Reliability and application of Pont's index in a Nigerian population

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Abstract

Objective: To determine the reliability and applicability of Pont index in Nigerian subjects.

Methods: One hundred and thirty two subjects with normal occlusion (well aligned arches) and who had not previously received any form of orthodontic treatment were recruited from the dental diagnosis clinic and general out-patient clinic of the University College Hospital, Ibadan. Ethical approval was sought and gotten from the University of Ibadan/ University College Hospital, Ibadan Ethics Committee. All selected subjects had their maxillary impression made in alginate impression material and was poured immediately in dental stone. Digital calipers was used in measuring the maxillary incisal teeth sizes and arch width and all the data were entered into a spread sheet and analyzed with SPSS version19 computer software. The level of confidence was set at $p < 0.05$.

Results: The mean age was 22.24 ± 1.74 years and the sample comprise of 66 males and 66 females. Mean maxillary inter – premolar and inter – molar arch widths were 41.87 ± 2.70mm and 51.47 ± 2.69mm respectively. Comparison of measured and predicted (Pont) arch widths revealed a statistically significant differences of 2.32 ± 3.20mm ($p = 0.000$) and 2.03 ± 3.83mm ($p = 0.000$) for inter-premolar and inter-molar arch widths respectively for the entire studied population

Conclusion: Pont's index underestimated the maxillary inter-premolar and inter-molar arch width in our study. Clinical applicability of Pont index in our environment is questionable.

Keywords: *Pont's index, Arch width, inter-premolar and inter-molar.*

Résumé

Objectif: Pour déterminer la fiabilité et l'applicabilité de l'indice du Pont chez des sujets Nigérians.

Méthodes: Cent trente-deux sujets ayant une occlusion normale (arcs bien alignés) et qui n'avaient jamais reçu de traitement orthodontique ont été recrutés dans la clinique de diagnostic dentaire et dans la clinique générale du Collège Hospitalier Universitaire d'Ibadan. L'approbation éthique a été demandée et obtenue duComité Ethique de l'Université d'Ibadan / Collège Hospitalier Universitaire, Ibadan. Tous les sujets sélectionnés avaient leur impression maxillaire réalisée en matériau d'empreinte d'alginate et ont été versés immédiatement dans la pierre dentaire. Des calibres numériques ont été utilisées pour mesurer la taille des dents incisales maxillaires et la largeur de l'arc et toutes les données ont été saisies dans une feuille de calcul et analysées avec le logiciel SPSS version19. Le niveau de confiance était fixé à $p < 0,05$.

Résultats: L'âge moyen était de $22,24 \pm 1,74$ ans et l'échantillon comprenait 66 hommes et 66 femmes. Les écartements moyens desarcs inter - prémolaires et inter - molaires maxillaires ont été $41,87 \pm 2,70$ mm et $51,47 \pm 2,69$ mm respectivement. La comparaison des écartements d'arc(Pont) mesurées et prédites a révélé des différences statistiquement significatives de $2,32 \pm 3,20$ mm ($p = 0,000$) et de $2,03 \pm 3,83$ mm ($p = 0,000$) pour les écartements inter-prémolaires et inter-molaires respectivement pour l'ensemble de la populationétudié.

Conclusion: L'indice de Pont a sous-estimé l'écartement inter-prémolaire et inter-molaire maxillaire de l'arc dans notre étude. L'applicabilité clinique de l'indice de Pont dans notre environnement est discutable.

Mots-clés: *Indice de Pont, Ecartement d'arc, inter-prémolaires et inter-molaires.*

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Introduction

The analysis of the tooth bone ratio of the arches is an important aspect of clinical orthodontics. A precise or accurate assessment and analysis of the arches especially in the mixed dentition stages is required for appropriate treatment planning and alignment of the teeth. In a situation of crowded arches, interdental stripping, expansion of the arches [1] and or extractions of teeth are procedures by which space is created on the arch to align the teeth.

Though, non-extraction therapy in orthodontics is currently being emphasized [2] and this has resulted in a reduction in the number of teeth extracted for orthodontic reasons [3]. Arch expansion has been documented to have been used to treat Angle's class I malocclusion subjects satisfactorily, though, this is dependent on the level of severity of crowding [1]. The level of arch width expansion required to achieve any desirable and stable result post treatment has being an issue of controversy [4] and this has led to the introduction of various indices to guide the clinician in predicting the ideal arch width required to produce a stable arch [5]. Some of these indices were proposed by Bonwill, Hawley, Pont, Schwarz, Korkhaus and McNamara [5]. Pont described a method which predetermines the maxillary arch width in the premolar and molar region using the maxillary incisors. This method of predetermining the maxillary arch with is today known as the "Pont's index'. He assumed a constant relationship between the sum of maxillary incisor widths and the widths of the dental arch in an ideal uncrowded dentition using an undisclosed sample of French population [6]. The Pont method of predetermining arch width has been found to be reliable in some societies and or races while in others, it is said to be unreliable [5-9]. Though, this is not surprising as he had already stressed that ethnicity and race [9] are likely to affect the reliability of his index hence he advised that it should be tested in other ethnic and racial groups for reliability. Also, he felt that arch width determination during orthodontic treatment planning was not based on teeth measurement alone. Other factors to consider include facial profile, Angle's classification, relationship of the arches and the midline [6].

