Pont's Index: A Clinical Evaluation*

Donald R. Joondeph, D.D.S., M.S.

Richard A. Riedel, D.D.S., M.S.

Alton W. Moore, D.D.S., M.S.

Introduction

Pont[1], in 1909, proposed a method of predetermining the ideal dental arch width which has become known as "Pont's Index." However, he felt that the method of measuring teeth to determine arch width was not the only factor to consider in orthodontic treatment planning. He also stressed the assessment of the facial profile, determination of the Angle classification, relationship of upper and lower jaws to one another, and the midline as important essentials to be considered.

In an interesting prelude to the index itself, Pont noted that the mesiodistal widths of the maxillary central and lateral incisors could be used to predict the mesiodistal width of the maxillary canines in normal dental arches. He suggested that half the mesiodistal diameter of the central plus the mesiodistal diameter of the lateral would, generally, equal the mesiodistal width of the canine.

Pont did not indicate the size of the sample used to determine his proposed index, but did state that they were of French nationality only. He postulated that there were certain relationships between the form of the skull (dolichocephalic, mesiocephalic and brachycephalic) and the form of the dental arch, but he never elaborated further on this subject. Instead, for each normal dental arch he suggested that a constant relationship existed between the width of the four upper anterior teeth and the width of the dental arch in the premolar and molar areas. All his measurements and predictions were related to the maxillary dental arch and did not include an assessment of the mandibular arch.

Pont determined a constant ratio between (1) the width of the four maxillary incisors, and (2) the width of the maxillary arch as measured from the center of the occlusal surfaces of the first premolars and first molars. In the ideal dental arch he concluded that the ratio of combined incisor width to transverse arch width was .80 in the premolar area and .64 in the molar area. These ratios have been translated into a table often referred to as "Pont's Index" in which the total mesiodistal diameters of the maxillary incisors are in the first column, the ideal width between premolars in the second column, and the ideal intermolar width in the third column (Table I).

In orthodontic procedures Pont suggested that the maxillary dental arch should be expanded one or two millimeters more than that found in normal occlusions to allow for relapse and included this factor in his ratios.

Review of Literature

Stifter[2] tested Pont's analysis on Ideal and Normal Class I dentitions. Cases with slightly slipped contacts, minor rotations, or insignificant deviations from perfect occlusion were used, but were considered in a group separately from the Ideal sample. The two groups were classified as "Normals" and "Ideals" to determine any significant differences. He indicated that, for the

From the Department of Orthodontics, School of Dentistry, University of Washington. This study was supported by Public Health Service Training Grant DE-00238-01.

TABLE I

PONT'S INDEX

Total mesiodistal diameters of the maxillary incisors	First Premolar Width	First Molar Width
18.	22.5	28.1
20.	25.	31.94
20.5	25.5	32.
21.	26.25	32.82
21.5	27.	33.77
22.	27.5	34.
22.5	28.	35.
23.	28.75	35.94
23.5	29.5	36.88
24.	30.	37.
24.5	30.5	38.
25.	31.	39.
25.5	32.	39.8
26.	32.5	40.9
26.5	33.	41.5
27.	33.5	42.5
27.5	34.	42.96
28.	35.	44.
28.5	35.5	44.5
29.	36.	45.3
29.5	37.	46.
30.	37.5	46.87
30.5	38.	47.6
31.	39.	48.4
31.5	39.5	49.2
32.	40.	50.
32.5	40.5	50.8
33.	41.	51.5
33.5	42.	52.3
34.	43.	53.
34.5	43.5	53.9
35.	44.	54.5
36.	45.	56.4
37.	46.25	57.8

Pont's Index is obtained as follows:

$\frac{(S) \times 100}{80}$ = Ideal interpremolar width.

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

(S) = Sum of the diameters of the four maxillary incisors

Ideal group, a significant correlation existed between the combined maxillary incisor widths and the intermolar and interpremolar widths. No corresponding correlation was found for the Normal group. The sample consisted of various nationalities. Statistical data were not given for his Pont's Index measurements.

