



Pont's Index, is it Reliable and Applicable for Iraqis?

Hiba M. Hussien⁽¹⁾
Shahbaa A. Mohammed⁽²⁾
Layth M. K. Nissan⁽³⁾
Mohammed Nahidh^{(4)*}

^(1,2,3,4)Department of Orthodontics, College of Dentistry, University of Baghdad, Iraq.

Keywords:

Bolton's ratio, Pont's index, arch width.

Article Info.:

Article History:

Received: 27/6/2023

Received in revised form:
6/7/2023.

Accepted: 9/7/2023

Final Proofreading: 9/7/2023

Available Online: 1/6/2024

© THIS IS AN OPEN ACCESS ARTICLE
UNDER THE CC BY LICENSE

<https://creativecommons.org/licenses/by/4.0/>



Citation: Hussien HM, Mohammed SA, Nissan LM, Nahidh M. Pont's Index, is it Reliable and Applicable for Iraqis?. Tikrit Journal for Dental Sciences 2024; 12(1): 165-171.

<https://doi.org/10.25130/tjds.12.1.18>

***Corresponding Author:**

Email:

m_nahidh79@yahoo.com

Tel: 00964-7702551616

(4) Department of
Orthodontics, College of
Dentistry, University of
Baghdad, Baghdad, Iraq

Abstract

To facilitate the correct diagnosis and treatment planning, a range of diagnostic orthodontic indices have been developed. Pont's index, as one of them, was documented to estimate the ideal maxillary dental arch widths from the sum of crown widths of maxillary incisors. This retrospective study aimed to evaluate the applicability of Pont's index to Iraqi individuals.

Fifty stone dental models for 25 females and 25 males were retrieved from the archives of the Department of Orthodontics in Baghdad College of Dentistry. The dental arch widths at the level of 1st premolar and molar areas in addition to the mesiodistal crown widths of all teeth were measured using an electronic vernier. The estimated arch widths were compared to the actual ones using paired sample t-test.

The results showed highly significant differences between the actual and estimated maxillary inter-premolar and intermolar widths with over-estimated values in both genders. New formulas were developed to make Pont's index more reliable, and the newly estimated widths were non-significantly different from the actual one. The original Pont's index is an unreliable and inapplicable method for arch width prediction. A specific modification of Pont's index is developed and can be applied for more reliable results.

Introduction:

The knowledge of variable tooth size discrepancies is very important. These discrepancies must be well identified to obtain a good orthodontic diagnosis and subsequently, a precise orthodontic

treatment planning followed by best treatment results. The presence of such variations can affect orthodontic treatment plans so either reduction of the teeth mass, augmentation by cosmetic options, or

elimination of selected units to get full benefits of appliance usage⁽¹⁻²⁾.

Normal occlusion is impossible unless teeth are matched for size. Variations of upper lateral incisors might be the most probable cause of disharmony in size between the upper and lower teeth, oddity of other teeth like the premolars also could be a contributing factor⁽³⁾.

The diagnostic methods in orthodontics did not develop and improve, unlike treatment techniques, thus, even now, dental casts play a crucial role as a diagnostic tool in the field of orthodontics, and the classical old analysis can be beneficial in orthodontic diagnoses such as Pont's index and Bolton tooth size analysis for correct maxillary and mandibular mesiodistal tooth size relationship in the finishing stage of treatment⁽⁴⁾. Pont in 1909 recommended a technique of predetermining the ideal dental arch width that has become known as "Pont's index", he suggested a consistent association between the maxillary permanent incisors width and the arch width measured between the premolars or molars. These indices were counted by dividing the sum of the maxillary incisor widths $\times 100$ by the respective arch widths. Based on a sample with an ideal occlusion, the values of 80 and 64 were determined for the premolar and the molar indices, respectively⁽⁵⁾.

Several studies of various ethnic backgrounds have evaluated the applicability of Pont's index. Most of them revealed that this index is not reliable, and the original maxillary and mandibular arch forms should be considered as the definitive guide for arch width rather than the values arrived at by using Pont's index⁽⁶⁻³⁸⁾. In Iraq, there are many races including Arabs, Kurds, Turkmen, etc. Two previous studies were conducted on individuals from Mousel and Kurdistan areas and revealed that this index is not reliable^(28,38).

This study aims to verify the applicability and reliability of Pont's index in a sample of Iraqi Arab subjects. The tested null hypothesis proposed that Pont's index could predict the ideal arch widths among Iraqi Arabs.

