A Study Of Pont's, Howes', Rees', Neff's And Bolton's Analyses On Class I Adult Dentitions*

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Since the beginning of modern orthodontics, the profession has continually tried to predict the success or failure of orthodontic treatment. While it must not be supposed that variations from normal occlusion can be measured accurately and that orthodontic diagnosis can be based upon mathematical calculation, nevertheless, the ability to predetermine arch size, within limits, is a useful diagnostic aid. Many methods of analyses have been formulated, based primarily upon successfully treated cases. This study is designed to test five prescribed model analyses of normal occlusions, Pont's, Howes', Rees', Neff's, and Bolton's and to note their validity.

Review of Literature

The validity of model analysis has been questioned by other men. In 1957 Martinek[9] presented an interesting paper comparing the analyses of Howes, Rees, Kesling[8], and Strayer[17] on five treated cases. They agreed in two of the five cases and varied in the others, pointing out their lack of agreement. These analyses were all based primarily on a relationship between tooth material and supporting bone; therefore, a review of these methods may reveal why the discrepancies occurred.

Howes developed his case analysis on the premise that, in normal dentitions, the width of the maxilla in the first premolar area must be at least 43 per cent of its tooth material. The tooth material referred to was the combined mesial distal measurements of all teeth in the arch from the right first permanent molar to the left first permanent molar inclusive, which he termed maxillary tooth material or M.T.M. The arch width in the first premolar region was taken just inside the summits of the buccal cusps of the first premolars. He felt that in order for an arch to maintain itself within this 43 per cent "normal" range, the width of the apical basal bone from canine fossa to canine fossa had to be 44 per cent of the M.T.M.

The canine fossa lies just above the first bicuspids and distal to the canine eminence. Maxillary apical base bone is that area which forms the junction between the body of the maxilla and the alveolar process, and lies at the level of the apices of the teeth. The canine fossa (C.F.) measurements were taken in the canine fossa just above the first bicuspids (Figure 1).

His study was started on fourteen normal dentitions. In two hundred subsequent cases, measured directly in the

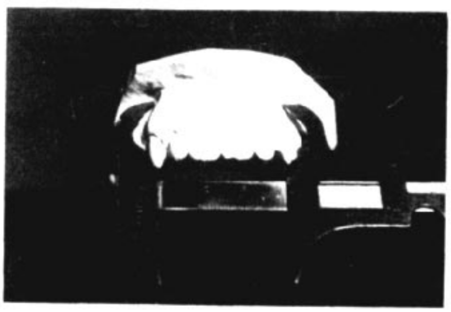

Fig. 1 Howes' method for measuring canine fossa width.

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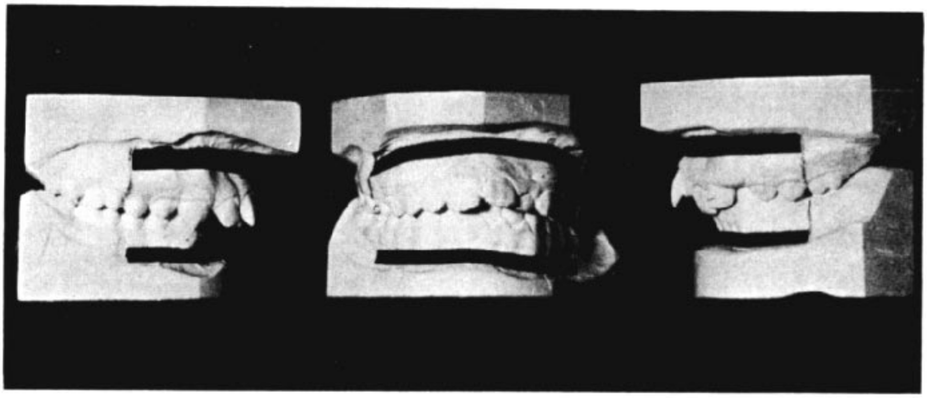

Fig. 2 Rees' method for measuring apical base.

mouth, he found that the C.F. measurement was never smaller than arch width at the first bicuspids. Thus, he interpreted a canine fossa measurement greater than that of the first bicuspid measurement as being the amount of expansion possible, and felt that no expansion could be expected to hold if it exceeded the canine fossa measurement. He also observed that distal movement of first bicuspids would increase the C.F. measurement.

