

Modified Pont's index for a Nigerian population

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Abstract

Objective: Pont's index is a tool that is of great value in clinical orthodontic treatment planning especially in ethnic and racial groups where its applicability in predicting arch width (interpremolar and intermolar) is excellent. Thus in ethnicities and races where its use has not being beneficial, a modification of the index in such populations might be necessary.

Materials and methods: Samples of 132 consenting and consecutive patients dental casts with normal occlusion (well aligned arches) who had not previously received any form of arch alignment treatment were assessed using a digital sharpened beaks callipers' which measured the cast tooth sizes and arch width. All data was entered into a spread sheet and analysis was done with SPSS version19 computer software. The level of confidence was set at $p < 0.05$.

Result: The mean mesiodistal width of the right central incisor was found to be 8.76 ± 0.61 mm and 8.73 ± 0.59 mm on the left. Mesiodistal width of right lateral incisor was 7.10 ± 0.55 mm while that of the left was 7.04 ± 0.58 mm. Mean maxillary arch widths observed for the studied population were 41.87 ± 2.70 mm and 51.47 ± 2.69 mm for inter-premolar width and inter-molar width respectively. Pont's ratio for inter premolar and inter molar widths was 0.76 and 0.61 respectively.

Conclusion: Pont's ratio for inter premolar and inter molar (0.80 and 0.64) is different from that gotten for the present population studied. With a modified index for this population; maxillary inter premolar and inter molar ratio equals 0.76 and 0.61 respectively.

Key words: Pont's index, Arch width, inter-premolar and inter-molar.

Abstract

Objectif : L'indice de Pont est un outil précieux pour la planification du traitement orthodontique clinique, en particulier dans les groupes ethniques et raciaux,

où son applicabilité dans la prédiction de la largeur de l'arcade (inter-prémolaire et inter-molaire) est excellente. Ainsi, dans les ethnies et les races où son utilisation n'a pas été bénéfique, une modification de l'indice dans de telles populations pourrait être nécessaire.

Matériaux et méthodes : Des échantillons de 132 modèles dentaires de patients consentants et consécutifs avec occlusion normale (arcades bien alignées) qui n'avaient auparavant reçu aucun traitement d'alignement des arcades ont été évalués à l'aide d'un compas digital à bec effilé qui mesurait la taille des dents coulées et la largeur de l'arcade. Toutes les données ont été entrées dans un tableur et l'analyse a été réalisée avec le logiciel informatique SPSS version 19. Le niveau de confiance a été fixé à $p < 0,05$.

Résultat : La largeur méso-distale moyenne de l'incisive centrale droite était de $8,76 \pm 0,61$ mm et de $8,73 \pm 0,59$ mm à gauche. La largeur méso-distale de l'incisive latérale droite était de $7,10 \pm 0,55$ mm alors que celle de la gauche était de $7,04 \pm 0,58$ mm. Les largeurs moyennes des arcades maxillaires observées pour la population étudiée étaient de $41,87 \pm 2,70$ mm et de $51,47 \pm 2,69$ mm pour la largeur inter-prémolaire et la largeur inter-molaire, respectivement. Le rapport de Pont pour les largeurs inter-prémolaires et inter-molaires était de 0,76 et 0,61 respectivement.

Conclusion : Le rapport de Pont inter-prémolaire et inter-molaire (0,80 et 0,64) est différent de celui obtenu pour la population actuelle étudiée. Avec un index modifié pour cette population ; Le rapport maxillaire inter-prémolaire et inter molaire est égal à 0,76 et 0,61 respectivement.

Mots clés : Index de Pont, largeur de l'arche, inter-prémolaire et inter-molaire.

Introduction

Tooth size arch length discrepancy is a form of malocclusion that presents when there is insufficient space on the dental arch to accommodate all the teeth present, leading to a displacement of the contact point of teeth. This problem is frequently encountered in clinical orthodontics and has a prevalence of up to 36% among Nigerian populations [1-3]. Precise tooth size arch length discrepancy analysis, especially in the mixed dentition stage is a panacea for appropriate treatment planning. The clinical options to get arch

space that is open to an orthodontist in the treatment of a crowded arch may include interdental stripping, expansion of the arches, and or tooth extraction [4]. One or a combination of these methods will serve as adjunct for solving the tooth size arch length discrepancies.

Non-extraction of tooth or teeth in unravelling crowding is gradually gaining preference and being emphasized [5] therefore, this has resulted in a reduction of teeth extracted for orthodontic reasons [6]. Arch expansion an alternative to extraction of teeth has been used for treating class I malocclusion crowding cases satisfactorily, though, this depends on the level of severity of the crowding [6]. In treating these cases, the amount of arch expansion required to produce a stable post treatment result has been an issue of controversy [7] and to solve this controversy different indices have been brought to the fore to guide the clinician in predicting the ideal arch width an individual requires to produce a stable arch [8]. One of these indices is the Pont's index. Pont described a method which predetermines the maxillary arch width in the premolar and molar region using the mesiodistal widths of maxillary incisors, and it has been proven by authors [8-12] to have underestimated ideal arch widths in many populations. Thus, the aim of this study was to modify the Pont's index to accurately predict ideal arch widths in a Nigerian population having been found to be inaccurate in its prediction in this same population [13].