Materials and Methods

Sample

In this retrospective study, stone dental models for 50 subjects (25 females and 25 males) were retrieved from the archive of the Department of Orthodontics, College of Dentistry, University of Baghdad. The inclusion criteria for sample selection included the followings:

1. All subjects are Iraqi Arabs.
2. Age ranges between 18 and 25 years.
3. Full set of permanent dentitions (excluding the third molars).
4. Normal dental relationships in three planes of space.
5. No previous orthopedic, orthodontic, or orthognathic intervention.

While the excluding criteria included:

1. Crowding and spacing of more than 2mm.
2. Anomalies in teeth number or form, so the Bolton ratio was applied.
3. Models with fractures, voids, or defects.

Methods

Firstly, the mesiodistal crown widths of all teeth except the second molars were measured using an electronic digital vernier (S.H®, China) with 0.01mm sensitivity at the greatest contact points to obtain the anterior and overall Bolton's ratios as followed⁽³⁹⁻⁴⁰⁾:

Anterior Bolton ratio= Crown width of mandibular 6 anterior teeth*100/ Crown width of 6 maxillary anterior teeth

Overall Bolton ratio= Crown width of 12 mandibular teeth*100/ Crown width of 12 maxillary anterior teeth

The second step was measuring the maxillary dental arch widths directly on the models at the level of the 1st premolars (IPW) from the distal ends of the occlusal groove and first molars (IMW) from the mesial pits occlusal (Fig. 1).

The third step was applying Pont's index to calculate the estimated inter-premolar and

inter-molar widths by applying the following formulas⁽⁴¹⁾:

Estimated Inter-premolar width = the collected width of the four maxillary incisors*100/80.

Estimated Inter-molar width = the collected width of the four maxillary incisors*100/64.

The fourth step was developing new formulas if the results proved a significant difference between the actual and estimated dental arch widths.

Statistical analysis

The data were analyzed using SPSS version 24. Inter and intra-observer reliability was tested by the intra-class correlation coefficient. Descriptive statistics were applied then a comparison was conducted using paired and unpaired sample t-tests. The probability value was set at 0.05.

Results

Inter and intra-examiner reliability was tested using intra-class correlation coefficient on ten pairs of study models with high reliability (0.93 and 0.97 for inter and intra-examiner respectively)

Descriptive and inferential statistics of Bolton's ratios for both genders were shown in Table (1). Females showed non-significant higher mean values in comparison with the male participants.

The actual (measured) and estimated maxillary dental arch widths were presented in Table (2). The results indicated that there was a highly significant method difference ($p \leq 0.001$) with over-estimated values.

A modification of the Pont's index was developed by dividing the sum width of maxillary incisors by the actual inter-premolar and inter-molar widths respectively, so the results were 92 and 73.29 for males while they were 90 and 72 for females. These modifications were applied, and the results of the newly estimated dental arch widths were compared to the actual ones and the findings proved non-significant method difference as shown in Table (3).

Discussion

Determination of the teeth size ratio is of enormous importance that needs to be routinely measured in orthodontic practice before starting any orthodontic treatment to localize any difference in tooth size for anterior and overall⁽⁴²⁾.

Estimation of dental arch widths based on Pont's index depends on the mesiodistal dimensions of the maxillary incisors crowns, so any discrepancy in the shape, size, and number of these teeth will affect the results. To exclude this factor, the Bolton ratios were determined, and results revealed that the values of these ratios in both genders were similar to the previous Iraqi studies^(39,40,42-44) with insignificant gender difference ($p > 0.05$). In an earlier study that investigated the effect of dental arch widths, lengths, and perimeter on the Bolton ratios, Al-Ansari et al.⁽⁴⁴⁾ found non-significant relation between these parameters and the major determinant factors is the mesiodistal width of the teeth that may be affected by the genetic or environmental factors. It had been suggested by Bolton that a tooth size ratio > 1 SD from the reported mean values indicated a need for diagnostic consideration. In the present study, the mean values are within this range.