On one hundred and twenty-five cases which he treated, Howes formulated his groups and made these conclusions:

1. If the ratio of canine fossa to the combined width of the maxillary first molars, premolars, canines, and incisors is 44 per cent, it may be assumed that the apical base is adequate.
2. If the ratio between C.F. and M.T.M. is between 37 per cent and 44 per cent, the adequacy of basal bone is questionable. In such cases, Howes suggests that it may be wise not to treat at all or to accept residual irregularity of the lower anterior teeth following treatment.
3. Extractions in treatment are definitely indicated if C.F. to M.T.M. is 37 per cent or less.

Rees developed a method for assessing the relationships that existed among maxillary apical base, mandibular apical base, maxillary tooth material, and mandibular tooth material. In this method tape was laid on an orthodontic cast in the zone of the apical base, from the mesial of each first molar to the other in its arch. The tape was firmly applied to the cast after all tissue attachments or artifacts were removed.

It was trimmed to represent the mesial of the first molar by placing a ruler against the side of the cast at right angles to the occlusal surface and cutting along that line. To ensure placing the tape over basal bone in the anterior region, it was placed 8 to 10 mm. apically from the gingival margin at the midline (Figure 2). The tape was then removed and its measurement in millimeters represented apical base. The tooth material, as in Howes, was the combined mesial distal measurements of all the teeth in the arch, but did not include the molars.

Rees measured twenty normal cases in which the teeth appeared in good relationship to basal bone, with no rotations, crowding, or spacing present. These measurements showed that upper apical base exceeds tooth mass by a mean of 3.2 mm., lower base exceeds lower teeth by a mean of 4.47 mm., the upper base exceeds the lower base by a mean of 6.34 mm., and upper teeth exceed lower teeth by a mean of 7.57 mm.

Rees formulated the following chart to be used for quick analysis on any type of malocclusion. The quantities were reduced to the nearest .5 mm. U.B. represents upper apical base; U.T. represents upper tooth material; L.B. represents lower apical base; and L.T. represents lower tooth material.

	Mean	*Minimum*	*Maximum*
U.B. — U.T. =	3.5	1.5	5.0
L.B. — L.T. =	4.5	2.0	7.0
U.B. — L.B. =	6.5	3.0	9.5
U.T. — L.T. =	7.5	5.0	10.0

By comparing the table of average normals with the measurements taken on any set of casts, a determination with reasonable accuracy of the following diagnostic facts can be made:

1. If the relationship of the apical base to the tooth material of each arch is beyond the range, a discrepancy exists. This should be corrected to within normal limits by extraction, or whatever orthodontic procedures the operator feels is best. In borderline cases, internal and external muscular forces, facial esthetics, and other factors must be taken into consideration. A disparity of 7 mm. less than minimum when comparing tooth material to apical base is enough to warrant extraction of dental units (Martinek).

2. If the relation of maxillary base to mandibular base is beyond the range, a discrepancy exists between the opposing arches. Reduction of the teeth and the base may be necessary in one arch or, if this is not indicated, an expansion of the other arch is the only alternative.

3. If the relation of tooth size in maxillary to mandibular arches showed discrepancies beyond the normal range, spacing or crowding are unavoidable in the finished case unless the tooth mass is equalized by reducing it in one arch or increasing it by judicious placement of crowns or inlays in the other (Rees).

The philosophy underlying Rees' approach is that of Nance[10] which follows: Growth of the apical basal bone of both jaws subsequent to the eruption of the first permanent molar is confined to the distal portions to be occupied by the second and third molars. Vertical dimension increases in the alveolar process until full eruption of the teeth. Apical basal bone from first molar to first molar does not appear to change subsequent to the eruption of these teeth, except to decrease the equivalent of the amount of forward migration during transition from mixed to permanent dentition.

Kesling's method of analysis is the so-called "diagnostic setup." The teeth are sawed from the casts with a fine blade to be repositioned in order to determine the need of reducing tooth material.

On a roentgenographic cephalogram, the Frankfort plane and the position of the apex of the mandibular incisor are located. A line is then drawn from the incisor apex to the Frankfort plane, forming with it an angle of 65 degrees. The exact inclination of the mandibular incisor is then drawn and a measurement is taken from the incisal edge to the line drawn at 65 degrees to the Frankfort plane. This measurement, then, is the guide which determines the amount the lower incisor must be tipped. By waxing the remaining teeth to the mandibular cast, the adequacy of basal bone is determined. The maxillary teeth are then sawed from the cast and set up to occlude with the lower teeth. Kesling does not resort to removal of teeth if he can compensate inclinations of the mandibular incisors to within three degrees of 65. He encourages one to range slightly toward a 70-degree angle rather than a 60-degree angle similar to the philosophy of Tweed[18], whose extraction deadline is 62 degrees. Kesling points out that Class II treatment usually increases the final angulation by about five degrees, which should be considered in the original calculations (Martinek).

