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RESEARCH ARTICLE

VALIDITY OF PONT'S ANALYSIS IN A GROUP OF YEMENI POPULATION

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Abstract

Background and aims: Ever since the emergence of new orthodontics, numerous indices have been developed to predict normal maxillary arch widths. Accurate prediction is essential for resolving dental crowding, ensuring stable occlusion, and minimizing the likelihood of relapse. The aim of this study was to assess the validity of Pont's Analysis in a group drawn from the Yemeni population residing in Sana'a.
Methods: This cross-sectional study examined dental casts obtained from 100 Yemeni participants (62 males and 38 females) aged 18–25 years with normal occlusion. Measurements were conducted with a high-precision sliding caliper (accuracy: 0.01 mm). In addition to the mesiodistal lengths of the four upper incisors, arch widths were measured at the first premolar region (between distal pits) and the first molar region (between mesial pits). The statistical package for social science software was used to conduct the statistical analysis.
Results: The analysis revealed a statistically significant disparity between the measured and calculated arch widths. Pont's Index consistently overestimated arch widths in both males and females (p<0.000). Paired sample t-tests highlighted a mean difference of -2.19 mm for premolar widths (t=-5.302, r=0.023) and -2.03 mm for molar widths (t=-4.165, r=0.093).
Conclusions: The study concludes that Pont's Index is unsuitable for the Yemeni population in Sana'a due to its tendency to overestimate maxillary arch widths. These findings underscore the need for population-specific adjustments to Pont's Index to enhance its predictive accuracy.
Keywords: Arch width, incisor dimensions validity, Pont's index, Yemeni population.

INTRODUCTION

Treatment planning in orthodontics focuses on the optimization of the occlusion, that can be achieved by different techniques of extraction or non extraction especially in the Class I cases with crowding[1]. Space analysis is the analysis of the orthodontic models and is an important aspect of the orthodontic process. It quantifies both the extent and the severity of the malocclusion in three planes, which cannot be assessed by simple observation of the patient's oral cavity especially the lingual aspect. As pointed out by Arcas *et al.*[2], dental model study needs a correct impression of the patient dentition and the production of a high quality plaster model. Yet, choosing between them as well as defining which of the approaches is more effective in a particular situation might be challenging. It is hypothesized that extraction-based treatments are more stable in general, but that they can relapse after the long term, whereas non-extraction methods are rather effective but are considered to lack stability[3].
Nonsurgical phase treatments primarily consist of arch expansion which is laden with stability issues. To enable clinicians to estimate the degree of the required optimal arch width to address crowding, many indices and techniques have been suggested historically. Another of these indices, Pont's Index made by Pont's in 1909=SI/the sum of the mesiodistal widths of the permanent maxillary incisors and the interpremolar or intermolar arch widths.
The sample size he used in determining his proposed index but reported that the sample was from French nationality only[4]. Pont's index, which measures the intermaxillary distance between the mesial pits of the first molars and the distal pit of the first premolar, indicates a consistent ratio between the width of the maxillary arch and the width of the four maxillary incisors in a normal arch. According to his findings, the premolar and molar regions had width ratios of 0.80

and 0.64, respectively, between the width of the four maxillary incisors and the intermaxillary arch width. In orthodontic treatment, relapse happens frequently and for this reason, Pont's suggested expansion of the maxillary arch from 1-2 mm more than the normal arch to accommodate for treatment relapse.

Pont's index is obtained by the following equations:

$$\frac{(SI) \times 100}{80} = \text{Ideal interpremolar width}$$

$$\frac{(SI) \times 100}{64} = \text{Ideal intermolar width}$$

Several subsequent studies tried to validate Pont's index using different patient samples. The results of these studies resulted in variable results, either agreed or disagreed with Pont's index. Further analysis to validate the applicability of Pont's index in certain populations is needed to test if Pont's index can be considered in the treatment plan or probably using other more reliable methods could be a potential alternative[5]. The general objective of this study was to evaluate the validity of Pont's analysis in a group of Yemeni population in Sana'a city.

MATERIALS AND METHODS

Study design and location: A cross-sectional study was carried out in the Faculty of Dentistry, Sana'a University during the year 2023 from January to December 2023.

Inclusion criteria: Yemeni participants, aged from 18-25 years, Angle class I occlusal relationship with normal overbite and overjet (overbite < 4 mm, overjet < 3 mm), upper and lower dental arches that are well aligned, the full complement of teeth from second molar to second molar in both arches, the requirement that all permanent teeth be present (no extraction or congenitally missing teeth), and the absence of any fractures or severely carious lesions in any of the teeth.

Exclusion criteria: Participants with orthodontic appliances or history of orthodontic treatment, history of extractions, systemic disease affecting growth, abnormal dental conditions (e.g. impactation, congenitally missing teeth)

Ethical Considerations: The current study approved by the Ethical Committee of the Faculty of Dentistry, Sana'a University, Yemen. An ethical approval reference number (OR: 19/05/2024). Authority to carry out the study was sought from the Dean of the School of dentistry, Sana'a University. Participants were informed about the study and informed consent was taken from each one and they could refuse this without stating any reason. All the information obtained was kept confidential. Each participant was given numeral codes and stored under password to enhance confidentiality.