Pont had previously claimed in 1909 that an optimal arch width is required to accommodate the dentition and relieve crowding. This width can be calculated by assuming a constant relationship between the mesiodistal widths of the maxillary permanent incisors and the widths of the inter-premolar and intermolar arch widths. According to Pont, the required arch width in the premolar area is by dividing the sum of the maxillary incisor by 0.80, thus obtaining premolar width. In the same way, intermolar width also can be calculated by dividing the sum of maxillary incisors by 0.64⁽⁵⁾. This type of analysis has many drawbacks that included:

1. Congenital missing maxillary lateral incisors are frequent⁽⁴⁵⁾.
2. Peg-shaped or small maxillary lateral incisors⁽⁴⁵⁾.
3. This index was developed and applied exclusively to the French population.

4. Skeletal mal-relationships were not taken into consideration.
5. The relationship of the teeth to the supporting bone, maxillary to mandibular arch dimension, or the difficulties in increasing the mandibular arch dimensions were not accounted for.

To verify the applicability and reliability of this index, researchers worldwide conducted many studies about this analysis on different ethnic groups and different types of malocclusion, and in most of these studies, the finding indicated low reliability of this analysis and cannot be applied without modification ⁽⁶⁻³⁸⁾. The present study evaluated this index's reliability and applicability for the maxillary arch of Iraqi Arabic subjects. Previously, two studies were conducted on two different ethnic groups and their findings come in accordance with the findings of the current study. Many important factors can determine the dental arch width like the arch shape itself, the presence of bad oral habits or pathology that affect the oronasal passages and may cause mouth breathing, in addition, the role of genetic factors that determine the facial and dental dimensions ⁽⁴⁶⁾. Applying the original formulas of Pont's on the Iraqi subjects in the current

study revealed significantly overestimated dental arch widths by about 4-8 mm. just like the results of the aforementioned studies (Table 2). To improve the reliability of this index, a modification was introduced by multiplying the sum width of the maxillary anterior teeth by 0.92 and 0.73 for males and 0.90 and 0.72 for females to get the corrected estimated inter-premolar and intermolar widths which were then compared with the corresponding actual dental arch widths (Table 3). The results from the corrected formulas revealed a non-significant method difference indicating that by this correction Pont's index can be applied reliably to the Iraqi sample.

The limitations of the present study that should be considered in the future are including a larger sample size with different dental and skeletal patterns.

Conclusions

Pont's index can be applied for estimating arch width in Iraqi subjects with a specific modification, the original Pont's index is an unreliable and inapplicable method for arch width prediction.

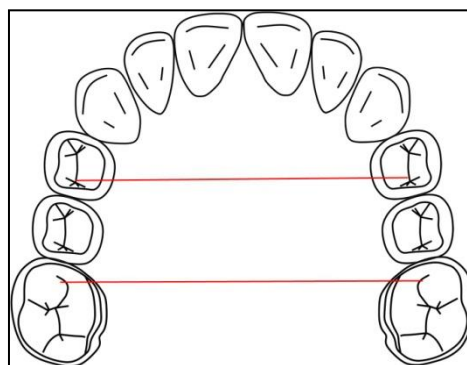


Fig. (1): The inter-premolar and intermolar widths

Table (1): Bolton's ratios in both genders

Bolton's ratios	Descriptive statistics				Gender difference		
	Male		Female		Mean difference	t-test	p-value
	Mean	S.D.	Mean	S.D.			
Overall	91.864	3.628	92.473	3.481	-0.609	-0.606	0.548
Anterior	79.536	5.031	80.212	3.908	-0.676	-0.531	0.598

Table (2): Comparison of the actual and estimated dental arch widths based on the original Pont's index

Gender	Parameters	Descriptive statistics				Method differences		
		Actual Width (mm.)		Estimated Width (mm.)		Mean difference	t-test	p-value
		Mean	S.D.	Mean	S.D.			
Male	IPW	37.348	3.763	42.695	3.878	-5.347	-6.276	≤0.001
	IMW	46.796	3.618	54.713	4.697	-7.916	-7.923	≤0.001
Female	IPW	36.316	2.711	40.765	2.963	-4.449	-6.239	≤0.001
	IMW	45.264	2.433	52.319	3.803	-7.055	-7.906	≤0.001

Table (3): Comparison of the actual and estimated dental arch widths based on the modified Pont's index

Gender s	Parameters	Descriptive statistics				Method differences		
		Actual Width (mm.)		Estimated Width (mm.)		Mean difference	t-test	p-value
		Mean	S.D.	Mean	S.D.			
Males	IPW	37.348	3.763	37.126	3.372	0.222	0.278	0.783
	IMW	46.796	3.618	47.777	4.101	-0.981	-1.070	0.295
Female s	IPW	36.316	2.711	36.236	2.634	0.080	0.120	0.906
	IMW	45.264	2.433	46.345	3.369	-1.081	-1.317	0.200