Strayer's method of analysis is a visual means of judging whether the apical base is of sufficient dimension to accommodate all the teeth. He makes a drawing on plexiglass, reproducing the apical base, and marks the widths of the teeth on it in a manner similar to a Bonwill-Hawley diagram. This drawing is co-ordinated with the model by using a measurement from the apical base of the centrals to the distal of the model, which determines the depth of the drawing. Thus, when the drawing is placed over the cast so that the posterior surface aligns with the distal edge of the drawing, the relationship of apical base and teeth is readily seen.

From this review we note that the conclusions formulated by Howes and Rees were derived from a very limited number of normal occlusions and that their analyses were based essentially on clinical cases. Strayer does not state his material, and Kesling uses Tweed's statistics in his determinations. The different samples both in quality and quantity utilized in these analyses may explain the discrepancy in the results reported by Martinek.

Many other analyses have been proposed. In 1909 Pont presented to the profession a system whereby the mere measurement of the four maxillary incisors automatically established the widths of the arches in the premolar and molar regions. He showed that, by using his method, the final result was no different from that of Hawley[5] for the predetermination of arch width.

His reasons for choosing the four maxillary incisors only were to simplify the method for arch predetermination and to permit the use of the principles of arch predetermination before the eruption of the canine tooth (Hemley[6]).

Pont stated, "I must warn you that my research has been made exclusively on the jaws of the people of the French race and I would be much pleased if, at a later date, others of my colleagues could verify the correctness of this on other races." In translations Pont's material has not been adequately described except to say that a complete normal dental arch or a large number of arches were used in calculating the dimensions. The greatest widths of the incisors were measured with calipers, recorded on a line, and their sums then recorded in millimeters. The distance between upper right first bicuspid and upper left first bicuspid, and between upper right first molar and upper left first molar were similarly recorded (Simon[16]).

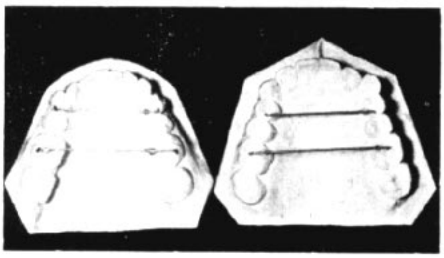

Fig. 3 Location of points used by Pont to determine arch width.

The measuring points were the distal end of the occlusal grooves of the first premolars and the mesial pits on the occlusal surface of the maxillary first molars (Figure 3). The points used on the mandibular teeth were the disto-buccal occlusal point angles on the first premolars and the highest point on the middle cusp of the buccal cusps of the first permanent molars (Salzmann[15]).

Pont's index can give an approximate indication of the degree of narrowness of the dental arches in a case of malocclusion, and also the amount of lateral expansion required in order that the arch be of sufficient size to accommodate the teeth in perfect alignment (White, Gardiner, Leighton[19]).

Barnes[2], in a recent article dealing with expansion of deciduous arches, restates the need and usefulness of such a diagnostic method as Pont's Index.

Hays N. Nance[10] points out the fact that the sum of the average widths of the maxillary deciduous canine, first and second molars of one side equals .9 mm. more than the total of the mesiodistal widths of the three permanent teeth which succeed them. This difference is known as "leeway" space. The same sort of comparison in the mandibular arch, again using average mesiodistal widths, shows that the average leeway is 1.7 mm., nearly one millimeter more than the maxillary arch. Although the difference in size between the deciduous and permanent teeth is partially or wholly taken up by the natural forward positioning of the mandibular first permanent molars, the consideration of this leeway is of value in analyzing transition cases.

In permanent dentition analysis Nance uses a brass wire contoured to pass over the buccal cusps of the bicuspids and over the center of the ridge area in the anterior segment to determine arch length. The wire is cut at the mesial buccal line angles of the first molars; thus it represents arch length from first molar to first molar. Then, if there is a disparity of 5 mm. between arch length and tooth material, extraction is necessary.

In 1949 Neff[11] developed the "Anterior Coefficient" which was then obtained by measuring the sum of the mesiodistal diameters of the six upper anteriors and dividing into that the sum of the mesiodistal diameters of the lower six anteriors. This figure was called the Anterior Coefficient.