Data collection: The participants of the study were clinically examined then alginate impressions were taken. Alginate impressions were taken for all participants and immediately poured using hard dental stone (both materials were sourced from the same protective company). Measurements of the study models were performed using a digital caliper with sharpened beaks, ensuring an accuracy of 0.01 mm.

1. **Maxillary Incisor Measurements:** By taking measurements from one anatomic contact point to another, the mesiodistal dimensions of the four maxillary incisors were determined.

2. **Maxillary Arch Width Measurements**:

Premolar Arch Width (Measured Premolar Value - MPV): Measured as the distance between the distal pits on the occlusal surfaces of the right first premolar and the left first premolar.

Molar Arch Width (Measured Molar Value - MMV): Measured as the distance between the mesial pits on the occlusal surfaces of the right first molar and the left first molar.

The Measurement Landmarks:

1. **Maxillary Interpremolar Width**: The distal pits of the maxillary first premolars.
2. **Maxillary Intermolar Width**: The mesial pits of the maxillary first molars.

The sum of mesiodistal dimensions of the four upper incisors were calculated for each cast.

The following equation was used to predict the arch Width:

Premolar width=Sum of mesiodistal dimensions of upper four incisors multiplied by 100/80.

Molar width=Sum of mesiodistal dimensions of upper four incisors multiplied by 100/64.

Statistical analysis: The collected data were coded and entered into the computer for analysis. The results were presented as mean, mode, standard deviation, percentages, and t-test results, along with tabular or graphical representations. To assess the accuracy of Pont's Index, a paired sample t-test was applied to determine the significance of the difference between the measured and calculated values for both premolar and molar widths. All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) software.

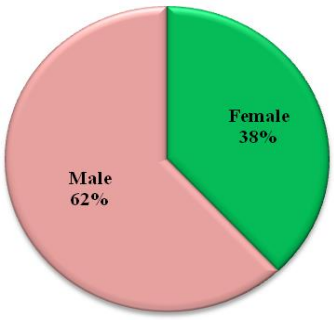

Figure 1: Gender distribution of the sample used to assess the validity of Pont's Analysis.

RESULTS

Measured premolar value of patients: The results of the distribution of the measured premolar values shown in Figure 1 showed that the largest number of patients was (from 35 to 40 mm) with a total number of (57) patients, representing (57%) of the total patients, then the group of measured premolar values (less than 35 mm) with a total number of (35) patients, representing (35%) of the total patients, while the last group of

measured premolar values was (more than 40 mm) with a total number of (8) patients, representing (8%) of the total patients.

Measured molar value of patients: The results of the distribution of the measured molar values shown in Figure 2 showed that the largest number of patients was (more than 40 mm) with a total number of (90) patients, representing (90%) of the total patients, then the group of measured molar values (from 35 to 40 mm) with a total number of (7) individuals, representing (7%) of the total patients, while the last group of measured molar values was (less than 35 mm) with a total number of (3) patients, representing (3%) of the total patients.

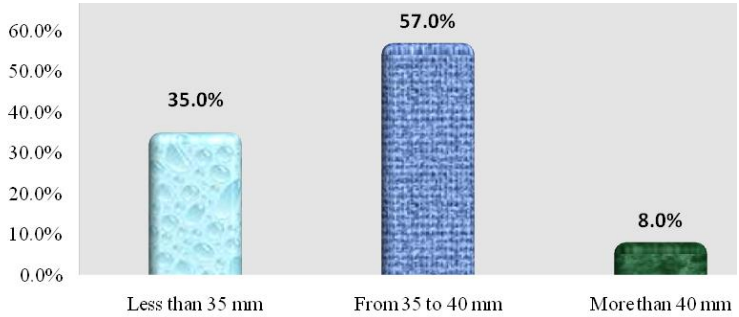

Figure 2: Measured premolar volume of patients.

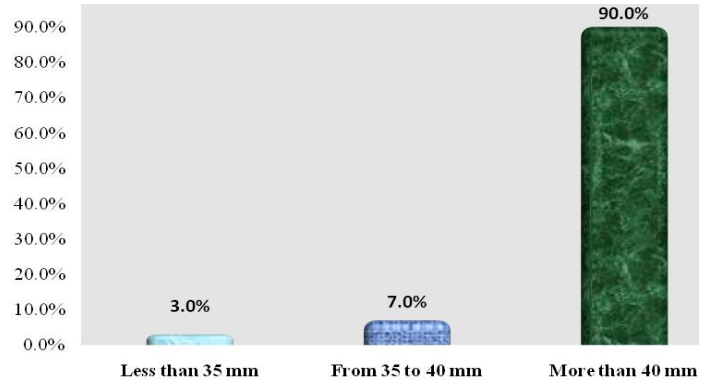

Figure 3: Molar values measured for patients residing in Sana'a city.

Measured maxillary incisors of patients

Right central distribution: The result of the right central distribution shown in Figure 3 illustrated that the greatest number of the patients was (More than 8 mm) with total number of (87) patients and represent (87%) of the total patients. Then the right central group (From 7 to 8 mm) with a total number of (13) individuals, representing (13%) of the total patients.