Studying ninety-one Navajo children with ideal occlusion, Worms[3] evaluated Pont's Index. He compared the calculated intertooth values with the actual interpremolar and intermolar arch widths. At a confidence level of 1%, there was a significant difference between observed and calculated premolar and molar widths. He indicated that the reliability of Pont's Index as a diagnostic tool in orthodontics is highly questionable.

Greve[4] critically analyzed the validity of Pont's Index. He found that in one hundred and two dentitions with perfect occlusion only low correlation coefficients existed between the sums of the mesiodistal crown diameters of the incisors and the arch breadth in the premolar region ($r = -0.34$), and arch breadth in the molar region ($r = +0.24$).

Hotz[5] suggested that deviations from Pont's Index may be related to long and narrowly shaped dental arches. He concluded that due consideration must be given to the shape of the skull in assessment of arch form and width.

Smyth and Young[6] found that the relationship between tooth size and arch width was below an r value of +0.4.

Korkhaus[7] proposed index values of 84 and 65 rather than Pont's values of 80 and 64. His study was of a Rhineland population.

From the foregoing review of the literature the orthodontist might well question the validity of using Pont's Index as a guide to treatment planning. More recently, the use of the index has

TABLE II

CASE	Mesiodistal Width of Anterior Teeth	Before Treatment Width		After Treatment Width		Ten Years Out of Retention Width	
		Premolar	Molar	Premolar	Molar	Premolar	Molar
1.	27.3	29.7	38.4	32.1	39.6	31.7	38.5
2.	28.6	37.2	46.4	40.5	48.2	39.8	46.7
3.	28.7	37.9	44.6	38.3	45.0	39.3	46.2
4.	29.3	30.4	40.2	33.9	40.4	32.3	39.4
5.	33.7	33.0	40.1	37.3	45.9	35.3	44.7
6.	30.5	35.9	43.5	39.8	50.3	41.0	48.9
7.	29.9	32.4	41.7	35.7	44.5	34.7	44.7
8.	34.0	39.3	46.9	41.5	48.0	40.2	46.7
9.	30.8	35.7	45.9	39.4	48.0	37.4	45.3
10.	29.1	36.4	41.5	37.9	45.8	38.0	47.8
11.	29.4	39.1	48.1	39.7	48.6	38.1	45.6
12.	32.1	*	43.3	*	45.0	35.9	43.2
13.	32.0	*	42.8	35.7	45.0	34.9	44.5
14.	31.0	*	37.8	34.0	45.0	33.0	43.0
15.	32.6	*	44.8	41.0	48.0	41.6	48.3
16.	28.7	33.5	44.9	37.0	46.1	36.8	47.8
17.	31.6	39.2	48.1	36.7	48.8	36.2	47.4
18.	29.3	35.8	41.9	36.5	43.6	33.9	42.7
19.	32.8	*	40.9	40.0	48.4	40.0	46.4
20.	33.3	30.5	42.1	37.4	43.0	37.0	43.4

* Teeth Unerupted

been brought into focus by certain practitioners who depend almost entirely on it for determining proper maxillary arch width.

Methods and Materials

In order to test the clinical fallibility of Pont's Index, the investigators applied it to the dental records of twenty individuals who had received full orthodontic treatment and who had been free of retaining appliances for at least ten years. Measurements were taken from dental casts of these individuals prior to treatment, at the completion of treatment, and at least ten years or more *after* all retention appliances had been discontinued (Table II). It was felt that a ten-year postretention period would be sufficient to allow for complete functional adjustment in the final positioning of the teeth. During orthodontic treatment of the individuals studied, an attempt was made to preserve the original mandibular arch form and width and thus it determined the maxillary arch form and width. All of the cases were treated without the extraction of any permanent teeth. Fifteen of the original malocclusions were Class II, Division 1, three were Class II, Division 2, one was Class I, and one was Class III. All of the individuals were treated with a complete edgewise orthodontic appliance. Retention time for these cases varied between two and four years. Pont's measurements were applied to the sample. Correlation coefficients were derived for the following relationships:

1. The calculated Pont's ideal interpremolar width compared with actual interpremolar widths of the casts ten years out of retention, $r = .23$ (Fig. 1).