Therefore, this study aimed to evaluate the reliability of the Pont's index in a sample of Nigerian population with normal occlusion

Materials and methods

The study was cross sectional and descriptive in design. It was conducted among 132 consenting consecutive individuals of age 18years and 25years who fulfilled the selection criteria and who were attending the dental and general out-patient clinics of the University College Hospital, Ibadan. Ethical approval was sought and obtained from the University of Ibadan/University College Hospital Ethics Committee.

The following criteria were used to select the studied population;

- Subjects of Yoruba decent in Nigeria (at least of two generation)
- Subjects aged 18years – 25years old.
- Subjects with full complement of the permanent dentition.
- Subjects with normal skeletal and dental anteroposterior and vertical relationships.
- Subjects with normal tooth-bone ratio.
- Normal maxillary first premolar and molar inclination shape and sizes.
- No missing teeth and no presence of supernumerary teeth.
- No history of previous orthodontic treatment
- No history of major jaw surgeries
- No history of sickle cell disease and cleft palate
- Absence of obvious transverse jaw discrepancy
- No history of sucking habits
- Subjects with no peg shaped lateral incisors.
- No dental caries or teeth fracture related to the maxillary incisors, first premolars and first permanent molars.
- No dental restoration related to the maxillary incisors, first premolars and first permanent molars.

The sample size was calculated as 132 subjects based on a significance level of 0.05 and a power of 95% confidence using the equation;

$$n = \frac{z^2 \, SD^2}{d^2}$$

(Betty and Kirkwood[10])

n= the desired sample size

z= the standard normal deviation (1.96) corresponds to a 2-sided level of significance of 5%

SD= the standard deviation of arch width measured in a pilot population (30 randomly selected Individuals) = 1.41mm

d = Precision (assume 18% of standard deviation, assumption of not more than 20% suggested for accuracy) = 0.252

All selected eligible subjects had their maxillary arches impression made with alginate impression material (elastic cromo, spofadental) and disinfection with cidex (2% glutaraldehyde) for five minutes. The impressions were poured immediately in dental stone (Kerr orthodontic model mix stone type). The set cast model was then carefully retrieved from the impression to avoid breakage or crack of any of its parts especially the dental structures (teeth). Each model was then serialized and kept in a safe place.

The landmarks for measurements of the arch width as demonstrated by Pont were located manually and the measurements were done using

electronic caliper with sharpened beaks (CB Mitutoyo corp. Tokyo Japan, accuracy of 0.01mm).

• Mesio-distal width of the maxillary incisors (MWMI) – mesio-distal width of the maxillary central incisors and the lateral incisors were measured from one anatomical contact point (mesial) to the other (distal) at a level of the widest portion of the tooth [6].

• Maxillary Inter-premolar Width (MIPW) – measured from the distal pit of the maxillary right first premolar to the distal pit of the maxillary left first premolar [6].

• Maxillary Inter-molar Width (MIMW) – measured from the depth of the central fossa of the maxillary right first molar to the central fossa on the maxillary left first molar [6].

In cases of mild attrition, the landmark for the measurement was determined using the middle of the wear facet on the tooth [6].

To determine intra-observer reliability associated with measurements, 20 cast models of the sample subjects were randomly selected and they were measured and re-measured at 2 weeks interval

also entered into the spreadsheet;
Prediction of arch width by Pont;
Inter-premolar arch width = SI × 100/80
Inter-molar arch width = SI × 100/64
Where SI is the sum of the mesio-distal widths of the maxillary incisors [6]

Statistical analyses were performed using the Statistical Package for Social Sciences software (Windows version 19; SPSS Inc., Chicago, IL, USA). Level of significance was set at 5%. Independent t-test was used to compare means of measure inter-premolar and inter-molar arch widths between males and females subjects and dependent t-test was used to compare measured and predicted means of arch widths (inter-premolar and inter-molar) among the total sample, males and females.

Results

The gender distribution of the sample was 66 males and 66 females with a mean age of 21.62 ± 1.67 years and 22.86 ± 1.60 years respectively. The mean age of all the subjects is 22.24 ± 1.74 years. Mean

Table 1: Mean arch widths and comparison of gender arch widths

Arch width	Mean maxillary Arch widths Total sample(mm)	Male mean maxillary arch width (mm)	female mean maxillary arch width (mm)	Mean difference (male and female) (mm)	P value
Inter-Premolar	41.87 ± 2.70	42.48 ± 2.62	41.26 ± 2.67	1.22 ± 0.46	0.009*
Inter-molar	51.47 ± 2.69	52.14 ± 2.27	50.79 ± 2.93	1.35 ± 0.46	0.004*

*P < 0.05 statistically significant

Table 2: Comparison of measured and predicted (Pont) arch widths in the studied sample (Reliability)

Arch width	Measured arch widths (mm)	Predicted (Pont) arch width (mm)	Mean difference (mm)	P value
Inter-Premolar	41.78 ± 2.70	39.55 ± 2.58	2.32 ± 3.20	0.000*
Inter-molar	51.47 ± 2.69	49.44 ± 3.22	2.03 ± 3.83	0.000*

*P < 0.05 statistically significant

by the same observer. The mean differences between the first and repeated measurements were not significantly different from zero. The error margin using Dahlberg's equation [11] ranges from 0.06mm to 0.27mm for tooth size width measurements and 0.08mm to 0.32mm for arch width dimensions. These values were found not to be statistically significant.

