Pont's Index Is Not Exact Science: A Reappraisal

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ABSTRACT

Background: Pont's Index was established to predict maxillary dental arch width from the sum of the mesiodistal diameters of the four maxillary incisors (interincisal width) of the French population. However, the use of Pont's Index in predicting ideal arch shape in orthodontics has been controversial due to racial differences. Pont suggested that the reliability of this Index be tested in other populations. Another objection to Pont's Index is that it doesn't take into account the subjects' craniofacial framework.

Materials and Methods: This reappraisal reviews literature on Pont's Index, with an emphasis on the application of the Pont's Index in various ethnic groups, especially non-Caucasians. Sixteen articles included in this study were identified by a literature search of Medline (1944 - Dec 2009) using predetermined key words, inclusion and exclusion criteria.

Results: The majority of the papers (75%) disagreed that Pont's index can be used to predict maxillary arch width. Out of the papers that disagreed, 50% of the papers reported Pont's index overestimates the maxillary arch width and 42% of the papers reported Pont's index underestimates the maxillary arch width. There is a lack of studies that correlate the craniofacial framework to the Pont's Index.

Conclusion: Most predictions based on Pont's Index either underestimated or overestimated the inter-premolar and inter-molar widths.

KEY WORDS

Pont's Index, maxilla, arch, ethnic

INTRODUCTION

In the clinical dentistry, arch size and shape are of particular interest to orthodontists. Therefore a variety of diagnostic indices have been proposed to help predict dental arch growth and assist with treatment planning. This is important because dental arch expansion in one of the method used to solve the dental crowding problem by non-extraction. However, dental arch expansion is a procedure where stability (hence final outcome) has always been controversial. Because of this, many formulate, indices and methods using tooth size have been proposed to predict the ideal inter premolar and inter molar size for the purpose of arch expansion. They have been suggested to guide clinicians in predicting the ideal arch width (hence the expansion) required to alleviate dental crowding.

Among them are the Pont's method, Linder's method, Korkhaus's method, Schmuth's method, Cha's method, Schwarz analysis, and the McNamara rule of thumb. All these researchers found that certain correlation exists between the arch length, width, and mesiodistal width of the upper maxillary incisors. Because of these correlations, these different formulae tried to provide ideal arch length and/or width prediction using the sum of mesiodistal (interincisal) widths of maxillary incisors. The standard values of the indices can be used to statistically correlate and compare with the actual values of the individual case. Certain diagnostic and prognostic indications such as deviation in transverse development of the arch widths and anteroposterior position of incisors can be gained by comparison of the actual and standard values.

Among the method that has gained resurgence in interest for establishing dental arch development objectives is the Pont's method. Dalidjan et al. suggested that its simplicity and apparent practicality have been very attractive to some dentists, particularly those inspired by entrepreneurial short courses of instruction. These non-specialists believed that Pont's Index can be used to determine the genetic potential of dental arch width despite studies providing scientific evidence that it is not clinically reliable. Pont's Index, established in 1909, reported a constant ratio between tooth sizes and arch widths in French population which came to be known as premolar and molar indices. These indices were established to predict maxillary dental arch width from the sum of the mesiodistal diameters of the four maxillary incisors. According to Pont, in ideal dental arches the ratio of combined mesiodistal incisal width to transverse arch width was 80 in the premolar area and 64 in the molar area. Unfortunately, Pont obtained his data from an ill-defined French population and did not even indicate the size of his sample. Nevertheless, he was aware of possible differences between races and ethnic groups and suggested that the reliability of this Index be tested in other populations.

There has been a large amount of controversy in the application of Pont's Index. The main concerns include the applicability of this index in different races and skeletal structure.

Therefore, the objective of the present systematic review was to evaluate the effectiveness of Pont's index in estimating arch width in various studies and its correlation with other craniofacial features.

MATERIAL AND METHODS

The articles used in this review were obtained by a literature search of Medline (1944 - Dec 2009). The terms used in this literature search were "Ponts", "Ponts Index", "Arch width", "Craniofacial Correlation" and "Incisor size". Using the titles of articles and where available, abstracts from Medline search, full - length articles were analyzed. From the references in these articles other relevant litera-
ture was accessed through the University Malaya dental library and University of Sheffield dental library.