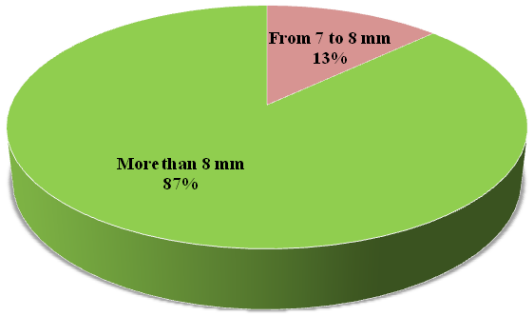

Figure 4: Right central distribution of measured maxillary incisors of study patients.

Left central distribution: The results of the left central distribution shown in Figure 4 showed that the largest number of patients was (more than 8 mm) with a total number of (83) patients, representing (83%) of the total patients, then the left central group (from 7 to 8 mm) with a total number of (16) individuals, representing (16%) of the total patients, while the last left central group was (less than 7 mm) with a total number of (1) patient, representing (1%) of the total patients.

Right lateral distribution: The results of the right lateral distribution shown in Figure 5 showed that the largest number of patients was (less than 7 mm) with a total of (77) patients, representing (77%) of the total number of patients, then the right lateral group (from 7 to 8 mm) with a total of (23) patients, representing (23%) of the total number of patients.

Left lateral distribution: The results of the left lateral distribution shown in Figure 6) showed that the largest number of patients was (less than 7 mm) with a total of (80) patients representing (80%) of the total number of patients, then the left lateral group (from 7 to 8 mm) with a total of (20) patients representing (20%) of the total number of patients.

Sum of incisors: The results of the distribution of the total incisors shown in Figure 7 showed that the largest number of patients was from (28 to 31 mm) with a total number of (59) patients, representing (59%) of the total patients, then the group of total incisors (more than 31 mm) with a total number of (33) patients, representing (33%) of the total patients, and finally the group of total incisors (less than 28 mm) with a total number of (8) patients, representing (8%) of the total patients.

Gender differences in orthodontic standards: Table 1 shows there are no statistically significant differences between males and females in the sum of SI, as the *p* value=0.975. The measured premolar value (MPV) statistically significant differences between males and females in the sum of MPV (*p*=0.004). The higher of the mean±SD has females was (36.8±3.71).

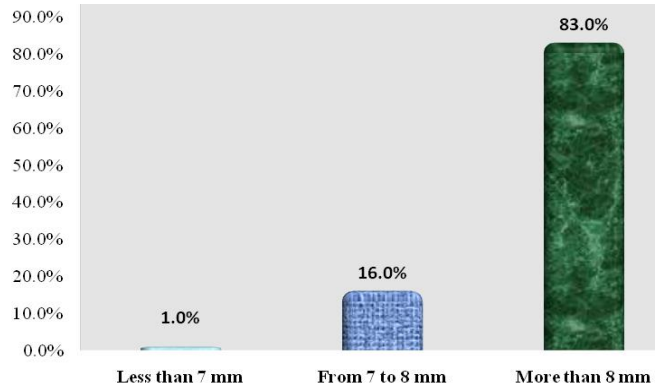

Figure 5: Left central distribution of measured maxillary incisors of study patients.

While the mean±SD has males was (34.89±2.71). There are no statistically significant differences between males and females in the sum of MMV (*p*=0.293). The sum of incisors/measured premolar value (SI/MPV) were statistically significant differences between males and females in the sum of SI/MPV (*p*=0.045). The higher of the mean±SD has males was (0.87±0.08).

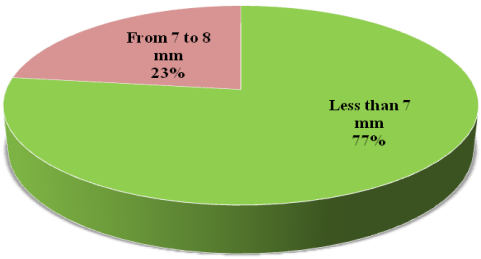

Figure 6: Right Lateral Distribution of measured maxillary incisors of study patients.

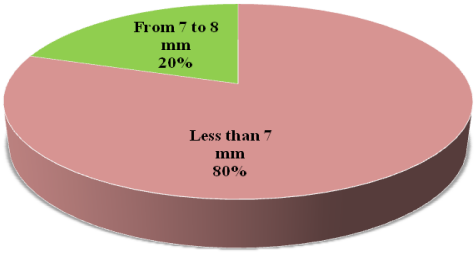

Figure 7: Left lateral distribution of measured maxillary incisors of study patients.

While the mean±SD has females was (0.83±0.11). There are no statistically significant differences between males and females in the sum of SI/MMV (0.506). However, no gender disparities were observed for sum of incisors (SI), measured molar value (MMV) and ratio of SI to MMV. The mean Pont's ratio in the current study (0.68±0.07 for males, and 0.67±0.09 for females).