2. The calculated Pont's ideal intermolar width compared with the actual inter first permanent molar width ten years out of retention, $r = .20$.

3. The completion of treatment arch width of the premolars with the same

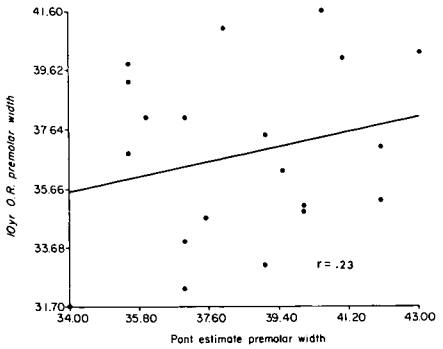

Fig. 1 Scatter diagram with calculated regression line between Pont's estimated premolar width and the actual premolar width 10 years out of retention (O.R.).

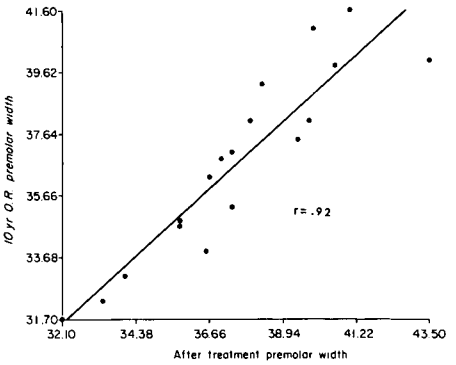

Fig. 2 Scatter diagram and calculated regression line between the premolar width after treatment and the same width 10 years out of retention (O.R.).

measurement made on the casts ten years out of retention, $r = .92$ (Fig. 2).

4. The completion of treatment arch width of the first permanent molars with the same measurement made on the ten year out of retention casts, $r = .89$.

5. Correlation of the actual combined mesiodistal widths of the maxillary incisors to the actual interpremolar width in the cases ten years out of retention, $r = .29$.

6. Comparison of the actual combined mesiodistal widths of the maxillary incisors with the actual intermolar widths of the casts 10 years out of retention, $r = .22$.

7. The relationship between the original interpremolar width and the same measurement made on the ten years out of retention casts, $r = .70$.

8. The original intermolar width with the same measurement made on the casts ten years out of retention, $r = .62$.

Discussion

In reviewing the cases studied, it was interesting to note that in one instance the width across the premolars immediately at the end of treatment was only .5 mm less than the predicted width as determined from Pont's Index. In this case, ten years postretention, the arch width had decreased 3.1 mm less than the predicted dimension and decreased 1.9 mm *less* than the interpremolar width present in the original malocclusion (case 18, Table II). Examination of several other cases further illustrated lack of compliance to Pont's prediction values. In two instances the intermolar width was within 0.5 mm of Pont's predicted width at the end of treatment; however, in one case the intermolar width *decreased* 2.9 mm, ten years postretention, and in the other, intermolar width *increased* 2 mm, ten years postretention.

Extreme variations in actual widths maintained from those derived from Pont's formula are represented by the following examples: In one instance the final interpremolar width was 4.3 mm wider than the Pont's estimate; in another it was 6.7 mm less than the Pont's prediction. The intermolar width in one case, ten years postretention, was 8.9 mm less than the Pont's predicted width (Fig. 3). Approximately 35% of the cases were more than 4 mm from Pont's predicted width in the premolar area. As to first molar area, approximately 50% were more than 4 mm from the prediction formula. It is interesting to note that in all but one of