To be included in this review, the article had to

a) Use Pont's index to calculate arch width
b) Population or sample adequately described
c) Be in English or there is an English translation of the paper
d) Published in form of paper and not abstract.

The selection process was done independently by two authors and their results were compared to settle discrepancies through discussion.

RESULTS

The independent searches by 2 experienced researchers produced 31 potential papers and a core of 16 papers were agreed by the 2 authors as meeting the criteria. Papers were commonly excluded because they were not in English or English translation was not available, they did not include Pont's index and one paper was excluded because the same results were presented in another paper.

The summary of the studies are listed in Table 1.

Although most of the studies reported Pearson Correlation (r), the figure was not comparable between the studies because of the very varied approach applied by the authors. For example some of the studies reported the correlation “r” between the individual incisor and calculated arch width, between width of arch end and beginning of orthodontic treatment, between calculated and observed arch width, between sum of incisor and arch width, between the amount of crowding (crowding index) and arch width and even between the sum of upper incisors and lower incisors. Therefore we reported whether the study agreed or disagreed on the use of Pont's index to predict the arch width in the table. If the study disagreed we classified whether it over or underestimated the arch width.

Of all the 16 papers reviewed, the majority of them (12) disagreed that Pont's index can be used to reliably predict the maxillary arch width. Out of these 12 papers, 6 papers reported it overestimated the arch size whilst 5 papers reported that it underestimates the arch size. Interestingly one paper reported that it overestimated the premolar width but underestimated the molar width.

DISCUSSION

The applicability of Pont's Index

The usefulness of Pont's Index is controversial. There have been different opinions on the applicability of Pont's Index in populations apart from the French (Table 1). Some investigators have supported its use as a guide in expanding the dental arch and as a determinant of arch development. Agnihotri and Gulati in a recent study reported a significant and definite correlation between the widths of four maxillary incisors and arch width found in the Northern Indian population, indicating parallelism with Pont's figures. Their Pont's values were 81 and 65 for premolar and molar indices respectively, which confirmed the indices, reported 3 decades earlier by Gupta et al. on another Northern Indian population. Their study have also taken the impact of "sex factor" into consideration, with the premolar index found to be 82 for males and 79.54 for females and the molar index found to be 66.10 for males and 63.42 for females. This confirmed the notion of a difference in arch width between genders. The debate on the differences in arch width between genders has been inconclusive. Several studies that have reported a greater arch width in males than in females in the British, Colombian, Saudi Arabian, Malay, and Northern Indian, are in disagreement with the findings for the Egyptian population. Stifter, in his study on Navaho Indians, concluded that there was a significant correlation between the interincisal distance and the interpreamolar and intermolar widths in ideal occlusion, but not in normal occlusion. Because of this variation, some researchers made modifications to the indices: for example, different index values of 84 and 65 have been proposed for the German and 81.66 and 65.44 for the Northern Indian.

In contrast, other researchers have found very low correlations between observed and predicted arch widths, even on Caucasian populations and have concluded that Pont's Index was not a reliable diagnostic procedure for planning orthodontic treatment. Studies conducted on non-Caucasians, like Indonesians, Korean, Jordanians, Iraqis, Southern (Singaporean) Chinese and Malays indicated that these indices were not useful to pre-determine ideal arch width in these populations. For example, the Pont's formula tended to overestimate the interpreamolar width (premolar index = 81.96) but underestimated the intermolar width (molar index = 62.55) of the Korean. In contrast, Lew reported that the predicted interpreamolar and intermolar arch widths in the Southern (Singaporean) Chinese were smaller (underestimated).