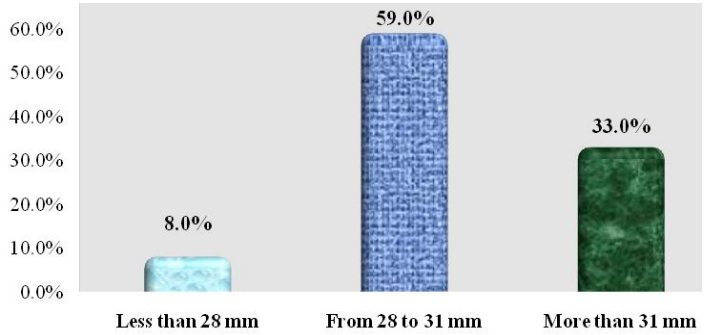

Figure 8: Sum of incisors.

DISCUSSION

This study aimed at assessing the accuracy of Pont's Index in estimating maxillary arch width among the Yemeni population. Pont's Index as a diagnostic tool in orthodontics has been revealed to have low inter-population validity. The study is important because it reveals significant differences between the measured and predicted values of arch widths in Yemenis as well as differences between males and females. These results support the calls for population-specific changes to enhance the effectiveness of orthodontic treatment planning[6,7]. It has been established that the diagnosis of orthodontic patients based on the differences in teeth size is highly effective and plays a major role in determining the patient's treatment plan.

Table 1: Gender differences in orthodontic standards.

Orthodontic parameters	Total				Male		Female		*p* value
	Mean	SD	Max.	Min.	Mean	SD	Mean	SD	
SI (mm)	30.25	2.10	35	25	30.24	2.07	30.25	2.18	0.975
MPV (mm)	35.62	3.25	47	30	34.89	2.71	36.80	3.71	0.004*
MMV (mm)	45.23	3.92	52	29	44.90	3.85	45.76	4.04	0.293
SI/MPV	0.86	0.10	1.17	0.66	0.87	0.08	0.83	0.11	0.045*
SI/MMV	0.67	0.08	0.96	0.54	0.68	0.07	0.67	0.09	0.506

SI: Sum of incisors. MPV: measured premolar value. MMV: measured molar value. SI/MPV: sum of incisors/measured premolar value ratio. SI/MMV: sum of incisors/measured molar value ratio. M: mean value. SD: standard deviation. mm: millimeter.

Table 2: Comparison between MPV and CPV.

MPV	CPV*	t test	Difference	*p*	Correlations R	*p*
35.62	37.81	-5.302	-2.19	0.000*	0.023	0.822

MPV: measured premolar value, *CPV=SI × 100 / 80, CPV: Calculated premolar value

Table 3: Comparison between MMV and CMV.

MMV	CMV*	t test	Difference	*P*	Correlations R	*p*
45.23	47.26	-4.165	-2.03	0.000*	0.093	0.357

*CMV=SI × 100/64, MMV: measured molar value ratio, CMV: Calculated molar value

Table 4: Comparison between MPV and CPV and MMV and CMV for 100 Yemeni patients used to assess the validity of Pont's analysis to predict normal maxillary arch widths.

No.	MPV	CPV*	Difference	MMV	CMV*	Difference
1	31.53	39.43	-7.90	43.48	49.28	-5.80
2	29.59	43.15	-13.56	43.06	53.94	-10.88
3	36.35	35.45	0.90	48.05	44.31	3.74
4	34.54	35.74	-1.20	44.35	44.67	-0.32
5	36.47	37.83	-1.36	48.26	47.28	0.98
6	40.54	40.58	-0.04	46.01	50.72	-4.71
7	34.79	36.31	-1.52	45.64	45.39	0.25
8	37.22	42.25	-5.03	47.52	52.81	-5.29
9	31.46	34.31	-2.85	42.93	42.89	0.04
10	36.27	39.99	-3.72	46.66	49.98	-3.32
11	33.07	36.70	-3.63	43.01	45.88	-2.87
12	42.3	39.96	2.34	50.19	49.95	0.24
13	35.88	36.00	-0.12	49.56	45.00	4.56
14	35.87	35.93	-0.06	45.72	44.91	0.81
15	36.57	36.61	-0.04	48.78	45.77	3.01
16	38.08	40.13	-2.05	48.38	50.16	-1.78
17	35.14	37.15	-2.01	46.19	46.44	-0.25
18	37.15	40.88	-3.73	48.15	51.09	-2.94
19	35.53	43.00	-7.47	48.31	53.75	-5.44
20	39.07	36.93	2.14	47.22	46.16	1.06
21	32.18	39.09	-6.91	47.25	48.86	-1.61
22	36.82	36.60	0.22	47.06	45.75	1.31
23	36.73	41.25	-4.52	45.31	51.56	-6.25
24	34.3	35.74	-1.44	42.94	44.67	-1.73
25	35.26	35.63	-0.37	46.04	44.53	1.51
26	35.07	35.98	-0.91	43.64	44.97	-1.33
27	29.91	39.15	-9.24	39.01	48.94	-9.93
28	38.62	34.96	3.66	47.00	43.70	3.30
29	29.74	36.38	-6.64	39.37	45.47	-6.10
30	37.04	35.79	1.25	48.69	44.73	3.96
31	31.79	34.50	-2.71	40.97	43.13	-2.16
32	37.36	36.20	1.16	48.19	45.25	2.94
33	42.4	35.08	7.32	51.29	43.84	7.45
34	42.06	38.13	3.93	49.95	47.66	2.29
35	36.31	37.38	-1.07	45.47	46.72	-1.25
36	46.9	38.66	8.24	33.28	48.33	-15.05
37	33.34	42.63	-9.29	43.09	53.28	-10.19
38	36.7	31.78	4.92	47.50	39.72	7.78
39	34.95	38.81	-3.86	39.52	48.52	-9.00
40	35.74	35.35	0.39	37.39	44.19	-6.80
41	34.47	42.39	-7.92	44.40	52.98	-8.58
42	38.35	35.35	3.00	43.08	44.19	-1.11