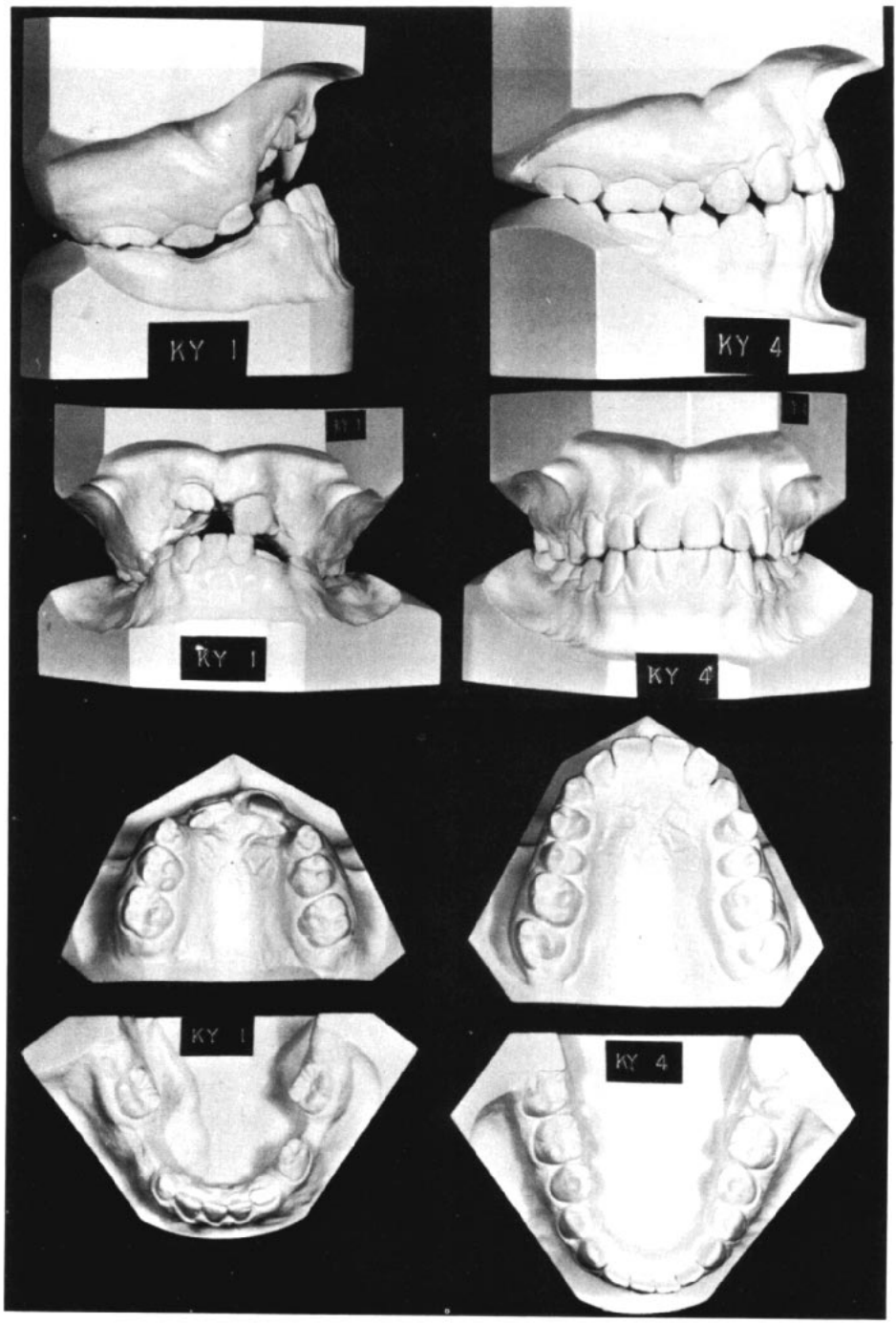

Fig. 3 A malocclusion before treatment and more than ten years out of retention. This case has settled into a physiologically stable occlusion and arch form. Yet the maxillary premolar width is 5.0 mm less than Pont's indicated treatment goal while the molar width is 8.9 mm less.

these cases the transmolar width was less than the prediction formula derived from Pont.