Arch width were also predicted using Pont's formula as stated below and predicted values were

maxillary arch widths observed for the studied population were 41.87 ± 2.70mm and 51.47 ± 2.69mm for inter-premolar width and inter-molar width respectively. In relation to gender, the mean maxillary widths observed for males were 42.48± 2.62mm and 52.14 ± 2.27mm for inter-premolar width and inter-molar width respectively. While that for females were 41.26 ± 2.67mm and 50.79

±2.93mm for inter-premolar width and inter-molar width respectively. (Table1).

Comparison of measured and predicted (Pont) arch widths revealed a difference of 2.32 ± 3.20mm and 2.03 ± 3.83mm for inter-premolar and inter-molar arch widths respectively for the studied population (Table 2). In relation to gender, the comparison of measured and predicted (Pont) arch widths revealed a difference of 2.56 ± 3.25mm and 2.26 ± 3.69mm for inter-premolar and inter-molar arch widths for males subjects and 2.09 ± 3.16mm and 1.81 ± 3.99mm for inter-premolar and inter-molar for females respectively (Table 3).

for inter-premolar and inter-molar arch widths respectively for males subjects and 2.09 ± 3.16mm (p = 0.000) and 1.81 ± 3.99mm (p = 0.000) for inter-premolar and inter-molar respectively for females (Table 3). The reliability was also found to be greater with the inter-molar width than width the inter-premolar width with statistically significant differences of 1.22 ± 0.46mm (p = 0.009) and 1.35 ± 0.46mm (p = 0.004) observed for inter-premolar and inter-molar widths respectively between males and females subjects (Table 1).

Comparing our study with other global studies we found similar Pont's index value underestimation in [6,12-15]. Contrary to our findings, overestimation

Table 2: Comparison of measured and predicted (Pont) arch widths in male and female subjects (Reliability)

Arch width	Measured arch widths widths (mm)	Male Predicted (Pont) arch width (mm)	Mean difference (mm)	P value	Measured arch widths (mm)	Female Predicted (Pont) arch width (mm)	Mean difference (mm)	P value
Inter-Pm	42.40±2.66	39.84±2.56	2.56±3.25	0.000*	41.34±2.66	39.25±2.58	2.09±3.16	0.000*
InterMolar	52.06±2.37	49.81±3.20	2.26±3.69	0.000*	50.87±2.88	49.06±3.23	1.81±3.99	0.000*

*P < 0.05 statistically significant

Discussion

The Pont's index is a simple tool which provides considerable guidance on arch width in clinical orthodontic practice. It has been evaluated by different authors in literature and its clinical application has been questioned by some authors whose observations in their various studies do not agree with that of Pont [5-9] therefore; its clinical applicability is controversial.

In this study, Pont's index was found to have underestimated the arch width for Nigerians (p = 0.000). Comparison of measured and predicted (Pont) arch widths revealed a statistically significant differences of 2.32 ± 3.20mm (p = 0.000) and 2.03 ± 3.83mm (p = 0.000) for inter-premolar and inter-molar arch widths respectively for the entire studied population (Table 2). There was scarcity of literature regarding the applicability of this index in our environment as none was found in literature therefore, we could not compare our result with other local study. Though, Pont underestimation of the studied population made its applicability in clinical practice unacceptable in our environment, the index was found to be more reliable in predicting maxillary arch width in females than in males. The comparison of measured and predicted (Pont) arch widths revealed a statistically significant differences of 2.56 ± 3.25mm (p = 0.000) and 2.26 ± 3.69mm (p = 0.000)

was observed in other ethnicities and races [7-9,16-18]. The findings from our study further confirms documented evidence in literature of variations in Pont estimation of maxillary arch widths [19,20] and Pont [9] reservations concerning his study when he said his observations is likely to be affected by ethnic and racial variations hence the index should be tested in other populations.

The maxillary arch width observed in this study 41.87mm and 51.47mm for both inter-premolar and inter-molar respectively was different from that observed in a similar Nigerian study in Lagos by Aluko *et al* [19]. The difference was attributed to protocol in arch landmarks. While our study strictly observed Pont [6] protocol in arch landmarks, Aluko et al relied on the buccal cusp tip of premolars and mesio-buccal cusp tips of the molars as the landmarks for their study resulting in a value difference of 4.0mm and 5.0mm for the premolar and molar measurements in both studies respectively.

Male subjects were found to have wider arch widths than females and this confirms other documented evidence in literature about gender dimorphism in arch width [19,20].

Conclusion

Pont's index underestimated the maxillary inter-premolar and inter-molar arch width in our study.

Its clinical applicability especially when orthodontic arch expansion is needed and it cannot solely be relied upon in our environment.

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