No.	MPV	CPV*	Difference	MMV	CMV*	Difference
43	30.68	42.65	-11.97	41.29	53.31	-12.02
44	37.52	36.66	0.86	42.33	45.83	-3.50
45	32.82	35.79	-2.97	42.06	44.73	-2.67
46	37.4	41.60	-4.20	48.71	52.00	-3.29
47	38.82	37.25	1.57	47.51	46.56	0.95
48	43.36	36.94	6.42	33.96	46.17	-12.21
49	30.44	37.04	-6.60	38.32	46.30	-7.98
50	33.39	34.95	-1.56	43.12	43.69	-0.57
51	32.39	38.35	-5.96	43.02	47.94	-4.92
52	35.08	42.40	-7.32	43.41	53.00	-9.59
53	34.01	36.13	-2.12	44.71	45.16	-0.45
54	34.69	41.55	-6.86	46.45	51.94	-5.49
55	30.82	36.48	-5.66	42.57	45.59	-3.02
56	36.88	31.54	5.34	46.61	39.42	7.19
57	30.76	35.09	-4.33	29.12	43.86	-14.74
58	33.67	36.23	-2.56	40.35	45.28	-4.93
59	30.84	39.25	-8.41	40.46	49.06	-8.60
60	35.82	36.13	-0.31	45.04	45.16	-0.12
61	33.79	36.79	-3.00	45.38	45.98	-0.60
62	36.89	38.41	-1.52	49.69	48.02	1.67
63	37.38	37.09	0.29	49.88	46.36	3.52
64	37.23	36.35	0.88	48.60	45.44	3.16
65	38.98	43.95	-4.97	50.84	54.94	-4.10
66	38.34	37.16	1.18	50.86	46.45	4.41
67	35.53	40.14	-4.61	45.90	50.17	-4.27
68	35.86	38.46	-2.60	45.35	48.08	-2.73
69	35.47	38.89	-3.42	51.65	48.61	3.04
70	31.53	39.78	-8.25	43.48	49.72	-6.24
71	29.59	35.28	-5.69	43.06	44.09	-1.03
72	36.35	37.55	-1.20	48.05	46.94	1.11
73	34.54	38.74	-4.20	44.35	48.42	-4.07
74	36.47	35.09	1.38	48.26	43.86	4.40
75	40.54	37.56	2.98	46.01	46.95	-0.94
76	34.79	42.34	-7.55	45.64	52.92	-7.28
77	37.22	35.15	2.07	47.52	43.94	3.58
78	31.46	35.84	-4.38	42.93	44.80	-1.87
79	36.27	36.21	0.06	46.66	45.27	1.39
80	33.07	37.33	-4.26	43.01	46.66	-3.65
81	42.3	37.69	4.61	50.19	47.11	3.08
82	35.88	37.20	-1.32	49.56	46.50	3.06
83	35.87	40.05	-4.18	45.72	50.06	-4.34
84	36.57	34.93	1.64	48.78	43.66	5.12
85	38.08	41.41	-3.33	48.38	51.77	-3.39
86	35.14	39.43	-4.29	46.19	49.28	-3.09
87	37.15	43.15	-6.00	48.15	53.94	-5.79
88	35.53	35.45	0.08	48.31	44.31	4.00
89	39.07	35.74	3.33	47.22	44.67	2.55
90	32.18	37.83	-5.65	47.25	47.28	-0.03
91	36.82	40.58	-3.76	47.06	50.72	-3.66
92	36.73	36.31	0.42	45.31	45.39	-0.08
93	34.3	42.25	-7.95	42.94	52.81	-9.87
94	35.26	34.31	0.95	46.04	42.89	3.15
95	35.07	39.99	-4.92	43.64	49.98	-6.34
96	29.91	36.70	-6.79	39.01	45.88	-6.87
97	38.62	39.96	-1.34	47.00	49.95	-2.95
98	29.74	36.00	-6.26	39.37	45.00	-5.63
99	37.04	35.93	1.11	48.69	44.91	3.78
100	36.35	36.61	-0.26	45.88	45.77	0.11

*CPV=SI × 100 / 80. CMV=SI × 100 / 64

SI: Sum of incisors. MPV: measured premolar value. MMV: measured molar value. SI/MPV: sum of incisors/measured premolar value ratio. SI/MMV: sum of incisors/measured molar value ratio. M: mean value. SD: standard deviation. mm: millimeter.

