Width Distribution According to Age Group (N = 150)

Arch width (mm)	≤13 years (Mean ± SD)	>13 years (Mean ± SD)	p-value
Maxillary			
Inter-canine width	34.97 ± 3.73	33.77 ± 3.88	0.222
Inter-molar width	40.00 ± 3.29	39.83 ± 4.09	0.861
Mandibular			
Inter-canine width	27.58 ± 2.71	26.43 ± 3.29	0.141
Inter-molar width	34.10 ± 3.30	34.17 ± 3.91	0.940

Among participants aged 13 years or younger, the mean maxillary inter-canine width was 34.97 ± 3.73 mm, compared with 33.77 ± 3.88 mm among those older than 13 years (p = 0.222). The mean maxillary inter-molar width was 40.00 ± 3.29 mm in the younger age group and 39.83 ± 4.09 mm in the older group (p = 0.861).

In the mandibular arch, participants aged 13 years or younger had a mean inter-canine width of 27.58 ± 2.71 mm, while those older than 13 years had a mean value of 26.43 ± 3.29 mm (p = 0.141). The mean mandibular inter-molar width was 34.10 ± 3.30 mm in the younger group and 34.17 ± 3.91 mm in the older group (p = 0.940). No statistically significant age-related differences were observed in any arch width parameter.

Table 4: Comparison of Mean Arch Widths by Anterior Arch Form

Arch width (mm)	Spacing (Mean ± SD)	p-value	Crowding (Mean ± SD)	p-value	Normal (Mean ± SD)	p-value
Maxillary						
Inter-canine width	35.30 ± 4.09	0.190	33.75 ± 4.26	0.305	34.22 ± 2.58	0.840
Inter-molar width	41.70 ± 3.33	0.007*	39.04 ± 3.46	0.305	39.28 ± 3.79	0.383
Mandibular						
Inter-canine width	27.65 ± 2.35	0.258	27.04 ± 4.07	0.959	26.33 ± 1.75	0.259
Inter-molar width	36.05 ± 3.63	0.003*	32.88 ± 3.22	0.026*	33.89 ± 3.20	0.735

Statistically significant (p < 0.05).

Casts with anterior spacing, crowding, and normal anterior arch forms showed comparable mean maxillary inter-canine widths, with values of 35.30 ± 4.09 mm, 33.75 ± 4.26 mm, and 34.22 ± 2.58 mm, respectively, and no statistically significant difference was observed ($p > 0.05$). In contrast, the mean maxillary inter-molar width was highest among casts with anterior spacing at 41.70 ± 3.33 mm, compared with 39.04 ± 3.46 mm among casts with crowding and 39.28 ± 3.79 mm among those with normal anterior arch forms, and this difference was statistically significant ($p = 0.007$).

In the mandibular arch, the mean inter-canine widths for spacing, crowding, and normal anterior arch forms were 27.65 ± 2.35 mm, 27.04 ± 4.07 mm, and 26.33 ± 1.75 mm, respectively, with no statistically significant differences observed ($p > 0.05$). However, the mean mandibular inter-molar width was significantly greater in casts with anterior spacing at 36.05 ± 3.63 mm compared with those with crowding at 32.88 ± 3.22 mm ($p = 0.026$) and those with normal anterior arch forms at 33.89 ± 3.20 mm ($p = 0.003$).

Discussion

This study evaluated maxillary and mandibular arch widths among pre-treatment orthodontic patients attending a tertiary health facility, to provide locally relevant baseline data to guide orthodontic diagnosis and treatment planning. The findings demonstrate significant associations between arch width and sex as well as anterior arch form, while age showed no significant influence on transverse arch dimensions.

The overall arch width values observed in this study are consistent with findings from African populations, which have been reported to exhibit relatively broader dental arches compared with Caucasian populations. Mack[16] reported wider maxillary and mandibular arch dimensions among Nigerian orthodontic patients when compared with established Caucasian norms, attributing these differences to ethnic and genetic influences on craniofacial morphology. Similar observations were also made by Janson *et al.*[17] , who emphasised the limitation of applying foreign normative values to African orthodontic patients. These findings support the need for population-specific reference standards in orthodontic practice.

Sexual dimorphism in arch width was evident in this study, with males demonstrating consistently higher mean values for all arch width parameters, although statistical significance was observed only for maxillary inter-canine width. This pattern aligns with the findings of Aluko *et al.*[18] and Etetafia *et al.*[19], who reported significantly wider maxillary inter-canine and intermolar widths in males compared with females. Comparable results were also documented by Wankhede *et al.*[20] who attributed male predominance in arch width to larger skeletal dimensions, prolonged growth periods, and increased masticatory muscle strength. Although not all parameters reached statistical significance in the present study, the observed trend remains clinically relevant for individualized treatment planning.

Age did not significantly influence maxillary or mandibular arch widths in this study. This finding was different from findings from Salem *et al.*[21] in Egypt, which showed moderate growth in arch widths with increasing age. The lack of age-related variation observed in this study may therefore reflect the completion of transverse growth in the study population.

The relationship between arch width and anterior arch form revealed important clinical insights. While inter-canine widths did not differ significantly across spacing, crowding, and normal arch forms, intermolar widths were significantly greater in casts with anterior spacing and significantly reduced in crowded arches. These findings are consistent with those of Selmani and Gjorgova[22], who reported a strong association between reduced posterior arch width and dental crowding. Also, Osemwenkhae *et al.*[23] also showed that dental arch shape also significantly affected the severity and prevalence of dental crowding in a cohort of untreated orthodontic patients. Posterior arch width has been shown to contribute more substantially to arch perimeter and space availability than anterior width, explaining its stronger association with crowding and spacing

patterns.[24]

The significantly wider mandibular and maxillary intermolar widths observed in spaced arches further support the concept that transverse posterior dimensions play a crucial role in maintaining dental alignment.[1] Failure to adequately assess and manage posterior transverse deficiencies may therefore result in unstable treatment outcomes and increased relapse rates.[25]

The clinical implications of this study are particularly relevant in tertiary health facilities, where complex orthodontic cases are commonly managed. The use of locally derived arch width data may enhance diagnostic precision, guide appropriate selection of expansion or extraction protocols, and improve long-term treatment stability. This is especially important in African populations, where broader arch forms may allow for more conservative, non-extraction approaches when appropriately assessed.[14]

Limitations

This study has some limitations. The use of dental casts, while reliable for measuring dental arch widths, does not assess underlying skeletal transverse relationships or soft tissue influences. This was mitigated by employing standardised anatomical landmarks and calibrated digital calipers to ensure measurement accuracy. Additionally, the single-centre nature of the study may limit generalisability; however, the inclusion of a relatively large and diverse sample of pre-treatment orthodontic patients enhances the representativeness of the findings.

Conclusion

This study established baseline maxillary and mandibular arch width measurements among pre-treatment orthodontic patients in a tertiary health facility. Arch width varied significantly by sex and anterior arch form, with males demonstrating wider arches and posterior arch width playing a significant role in spacing and crowding, while age showed no significant influence. These findings highlight the importance of population-specific arch width assessment in orthodontic diagnosis and support evidence-based treatment planning in African orthodontic populations.

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Conflict of Interest - None to declare

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