In Dalidjan et al. study that evaluated Pont's Index in the untreated, non-crowded samples of Australian Aborigines, Indonesians, and White, a considerable individual variability was noted in each population with regard to the difference between measured values and Pont's estimates, ranging from -5.9 mm to +6.2 mm in interpreamolar width and -6.1 mm to +12.7 mm in intermolar width. Similar comparable results were reported by Thu et al. among the Malays. None of the subjects of these 2 studies displayed ideal arch dimensions predicted by Pont's Index, but values were within +/- 1.0 mm for 17.5% of the Indonesian sample, 20.6% of the Aboriginal sample, 30.8% of the White sample, and 19.5 to 20.7% in the Malays. Dental arch width was generally underestimated by the Index in Indonesians who tended to display relatively small tooth size and large arch width. A more even distribution of estimates was noted in Australian Aborigines and Caucasian subjects, with the Aborigines showing large tooth sizes and broad dental arches, and the White subjects displaying smaller tooth size and narrow arches. Interestingly, the indices for the Malay tends to be higher than the original Pont's Index (estimated premolar index = 90; molar index = 67.7, calculated based on their data). The premolar index is especially high among the Malay, partly contributed by their small interpreamolar width. As a result, Pont's indices consistently over-estimated the dental arch widths. Naturally, because of the large discrepancies between the observed and expected values in these 2 studies, correlation coefficients computed were low.

The variations observed may possibly be attributed to the different genetic inheritance of the different races, as the Indonesians, Southern (Singaporean) Chinese, Malay and Korean are Mongoloid while Jordanians and Iraqis are Arabs.

Craniofacial Influence to Pont's Index

Alvaran et al. found the Pont's Index to be less reliable than results computed on multiple regressions. However, while their predictors were better than previously reported using the regression model, they left much of the variation unexplained, indicating that additional determinants of arch width remain to be identified. One of the objections against the Pont's Index is that it doesn't take into account the subjects' craniofacial framework. However, it had to be noted that Pont did emphasize the importance of facial profile, Angle's classification, midline, and relationship of one jaw to the other, though he did not explain whether or not he factored in these parameters in his study. He also postulated that there were certain relationships between the form of the skull (dolichocephalic, mesiocephalic and brachycephalic) and the form of the dental arch, but again, he never elaborated further on this subject, unlike Schwarz's analysis which factored in the facial type in the calculation.

There are 4 studies on the validation of Pont's Index that had incorporated an analysis of relationship to various craniofacial measurements. The study to obtain craniofacial measurements is termed craniofacial anthropometry. Craniofacial anthropometry is the science that is specifically dedicated to the measurement of human skull and face and provides valuable information on differences in shape and size of the skull and face of different race, age and sex.

Serg et al. found that face (zygomatic) width (zy-zy) exhibited the highest correlation to Pont's Index. However, a recent study conducted by Alvaran et al. may have wider ranging implications due to the correlation coefficient of 0.82 between facial width and interpreamolar width. The strong correlation in the former study may be because the data were obtained from the models and anthropological measurements of 50 adult German subjects with fairly eugnathic dentition. In addition, although Thu et al. incorporated the physical feature of their subjects' head shape (based on cephalic index) into their study, they did not correlate it with the Pont's Index, probably because of the weak association to the face width.

Alvaran et al. using standardized regression coefficients,
reported that mandibular width (bigonial breadth/go-go) was the most important predictor for inter-premolar width \( r = 0.85 \) and inter-molar \( r = 0.82 \). Nevertheless, they found Pont's Index was not reliable as it did not factor in the effect of mandibular width into the formula.

Lew investigated whether a relationship existed between Pont's Index and mandibular plane angle, in a group of 48 Chinese adult subjects with orthodontically untreated excellent Class I dental occlusion and good facial balance. His results showed a weak correlation between the combined mesiodistal maxillary incisor widths and the inter-premolar \( r = 0.27 \) and inter-molar arch widths \( r = 0.21 \). The correlation between mandibular plane angle and inter-premolar distance was not significant. Their dental arch widths showed a good correlation with Pont's Index.

**CONCLUSION**

Most predictions based on Pont's Index either underestimated or overestimated the inter-premolar and inter-molar widths. This reappraisal found no strong evidence to suggest that Pont's Index could be...
used reliably in Asian populations. More studies on various ethnic groups that take into consideration their craniofacial framework, should be undertaken to ascertain the usefulness of this prediction index in Asian populations.

REFERENCES