References

1. Cançado RH, Gonçalves Júnior W, Valarelli FP, Freitas Km, Crêspo JA. Association between Bolton discrepancy and Angle malocclusions. *Braz Oral Res* 2015; 29(1): 1-6.
2. Akyalçın S, Doğan S, Dinçer B, Erdinc AME, Öncəğ G. Bolton tooth size discrepancies in skeletal Class I individuals presenting with different dental angle classifications. *Angle Orthod* 2006; 76(4): 637-643.
3. Santoro M, Ayoub ME, Pardi VA, Cangialosi TJ. Mesiodistal crown dimensions and tooth size discrepancy of the permanent dentition of Dominican Americans. *Angle Orthod* 2000; 70(4): 303-307.
4. Proffit WR, Fields HW Jr., Larson BE, Sarver D.M. *Contemporary orthodontics*. 6th ed. Philadelphia: Elsevier, 2019.

5. Pont A. Derzahn-index in der orthodontie. Zeitschrift für Zahnärztliche Orthopaedie 1909; 3: 306-321.
6. Sergl HG, Reinhardt R, Zentner A, Schmidt J. A dental arch index related to tooth size and facial breadth. Fortschr Kieferorthop 1944; 55(3): 119-125.
7. Stifter J. A study of Pont's, Howe's, Ree's, Neff's and Bolton analyses on Class I adult dentitions. Angle Orthod 1958; 28(4): 215-225.
8. Greve K. Über die Gültigkeit des Pont'schen Index. Cited by: Moorrees CFA. The dentition of the growing child: a longitudinal study of dental development between 3 and 18 years of age. Cambridge, Mass, Harvard University Press; 1959.
9. Worms F, et al. The validity of Pont's index as an orthodontic diagnostic tool. Abstracted, IADR Program and Abstracts No. 691 March 1969.
10. Joondeph DR, Riedel RA, Moore AW. Pont's index: a clinical evaluation. Angle Orthod 1970; 40(2): 112-118.
11. Worms FW, Speidel TM, Isaacson RJ, Meskin LH. Pont's index and dental arch form. J Am Dent Assoc 1972; 85(4): 876-881
12. Gupta DS, Sharma VP, Aggarwal SP. Pont's Index as applied on Indians. Angle Orthod 1979; 49(4): 269-271.
13. Marshall K. An investigation into Pont's index and arch width changes. M.Sc. thesis. Health Sciences University, Portland, Ore, USA, 1987.
14. Berg R. Der Pont Index-- Ein Diskussionsbeitrag [Pont's index--a discussion]. Inf Orthod Kieferorthop 1991; 23(2): 163-166.
15. Lew K. The effect of variations in the mandibular plane angle on the Pont's index. Funct Orthod 1991; 8(2): 24-27.
16. Dalidjan M, Sampson W, Townsend G. Prediction of dental arch development: an assessment of Pont's index in three human populations. Am J Orthod Dentofacial Orthop 1995; 107(5): 465-475.
17. Nimkarn Y, Miles PG, O'Reilly MT, Weyant RJ. The validity of maxillary expansion indices. Angle Orthod 1995; 65(5): 321-326.
18. Kim SH, Lee KS. An evaluation of the adequacy of Pont's Index. Korean J Orthod 2000; 30(1): 115-126.
19. Al-Omari IK, Duaibis RB, Al-Bitar ZB. Application of Pont's index to a Jordanian population. Eur J Orthod 2007; 29(6): 627-631.
20. Ordoubazary M, Zafarmand AH, Madani A, Ordoubazary A. Comparison of Pont's and Korkhaus indices at different populations. Hellenic Orthod Rev 2007; 10(2): 67-74.
21. Hong Q, Tan J, Koirala R, et al. A study of Bolton's and Pont's analysis on permanent dentition of Nepalese. J Hard Tissue Biol 2008; 17(2): 55-62.
22. Agnihotri G, Gulati M. Maxillary molar and premolar indices in North Indians: A dimorphic study. Internet J Biol Anthropol 2007; 2(1): 1-5.
23. Alvaran N, Roldan SI, Buschang PH. Maxillary and mandibular arch widths of Colombians. Am J Orthod Dentofacial Orthop 2009; 135(5): 649-656.
24. Sridharan K. Evaluation of validity of Pont's analysis in Tumkur population. J Dental Sci Res 2011; 2(1): 41-49.