If the lower anterior teeth were in an upright position over basal bone and all other factors were normal in the case, a definite correlation was found to exist between the Anterior Coefficient and per cent of overbite.

He set up this table to correlate coefficient to per cent of overbite.

Coefficient	*Per Cent Overbite*
1.10	0
1.20	20
1.30	35
1.40	55
1.55+	100

Three hundred cases of malocclusion were used in this study. Neff came to the conclusion that, everything else being normal, an orthodontic or nonorthodontic normal will settle to the degree of overbite indicated by the Anterior Coefficient. However, he felt it would be necessary to measure many more normal occlusions to prove his thesis.

In a later paper Neff[12] analyzed a subsequent three hundred malocclusions. In this paper he used what is known as the "Anterior Percentage Relation" or A.P.R. Anterior Percentage Relation is the per cent acquired when the maxillary six anteriors are divided into the mandibular six anterior incisors. Actually, Anterior Percentage Relation is the reciprocal of Anterior Coefficient. Neff adapted his Anterior Coefficient to the Anterior Percentage Relation to more easily compare his results with other methods dividing upper teeth into lower teeth.

Thus, the sum of six hundred malocclusions was used to establish Neff's A.P.R. These cases were all measured directly in the patients' mouths.

Neff concluded that the maxillary six anteriors were 18 per cent to 36 per cent larger than the mandibular six anteriors. He points out that his ranges varied from those of Bolton[3] who examined excellent occlusions and whose figures ranged from 24 per cent to 34 per cent.

In this paper Neff set up the following chart:

A.P.R.	*% Overbite*
10-18%	0
22	15
30	30
36	35
40	50
55	100

He pointed out that the anterior teeth had to come as close as possible to Downs'[4] rating of 135 degrees for upper incisor to lower incisor in order for the A.P.R. to be valid.

Two other analyses have been developed by Bolton[3]; in these he determines a ratio of mandibular tooth material to maxillary tooth material. By using this ratio and comparing it with his standard, the arch that is deficient is determined. The amount of the discrepancy is determined by referring to a table which predicts the amount of tooth material that the deficient arch should have.

From the amount of tooth material from first molar to first molar inclusive, a ratio is established by dividing the sum of the mandibular teeth by the maxillary teeth. If this ratio exceeds 91.3 per cent, the discrepancy is in excessive mandibular tooth material. If the ratio is less than 91.3 per cent, the mandibular tooth material may be assumed to be correct, and the discrepancy is in the maxillary arch of teeth.

For analysis of anterior teeth, the ratio of the sums of the six anteriors is established by dividing maxillary teeth into mandibular teeth. If the ratio exceeds 77.2, the discrepancy is in the mandibular arch. If it is less than 77.2, it is in the maxillary arch.

Bolton's mean, standard deviation and range for the analyses are shown by the following:

	Total Tooth Material	*Incisor Tooth Material*
Mean	91.3	77.2
S.D.	1.91	1.65
Range	87.5-94.8	74.5-80.4

These are the standards we will compare with our findings.

An ideal occlusion based primarily on the structural design of tooth forms has long been the standard of normal. Angle[1] derived this hypothetical ideal as a standard from his study of the morphology of the teeth. Strict adherence to the concept of an ideal normal occlusion has been severely criticized in recent years.

Normal occlusion of the teeth has been defined in this way: Occlusion of the teeth is normal when their manifold functions are efficiently performed and the health of the supporting structures is maintained. The primary functions of the teeth include mastication, esthetics, and functions of speech and deglutition (Hemley). However, there is no better way to refer to types of occlusions and to arrive at an understanding of the exact features involved than Angle's classification. It is obvious that the analyses so far discussed were based to a great extent on malocclusions. Therefore, it is the object of this study to test Pont's, Howes', Rees', Neff's, and Bolton's analyses on normal Class I dentitions. As pointed out by Angle, the perfect occlusion is rare. In this study cases with slight slipped contacts, minor rotations, or insignificant deviations from perfect occlusion were used. These cases were, however, considered in a group *separately* from the perfect samples. The two groups were classified as "normals" and "ideals" to see whether they showed any significant differences in their analyses.

Methods and Materials

This investigation was limited to model analyses that could be done with similar measurements and armamentarium, relating tooth material to basal bone.