The interarch Periodontal Proximity between the upper and lower anterior and posterior dentition is critical in attainment of a stable occlusion and reduction of chances of relapse. In order to understand what arch width may be best for a particular patient, several indices have been developed one of which is Pont's Index. However, Pont's Index was calculated from data derived from a poorly defined French population for which the sample size is unknown. Nevertheless, Pont himself recognised the need for; at least, cross-ethnic calibration because of genetic and environmental differences in tooth dimensions[8]. Recently, there has

been a revolution in Yemen to know many dental standards, including "the reliability of modern dental age estimation methods using X-rays among Yemeni children[9], dental cavities and the need for treatment in children with physical disabilities[10], the impact of dental implants on the rate at which aerobic bacteria colonize the oral cavity[11], the impact of dental implants on the colonization of aerobic bacteria in the oral cavity. The antibiotic profile of common isolated aerobic bacteria[12], temporo-mandibular dystonia: prevalence, clinical and demographic data[13], and results of treatment strategies for hundreds of patients, radiographic evaluation of prominent fillings using cone beam computed tomography[14], factor resolution, and the pattern of permanent tooth extraction[15], the prevalence of signs of temporomandibular joint disorders in healthy edentulous individuals[16], and the validity of Tanaka and Johnston's mixed dentition among Yemeni adults[17], but no study has addressed the Pont's Index. This is the first study of its kind in Yemen and to reduce possible confounding factors such as wear, restoration, or caries that may affect the mesiodistal dimensions, subjects considered in this study ranged from 18 to 25 years. Clinical examinations and alginate impressions were made on one hundred Yemeni dental students (62 male, 38 female) from Sana'a. The obtained premolar and molar values were significantly lower than the values computed from the indices of Pont's Index.

Table 5: Comparison between MPV and CPVy.

MPV	CPVy*	t test	Difference	*p* value	Correlations R	*p* value
35.62	35.17	1.116	0.45	0.267	0.023	0.822

* CPVy=SI × 100 / 86

CPVy: Calculated premolar value of Yemeni population, MPV: measured premolar value

Table 6: Comparison between MMV and CMVy.

MMV	CMVy*	t test	Difference	*p* value	Correlations R	*p* value
45.23	45.14	0.178	0.09	0.859	0.093	0.357

* CMVy=SI × 100 / 67, CMVy: Calculated premolar value of Yemeni population, MMV: Measured molar value

Table 7: Comparison between MPV and CPVy and difference between MMV and CMVy for each individual in the sample.

No.	SI	MPV	CPVy *	Difference	MMV	CMVy*	Difference
1	32	31.53	36.67	-5.14	43.48	47.07	-3.59
2	35	29.59	40.14	-10.55	43.06	51.52	-8.46
3	28	36.35	32.98	3.37	48.05	42.33	5.72
4	29	34.54	33.24	1.3	44.35	42.67	1.68
5	30	36.47	35.19	1.28	48.26	45.16	3.1
6	32	40.54	37.74	2.8	46.01	48.45	-2.44
7	29	34.79	33.78	1.01	45.64	43.36	2.28
8	34	37.22	39.30	-2.08	47.52	50.45	-2.93
9	27	31.46	31.92	-0.46	42.93	40.97	1.96
10	32	36.27	37.20	-0.93	46.66	47.75	-1.09
11	29	33.07	34.14	-1.07	43.01	43.82	-0.81
12	32	42.3	37.17	5.13	50.19	47.72	2.47
13	29	35.88	33.49	2.39	49.56	42.99	6.57
14	29	35.87	33.42	2.45	45.72	42.90	2.82
15	29	36.57	34.06	2.51	48.78	43.72	5.06
16	32	38.08	37.33	0.75	48.38	47.91	0.47
17	30	35.14	34.56	0.58	46.19	44.36	1.83
18	33	37.15	38.02	-0.87	48.15	48.81	-0.66
19	34	35.53	40.00	-4.47	48.31	51.34	-3.03
20	30	39.07	34.35	4.72	47.22	44.09	3.13
21	31	32.18	36.36	-4.18	47.25	46.67	0.58
22	29	36.82	34.05	2.77	47.06	43.70	3.36
23	33	36.73	38.37	-1.64	45.31	49.25	-3.94
24	29	34.3	33.24	1.06	42.94	42.67	0.27
25	29	35.26	33.14	2.12	46.04	42.54	3.5
26	29	35.07	33.47	1.6	43.64	42.96	0.68
27	31	29.91	36.42	-6.51	39.01	46.75	-7.74
28	28	38.62	32.52	6.1	47.00	41.75	5.25
29	29	29.74	33.84	-4.1	39.37	43.43	-4.06
30	29	37.04	33.29	3.75	48.69	42.73	5.96
31	28	31.79	32.09	-0.3	40.97	41.19	-0.22
32	29	37.36	33.67	3.69	48.19	43.22	4.97
33	28	42.4	32.63	9.77	51.29	41.88	9.41
34	31	42.06	35.47	6.59	49.95	45.52	4.43
35	30	36.31	34.77	1.54	45.47	44.63	0.84