When the various correlation coefficients calculated for this patient sample are studied, it becomes evident that the *least* reliable relationship found was that proposed by Pont, i.e., the combined mesiodistal widths of the maxillary incisors to the final interpremolar ($r = 0.29$) and intermolar ($r = 0.22$) arch widths. The original values for the interpremolar and intermolar arch widths provided a much more reliable prediction relationship of the ultimate stable arch-width measurements than Pont's Index, $r = 0.70$ for the interpremolar width and $r = 0.62$ for the intermolar width.

All of the cases in this sample were orthodontically treated with the concept that every attempt be made to preserve the original mandibular arch form and width as far as possible. Numerous investigations have suggested that the original mandibular intercanine width can seldom be permanently increased and may serve as a fairly accurate guide to arch width in that area. It, in turn, will influence the arch form in the maxillary arch if normal occlusion is to be attained. In sixteen of the twenty cases, mandibular intercanine width, ten years postretention, was within 1.5 mm of the original malocclusion width. The original mandibular arch form was generally found to be repeated in the cases ten years out of retention, thus suggesting that the original mandibular arch form may act as a satisfactory guide in treatment planning. The cases were treated following this concept which, when carried out, dictated the final maxillary arch form and width attained by orthodontic therapy. When interpremolar and intermolar widths at the end of treatment were compared with the same measurements, ten years postretention, extremely high correlations were found (premolars $r = 0.92$, molars, $r = 0.89$). This would seem to reinforce the validity of predicating orthodontic treatment planning on the original mandibular arch form and width and allowing it to determine the ultimate maxillary arch width and form.

Summary

The combined mesiodistal widths of maxillary incisors, as well as maxillary interpremolar and intermolar widths, were measured in twenty nonextraction treated orthodontic cases before and after full treatment, and at least ten years out of retention. Correlation coefficients were determined for eight possible relationships between combined incisor widths, interpremolar and intermolar widths.

1. Poor correlation was found between the combined maxillary incisor widths and the ultimate arch width in the molar and premolar areas.
2. Fair correlation was found between original maxillary arch width and the arch width ten years out of retention.
3. High correlation was found between after treatment maxillary arch width and the arch width ten years out of retention.

Conclusions

Measuring mesiodistal widths of incisors to predetermine maxillary interpremolar and intermolar widths is of no value in predicting ultimate arch width in those areas. Mandibular arch form and mandibular intercanine width, as present in the original malocclusion, offer a more reasonable treatment guide for both mandibular and maxillary ultimate arch widths than does Pont's Index.

Univ. of Washington
Seattle, Washington 98105

BIBLIOGRAPHY

1. Pont, A.: Der Zahn-Index in der Orthodontie. *Zahnarztuche Orthopadie*, 3:306-321, 1909.
2. Stifter, J.: A Study of Pont's, Howes', Rees', Neff's and Bolton's Analyses on Class I Adult Dentitions. *Angle Orthodont.*, 28:215-225, 1958.
3. Worms, F., Speidel, T., Meskin, L., and Isaacson, R.: The Validity of Pont's Index as an Orthodontic Diagnostic Tool. Abstracts of I.A.D.R. Meeting, Abstract No. 691, Page 213, 1969.
4. Greve, K.: Über die Gültigkeit des Pont'schen Index. Fortschr. Orthodontik 3:163-186, 1933. Cited by Moorrees, C.: *The Dentition of the Growing Child.* Harvard University Press, 1959.
5. Hotz, R.: *Orthodontia In Everyday Practice.* J. B. Lippincott Co., Philadelphia, Page 63, 1961.
6. Smyth, C. and Young, M.: Facial Growth in Children With Special Reference to Dentition. Medical Research Council, Special Report Series No. 171, London, 1932. Cited by Horowitz and Hixon: *The Nature of Orthodontic Diagnosis.* C. V. Mosby Co., St. Louis, 1966.
7. Korkhaus, G.: Biomechanische Gebiss-und Kieferorthopädie. Handbuch der Zahnheilk. J. F. Bergmann, Munich, Vol. IV, 1939. Cited by Hotz, R.: *Orthodontia In Everyday Practice.* J. B. Lippincott Co., Philadelphia, 1961.