All cases were normal Class I (Angle) adult dentitions selected from the models of fifty-seven dental students and eight Navaho Indians whose casts were on file at the College of Dentistry, Ohio State University. Bridges or missing teeth anterior to the second molar automatically disqualified the case. Cases with peg laterals or obvious anomalies were also discarded. Overjet and overbite had to be within acceptable limits; that is, up to about 2 mm. overjet, and no case with less than 1 mm. overbite or lower incisors exceeding the cingulum of the upper incisors when in centric occlusion. Cases with obvious diastema, reverse curves of Spee, buccal tipping of lower posterior teeth, lingual tipping of upper posterior teeth or anterior teeth were not acceptable. Obviously, any crossbite relation eliminated the case. In all, thirty-four normals and twenty-four ideals were studied.

The armamentarium used included protractor, Boley gauge, dividers, and tape.

All measurements and observations were made on plaster models in accordance with the methods prescribed by the authors involved (Figures 1, 2, 3).

Findings and Observations

The number of models used in this study was relatively small; therefore, the range for comparison with Pont's index covered only a portion of his table. However, the sample does reflect the range most likely to be encountered, which are the figures of greatest practical value. The figures reflected by the cases here ranged from 28.3 mm. combined mesial distal widths of the maxillary centrals and laterals to 34.6 mm., with the greatest concentration in the range 31 mm. to 31.5 mm. In statistical analysis of the ideals, computation for the regression equation revealed that a significant correlation existed between the combined incisor widths and the molar and upper premolar widths. No corresponding correlation could be found in the normals. The lower premolar width had no significant correlation to incisor width in either the ideals or the normals.

For Howes' analysis, the cases ranged from 37.5 to 51.5 for canine fossa to tooth material, with a mean of 43.43 and a standard deviation of 2.74 (Table I). Twenty-nine cases were less than 44 per cent; twenty-five cases were greater than 44 per cent; and none of the cases were less than 37 per cent.

In considering Rees' analysis, the upper base to upper teeth ranged from —5.3 to +10.3, with a mean of 0.31 and a standard deviation of 3.65 (Table II). Six of the cases exceeded Rees' maximum of +5, and thirty-seven were less than his minimum of +1.5.

Lower base to lower tooth material ranged from —3.7 to +8.6, with a mean of 2.83 and a standard deviation of 2.99. Rees' minimum of +2 was exceeded twenty-two times by quite a large differential.

In comparing upper base with lower base, the mean for the combined figures of the ideals and the normals was 7.07, with a standard deviation of 2.79 and a range from 1.5 to 12.4 (Table II).

The ranges for upper tooth material to lower tooth material were 2.4 to 13.8 mm., with a mean of 9.61 and a standard deviation of 2.05. Rees' maximum of +10 mm. was exceeded

TABLE I

HOWES' ANALYSIS COMPUTATIONS

	Canine Fossa	*Canine Fossa*	*First Bicuspid Arch Width*	*First Bicuspid Arch Width*
	Tooth Material (Normals)	*Tooth Material (Ideals)*	*Tooth Material (Normals)*	*Tooth Material (Ideals)*
Number	34	21	34	21
Mean	43.66	43.05	42.44	43.08
Standard Deviation	2.95	2.38	1.81	1.19
Largest	51.5	46.5	46.9	45.8
Smallest	39.3	37.5	38.8	40.3

	Canine Fossa	*First Bicuspid Arch Width*
	Tooth Material (Ideals + Normals)	*Tooth Material (Ideals + Normals)*
Number	55	55
Mean	43.43	42.72
Standard Deviation	2.74	1.61
Largest	51.5	46.9
Smallest	37.5	38.8

twenty-three times; however, his minimum of +5 mm. was never exceeded.

In Bolton's analysis of the percentage of mandibular tooth material to maxillary tooth material, there was no apparent difference in the ideals from that of the normals. The sample ranged from 87.2 to 94.6, with a mean of 91.04 and a standard deviation of 1.90. There was, however, a difference between the percentage of the mandibular six anteriors to the maxillary six anteriors when comparing ideals to normals. The ideals ranged from 72.5 to 81.7 per cent, with a mean of 77.55 and a standard deviation of 2.72. The normals ranged from 73.9 to 83.3 per cent with a mean of 78.59 and a

TABLE II

REES' ANALYSIS COMPUTATIONS

	Upper Base to Upper Teeth (Ideals & Normals)	*Upper Base to Lower Base (Ideals & Normals)*	*Lower Base to Lower Teeth (Ideals & Normals)*	*Upper Tooth Mat. to Lower Tooth Mat. (Ideals & Normals)*
Number	56	54	55	56
Mean	0.31	7.07	2.83	9.61
Standard Deviation	3.65	2.79	2.99	2.05
Largest	10.3	12.4	8.6	13.8
Smallest	—5.3	1.5	—3.7	2.4