No.	SI	MPV	CPVy *	Difference	MMV	CMVy*	Difference
36	31	46.9	35.97	10.93	33.28	46.16	-12.88
37	34	33.34	39.65	-6.31	43.09	50.90	-7.81
38	25	36.7	29.56	7.14	47.50	37.94	9.56
39	31	34.95	36.10	-1.15	39.52	46.34	-6.82
40	28	35.74	32.88	2.86	37.39	42.21	-4.82
41	34	34.47	39.43	-4.96	44.40	50.61	-6.21
42	28	38.35	32.88	5.47	43.08	42.21	0.87
43	34	30.68	39.67	-8.99	41.29	50.93	-9.64
44	29	37.52	34.10	3.42	42.33	43.78	-1.45
45	29	32.82	33.29	-0.47	42.06	42.73	-0.67
46	33	37.4	38.70	-1.3	48.71	49.67	-0.96
47	30	38.82	34.65	4.17	47.51	44.48	3.03
48	30	43.36	34.36	9	33.96	44.10	-10.14
49	30	30.44	34.45	-4.01	38.32	44.22	-5.9
50	28	33.39	32.51	0.88	43.12	41.73	1.39
51	31	32.39	35.67	-3.28	43.02	45.79	-2.77
52	34	35.08	39.44	-4.36	43.41	50.63	-7.22
53	29	34.01	33.60	0.41	44.71	43.13	1.58
54	33	34.69	38.65	-3.96	46.45	49.61	-3.16
55	29	30.82	33.93	-3.11	42.57	43.55	-0.98
56	25	36.88	29.34	7.54	46.61	37.66	8.95
57	28	30.76	32.64	-1.88	29.12	41.90	-12.78
58	29	33.67	33.70	-0.03	40.35	43.25	-2.9
59	31	30.84	36.51	-5.67	40.46	46.87	-6.41
60	29	35.82	33.60	2.22	45.04	43.13	1.91
61	29	33.79	34.22	-0.43	45.38	43.93	1.45
62	31	36.89	35.73	1.16	49.69	45.87	3.82
63	30	37.38	34.50	2.88	49.88	44.28	5.6
64	29	37.23	33.81	3.42	48.60	43.40	5.2
65	35	38.98	40.88	-1.9	50.84	52.48	-1.64
66	30	38.34	34.57	3.77	50.86	44.37	6.49
67	32	35.53	37.34	-1.81	45.90	47.93	-2.03
68	31	35.86	35.78	0.08	45.35	45.93	-0.58
69	31	35.47	36.17	-0.7	51.65	46.43	5.22
70	32	31.53	37.00	-5.47	43.48	47.49	-4.01
71	28	29.59	32.81	-3.22	43.06	42.12	0.94
72	30	36.35	34.93	1.42	48.05	44.84	3.21
73	31	34.54	36.03	-1.49	44.35	46.25	-1.9
74	28	36.47	32.64	3.83	48.26	41.90	6.36
75	30	40.54	34.94	5.6	46.01	44.85	1.16
76	34	34.79	39.38	-4.59	45.64	50.55	-4.91
77	28	37.22	32.70	4.52	47.52	41.97	5.55
78	29	31.46	33.34	-1.88	42.93	42.79	0.14
79	29	36.27	33.69	2.58	46.66	43.24	3.42
80	30	33.07	34.72	-1.65	43.01	44.57	-1.56
81	30	42.3	35.06	7.24	50.19	45.00	5.19
82	30	35.88	34.60	1.28	49.56	44.42	5.14
83	32	35.87	37.26	-1.39	45.72	47.82	-2.1
84	28	36.57	32.49	4.08	48.78	41.70	7.08
85	33	38.08	38.52	-0.44	48.38	49.45	-1.07
86	32	35.14	36.67	-1.53	46.19	47.07	-0.88
87	35	37.15	40.14	-2.99	48.15	51.52	-3.37
88	28	35.53	32.98	2.55	48.31	42.33	5.98
89	29	39.07	33.24	5.83	47.22	42.67	4.55
90	30	32.18	35.19	-3.01	47.25	45.16	2.09
91	32	36.82	37.74	-0.92	47.06	48.45	-1.39
92	29	36.73	33.78	2.95	45.31	43.36	1.95
93	34	34.3	39.30	-5	42.94	50.45	-7.51
94	27	35.26	31.92	3.34	46.04	40.97	5.07
95	32	35.07	37.20	-2.13	43.64	47.75	-4.11
96	29	29.91	34.14	-4.23	39.01	43.82	-4.81
97	32	38.62	37.17	1.45	47.00	47.72	-0.72
98	29	29.74	33.49	-3.75	39.37	42.99	-3.62
99	29	37.04	33.42	3.62	48.69	42.90	5.79
100	29	36.35	34.06	2.29	45.88	43.72	2.16

*CPVy=SI × 100/86. CMVy=SI × 100 / 67

* CMVy=SI × 100 / 67, CMVy: Calculated premolar value of Yemeni population, MMV: Measured molar value; CPVy: Calculated premolar value of Yemeni population, MPV: measured premolar value.