Materials and methods

This was a cross sectional and descriptive study of 132 consenting consecutive individuals of age 18years and 25years. The study was conducted at dental and general out-patient clinics of a tertiary health care facility in the south west region of Nigeria. Ethical approval was sought and obtained from University of Ibadan/University College Hospital Ethics Committee (UI/EC/13/0235).

The following inclusion criteria were used for participant's selection;

- 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.

All participants that met the inclusion criteria had their maxillary and mandibular arches impression made in alginate impressions material (elastic cromo by spofa dental a.s). Cast models were made from the alginate impression using dental stone (Kerr orthodontic model mix stone type) following disinfection of the impression with Cidex (2% glutaraldehyde). The set cast model was then carefully retrieved to avoid damages in any form. Each model was then serialized and kept in a safe place.

The landmarks for measurements of the arch width as demonstrated by Pont [9] were located manually as stated below and the measurements were done using electronic calliper with sharpened beaks (CB Mitutoyo corp. Tokyo Japan, accuracy of 0.01mm).

- Mesiodistal width of the maxillary incisors (MIMDW) – mesiodistal 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 [9].
- Maxillary Interpremolar Width (MIPW) – measured from the distal pit of the maxillary right first premolar to the distal pit of the maxillary left first premolar [9].
- Maxillary Intermolar 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 [9].

In cases of mild attrition, the landmark for the measurement was determined using the middle of the wear facet on the tooth [9].

Intra-observer reliability associated with measurements was determined by randomly selecting 20 cast models of the sample subject. These casts were measured using a sharpened beak digital calliper and they were re-measured at 2 weeks

interval 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 (14) ranges from 0.08mm to 0.15mm for tooth size width measurements and 0.11mm to 0.34mm for arch width dimensions. These findings indicated that experimental errors were generally small and unlikely to cause bias in the result.

The predicted arch widths were calculated for each subject and also entered into the spread sheet

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 the study population was found to be 22.24 ± 1.74 years.

Table 1: Mesiodistal widths of maxillary incisors of subjects in the study population

Tooth	Right				Left			
	Range (mm)	Mean (mm)	*SD (mm)	*CV (%)	Range (mm)	Mean (mm)	*SD (mm)	*CV (%)
Central incisor	7.33 - 11.01	8.76	0.61	6.96	7.50 - 10.44	8.73	0.59	6.76
Lateral incisor	5.78 - 8.37	7.10	0.55	7.75	5.78 - 8.37	7.04	0.58	8.24

*SD: Standard deviation, *CV: Coefficient of variation.

Table 2: Mesiodistal widths of teeth measured in male and female subjects.

Tooth	Male		Female		Gender difference		PValue
	Mean (mm)	*SD (mm)	Mean (mm)	*SD (mm)	Mean (mm)	*SD (mm)	
RCI	8.81	0.57	8.71	0.65	0.10	0.01	0.165
LCI	8.80	0.56	8.67	0.62	0.13	0.01	0.297
RLI	7.15	0.58	7.05	0.52	0.10	0.01	0.135
LLI	7.12	0.57	6.96	0.60	0.16	0.01	0.241

*SD-Standard deviation. RCI – Right Central Incisor, LCI – Left Central Incisor, RLI – Right Lateral Incisor, LLI – Left Lateral Incisor

All measurements were entered into a spread sheet and 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 measured 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.

Prediction of arch width by Pont [9];

Inter-premolar arch width = $SI \times 100/80$

Inter-molar arch width = $SI \times 100/64$

Where SI is the sum of the mesio-distal widths of the maxillary incisors

The mean mesiodistal width of the right central incisor was found to be 8.76 ± 0.61 mm and 8.73 ± 0.59 mm on the left. Mesiodistal width of right lateral incisor found was 7.10 ± 0.55 mm and 7.04 ± 0.58 mm on the left (Table 1).

Generally, the mean mesiodistal widths of the maxillary central and lateral incisors were observed to be larger in males than females (Table 2). The difference in mean mesiodistal widths of central incisors between male and female was observed to be 0.10 ± 0.01 mm on the right side ($p=0.165$), while it was found to be 0.13 ± 0.01 mm on the left side ($P=0.297$). For lateral incisors, the difference in mean mesiodistal width between the two gender groups was found to be 0.10 ± 0.01 mm on the right side ($p=0.135$) and 0.16 ± 0.01 mm on

Table 3: 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*

Table 4: Modified Pont's index for the study population.