25. Celebi AA, Tan E, Gelgor IE. Determination and application of Pont's index in Turkish population. Sci World J 2012; 2012: 494623.
26. Purmal K, Alam MK, Cheong NW. Pont's index is not exact science: A reappraisal. Int Med J 2013; 20(2): 204-207.
27. Purmal K, Alam MK, Moganadass DD, Zakariat NN, Cheong NW. The application and correlation of Pont's index to the facial framework of three main ethnic groups in Malaysia. Aust Orthod J 2013; 29(1): 34-42.
28. Al-Sarraf HA, Abdul-Mawjood AA, Al-Sayagh NM. Re-assessment of Pont's index in class I normal occlusion. Al-Rafidain Dent J 2013; 6(1): 1-5.
29. Rathi MK, Fida M. Applicability of Pont's index in orthodontics. J Coll Physicians Surg Pak 2014; 24(4): 256-260.
30. Alam MK, Purmal K, Begum S, Saifuddin M, Sikder M. Fallibility of Pont's index in a Bangladeshi population. Orthod Waves 2014; 73(2): 61-67.
31. Dhakal J, Shrestha RM, Pyakurel U. Assessment of validity of Pont's index and establishment of regression equation to predict arch width in Nepalese sample. Orthod J Nepal 2014; 4(1): 12-16.
32. Alam MK, Shahid F, Purmal K, Khamis MF. Cone-beam computed tomography evaluation of Pont's index predictability for Malay population in orthodontics. J Nat Sci Biol Med 2015; 6(Suppl 1): S113-S117.
33. Rykman A, Smaliene D. Application of Pont's index to Lithuanian individuals: a pilot study. J Oral Maxillofac Res 2015; 6(4): e4.
34. Sajib NH, Alam MK. Validity of Pont's analysis in a sample of Bangladeshi orthodontic patients. J Oral Res 2017; 6(2): 36-38.
35. Lohakare, S. Application of Pont's index to Gujrati population. J Med Sci Clin Res 2018; 6(8): 171-178.
36. Jehan S, Iftikhar A, Fayyaz R. Assessment of accuracy and reliability of Pont's index in different classes of dental malocclusion. Pak Orthod J 2021; 13(2): 72-76.
37. FeştilâD, Enache AM, Nagy EB, Hedeşiu M, Ghergie M. Testing the accuracy of Pont's index in diagnosing maxillary transverse discrepancy as compared to the University of Pennsylvania CBCT analysis. Dent J (Basel) 2022; 10(2): 23.
38. Mahmood TMA, Noori AJ, Aziz ZH, Rauf AM, Kareem FA. Scan aided dental arch width prediction via internationally recognized formulas and indices in a sample of Kurdish population/Iraq. Diagnostics (Basel) 2023; 13(11): 1900.
39. Saleem AE, Ghaib NH. Permanent tooth size ratio assessment for a sample of Iraqi patients aged 14-25 years with different malocclusion types. Iraqi Orthod J 2011; 7(1): 24-26.
40. Al-Huwaizi AF, Mehdi BS. Determination of normal and anterior overall ratio in an Iraqi sample. Iraqi Orthod J 2011; 7(1): 1-7.

41. Phulari BS. Orthodontics principles and practice. 2nd ed. New Delhi: Jaypee Brothers Medical Publishers; 2017.
42. Al-Duliamy MJ, Othman SS, Hussien FA. Comparison of Bolton's ratios in a sample of Iraqi and Egyptian populations. J Bagh Coll Dent 2016; 28(4): 172-175.
43. Nahidh M, Falih F, Ahmed N, Al-Dabagh DJ, Al-Sheakli II. Bolton's ratios in normal, spaced and crowded dental arches (Iraqi study). Indian J Public Health Res Develop 2019; 10(8): 2476-2481.
44. Al-Ansari NB, Abdul Ameer SA, Nahidh M. Do dental arches lengths, widths and perimeters affect Bolton's ratios? Indian J Public Health Res Develop 2019; 10(5): 1288-1293.
45. Sedeeq BI, Abdullah AG. Maxillary lateral incisors: different agenesis patterns. Tikrit J Dent Sci 2021; 9(1): 52-56.
46. Enlow DH, Hans MG. Essentials of facial growth. 1st ed. Philadelphia: W. B. Saunders Company; 1996.