Regarding the width of the premolars 57/31 participants had width between 35-40 mm, 19/31 participants had width less than 35 mm and only three participants had width more than 40 mm. In their widths, 90% of participants surpassed 40 mm for molars and only 3% for them were below 35 mm. Likewise, 59% of participants with a sum of incisors ranging between 28 to 31 mm, 33% with sum of incisors above 31 mm and 8% of participants recorded a sum of incisors below 28 mm.

Using gender comparison, it was noted that the mean premolar values for the present study were higher in females (p=0.004) while SI/MPV ratios were higher in males (p=0.045). No differences in mean values between genders were identified for all studied variables, including measured molar values, the sum of incisors, and the ratio of SI to MMV. These findings corroborate similar studies that were conducted in the past to stress on the role of gender specific norms in diagnosis of orthodontic problem. However, they are different from the findings of the present study with other populations like Turkish population in which male was observed to have a larger tooth dimensions[18]. Also, research targeting Jordanian populations showed no gender-related variations in tooth dimensions[19].

The conclusions drawn from this study also validate data obtained in other population groups that Pont's Index tended to overestimate arch widths in at least 15% of study participants. For example, investigations on Serbian and Bangladeshi populations revealed overestimations of the mean of interpremolar and intermolar widths respectively[6,7]. Similar trends were recorded in Northern Indians; though, Pont's Index of 81 in the premolars and 65 in the molars leading to over estimations by Gupta *et al.*[4]. Similar overestimations were found in Jordanian and Iranian general populations[19,20]. In Caucasian population, Nimkarn *et al*., observed overestimations of 4.7 mm in premolar width and 2.5 mm in molar width[21].

On the other hand, some previous investigations proved that Pont's Index yielded narrower arch widths in specific sample groups. For instance, underestimations of between 0.02 mm and 2.4 mm were established through studies with population samples of the Turkish and Colombian populations[22,23]. Likewise other researches done on Iraqi and Southern Chinese population yielded low coefficients of determination of measured dimensions with Pont's predicted values and the index provided low estimate of arch widths[24,25].

Similar to other studies, poor relationships between Pont's Index and actual measurements have also been reported. In his study, Dalidjan *et al.*[8], stated that Pont's Index was able to account for less than 32% of the variation in arch width observed in the Australian Aborigines, Indonesians and Caucasians. JooNDEPH *et al.*[5], also observed that for patients followed from pre-treatment to 10yr post-retention, variation in arch width was explained <6% by Pont's Index. These discrepancies indicate that genetic difference, dietary practices, socioeconomic status, and the examiners' bias affect the models used to predict arch width.

The results of the present investigation clearly indicate that there are indeed limitations for using Pont's Index in the Yemeni sample in which it tends to provide wider arch widths than those actually present. To address these limitations, this study proposes modified formulas: The obtained comparisons of premolar widths are CPVy=SI×100/86 and for molar widths CMVy=SI×100/67. These changes should help, in turn, to offer better and more relevant predictions that can be made for the Yemeni demographic. Hence, the application of the Ponts index is not appropriate for the Yemeni population as it stands. Interestingly, the results support the call for improved diagnostic methods for specific populations in order to better plan orthodontic treatment. Future work should also aim to provide evidence for these proposed changes and examine other indicators to develop sound diagnostic criteria across different populations.

Limitation of the study

Although the study provides valuable insights, the relatively small sample size and specific demographics (dental students in Sana'a) may limit the generalizability of the results. Also, the methodology of using alginate impressions and dental sone models, although standardized, may introduce minor errors.

CONCLUSIONS AND RECOMMENDATION

The results of the study show that the Pont's Index has limited reliability in predicting dental arch width in the Yemeni population. The large discrepancies and gender differences highlight the need to develop more accurate and population-specific indices. Orthodontists should incorporate these findings into clinical practice to improve diagnostic accuracy and treatment planning. The Pont's index is not a reliable tool for determining ideal dental arch width values for both Yemeni males and females.

The findings of this study have significant implications for orthodontic treatment planning in the Yemeni population. The underestimations and overestimations of arch widths using Pont's Index highlight the risk of misdiagnosis and inappropriate treatment planning. Orthodontists should consider these discrepancies and possibly rely on more accurate, population-specific indices or combine Pont's Index with other diagnostic tools. This is particularly important given the significant gender differences observed, which necessitate gender-specific norms. Given the significant gender differences and the overall discrepancies found in this study, there is a clear need for developing customized orthodontic indices for the Yemeni population. Such indices would ensure more accurate predictions of arch widths, leading to better treatment outcomes.

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AUTHOR'S CONTRIBUTIONS

Awath AMA: original draft writing, methodology, investigation, conceptualization. **Almotareb FL:** review and editing. **Al-Shamahy HA:** Formal analysis, data processing, conceptualization. Final article was checked and approved by all authors.

DATA AVAILABILITY

Upon request, the accompanying author can furnish the empirical data used to bolster the findings of the study.

CONFLICT OF INTEREST

None to declare.

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