Arch widths (mm)	Mean value (mm)	Mean sum of incisors (mm)	Ratio of sum of maxillary incisors to maxillary arch widths
Interpremolar	41.87 ± 2.70	31.64 ± 2.06	0.76
Intermolar	51.47 ± 2.69	31.64 ± 2.06	0.61

the left side ($p=0.241$). All these differences were statistically insignificant (Table 2)

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

width and inter-molar width respectively. While that for females were 41.26 ± 2.67 mm and 50.79 ± 2.93 mm for inter-premolar width and inter-molar width respectively. Statistically significant differences of 1.22 ± 0.46 mm ($p = 0.009$) and 1.34 ± 0.46 mm ($p = 0.004$) were observed for interpremolar and intermolar widths respectively between males and females subjects (Table 3).

Table 5: Pont's ratio for different populations.

Study	Sample size	Population	Findings	Verdict
Pont (1909)	Not available	French	Premolar index 80 Molar index 64	
Joondeph (1970)	30	Germans	Premolar index 84 Molar index 65	Disagree with Pont.
Gupta <i>et al.</i> (1979)	100	North Indians	Premolar index 81.66 Molar index 65.44	Agree with Pont
Prasad, Valiathan (1994)	100	Indian (50) Chinese (50)	Premolar index 83.86 Molar index 66.36 Premolar index 80.27 Molar index 63.97	Agree with Pont
Karanth, Jayade (1998)	50	Tibetan	Premolar index 79.56 Molar index 61.64	Agree with Pont
Kim, Lee (2000)	119	Korean	Premolar index 81.96 Molar index 62.55	Disagree with Pont
Shrestha, Pradhan (2006)	100	Nepalese	Premolar index 79.60 Molar index 63.36	Agree with Pont
Agnihotri, Gulati (2008)	100	North Indians	Premolar index 81 Molar index 65	Agree with Pont
Dhokal, Shrestha (2014)	100	Nepalese	Premolar index 80.51 Molar index 63.65	Agree with Pont
Agneska, Dalia (2015)	52	Lithuanians	Premolar index 85.57 Molar index 66.24	Disagree with Pont
Present Study	132	Nigerians	Premolar index 76 Molar index 61	Disagree with Pont

Pont ratio, which is the ratio of sum of maxillary incisors to maxillary arch width, was calculated and found to be 0.76 for interpremolar arch width as opposed to 0.80 observed by Pont among a French population. For intermolar arch width, a ratio of 0.61 was observed as opposed to 0.64 observed by Pont among his own population (Table 4).

Discussion

The relationship between the sum of maxillary incisors and maxillary arch widths were used by Pont to generate a mathematical expression [9]. In this study, the ratio of mean sum of maxillary incisors to the mean arch widths (interpremolar and intermolar) recorded an index value of 0.76 and 0.61 respectively. These index values are different from that proposed by Pont. Pont proposed an index value of 0.80 for interpremolar arch width and 0.64 for intermolar arch width from a French population. Hence, there is an overestimation of the inter premolar and inter molar width by Pont by an index difference of 0.04 and 0.03 respectively. The difference in the index values between the present study and that reported by Pont could be due to racial variation in mesiodistal tooth widths and dental arch width across populations [13, 15].

Since no literature on the modified Pont's index among Nigerians exists, thus no mathematical expression of the relationship of the sum of maxillary incisors and maxillary arch widths has been reported and also there was no mathematical expression within similar racial group to compare with. Though, the index values reported in this study was different from those that have been reported in literature. These includes; Gupta *et al.* [16] among Indians who reported 0.82 and 0.65 as values for predicting inter premolar and inter molar arch width prediction respectively, Kim and Lee [17] reported 0.82 and 0.63 for a Korean population, Agnihotri and Gulati (18) reported 0.81 and 0.65 for northern Indian population, and more recently, Rathi and Fida [15] reported 0.85 and 0.66 among Karachi subjects, as index values for predicting inter premolar and inter molar widths respectively. Therefore the index values observed from the various studies [15-18] is greater in both the inter premolar and inter molar arch width when compared to the current study. The interpretation of this is that the ratio of the tooth width size of the maxillary incisors compared to the arch width in Nigerians is smaller when compared to that of other races [15-18]. The difference in these values reported by other studies and that found in this study corroborate the mesiodistal tooth width

and dental arch width variation across races and ethnic groups [19]. In the current study, there is a statistically significant difference between gender in relation to the inter premolar and inter molar width. This difference in arch width has been reported by many authors where they observed males as having a larger inter premolar and inter molar width as compared to females which is also the case in this present study (Table 3). The difference in inter premolar and inter molar width is due to established significant gender dimorphism of human teeth [20]. Therefore, using the sum of the four maxillary incisors teeth width to predict the maxillary dental arch width according to Pont is bound to produce a difference in arch width size. The various studies in the literature over time have shown different verdict of Pont's ratio among different population as reported in Table 5.

Conclusion

Having found that Pont's index (1909) underestimated ideal arch widths in a Nigerian population, it was necessary to modify the index so as to accurately predict arch widths in this same population.

Modified index for this population were; maxillary interpremolar width equals sum of maxillary incisors divided by 0.76, as opposed to 0.80 in the real Pont's index, and maxillary intermolar width equals sum of maxillary incisors divided by 0.61 as opposed to 0.64 observed by Pont.

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