TABLE III
BOLTON'S ANALYSIS COMPUTATIONS

	% Mand. Teeth / Max. Teeth (*Normals*)	*% Mand. Teeth / Max. Teeth* (*Ideals*)	*% Mand. Ant. Teeth / Max. Ant. Teeth* (*Normals*)	*% Mand. Ant. Teeth / Max. Ant. Teeth* (*Ideals*)
Number	34	23	34	22
Mean	91.10	90.94	78.59	77.55
Standard Deviation	1.79	2.08	2.37	2.72
t				1.510
Largest	94.6	94.2	83.3	81.7
Smallest	87.9	87.2	73.9	72.5

	% Mand. Teeth / Max. Teeth (*Ideals + Normals*)	*% Mand. Ant. Teeth / Max. Ant. Teeth* (*Ideals + Normals*)
Number	57	56
Mean	91.04	78.18
Standard Deviation	1.90	2.54
Largest	94.6	83.3
Smallest	87.2	72.5

standard deviation of 2.37 (Table III).

Discussion

By plotting the combined widths of the maxillary centrals and laterals to the arch widths of the maxilla and mandible in the bicuspid and molar regions, scattergrams were produced in which the ideal occlusions formulated a curve, falling quite close to that predicted by Pont's index. A similar comparison for the normals was much more difficult to demonstrate because of the greater range of measurements encountered. These curves all fell below those predicted by Pont's index. Arch width measurements of the molar area were found to be the same in the maxilla and the mandible; therefore, no calculations were made for lower molar arch width.

Apparently the findings here paralleled Pont's figures. It is significant that there was a definite correlation found in the ideals between anterior tooth size and arch width. The normals did not correlate and had such a large range that it would be fallacious to assume that every case must be regulated to the measurements predicted by Pont's index in order to be successful. However, Pont's measurements should be a goal to strive for when working toward the ideal.

Pont's sample was composed entirely of persons of French nationality. Ours was done on Americans of many different national groups. This may possibly be the reason our normals did not agree with Pont's figures.

It was observed that the points used in measuring the arch width of the maxilla in the first bicuspid area were more difficult to locate than those in the mandible, and that these two measurements were not equal.

In Howes' analysis there was no difference between the ideals and the normals when compared graphically, and both were in agreement with Howes' figures. Apparently Howes' theory that canine fossa cannot be exceeded by the bicuspid arch width is not valid. True, it was found that the mean of the upper bicuspid arch width did not exceed canine fossa statistically; however, in actual count the canine fossa was exceeded in sixteen cases out of fifty-five. Perhaps our findings differ from Howes' on this point because in all of his measurements only fourteen normal occlusions were considered, whereas all of our measurements were done on normal occlusions.

It would be interesting to make a study by using Howes' analysis of C.F. and correlate it with Pont's lower arch width. Pont's measurement of the mandibular arch width in the bicuspid area was always less than that of the maxilla and was never more than that of the canine fossa. By this method the lower arch could be correlated to the upper arch; Howes' analysis has been criticized because it does not do this.

Howes believes that because the maxillary teeth overlap the mandibular teeth they are in control of the shape and size of the lower arch. It would seem from the findings of this study that the maxillary basal bone controls the lower dental arch, and it in turn controls the upper dental arch.

In this study, eight cases of Navaho Indians were included. In seven of these eight, the canine fossa was exceeded by the bicuspid arch width. Could environment be the reason or is it the hereditary pattern of the ethnic group?

In considering Rees' analysis, the normals and the ideals all compared graphically quite similarly except when considering upper base to lower base, and this comparison showed only a slight difference. Ninety per cent of the ideals ranged from 5.3 to 10.5. Ninety per cent of the normals ranged from 1.9 to 11.2. The ideals did not exceed Rees' range for the minimum amount of 3 mm. but did exceed his maximum amount of 9.5 mm. in a few cases by 1 mm. A few of the normals exceeded both the maximum and the minimum.

When Rees' analysis was compared with the normal and ideal, there was a lack of agreement on the limits involved. The cases tested here indicated that Rees' ratings, changed to the nearest .5 mm., should be as follows:

	Mean	*Minimum*	*Maximum*
U.B.-U.T.	+ .5	—3.5	+ 4
L.B.-L.T.	+3	0	+ 6
U.B.-L.B.	+7	+4.5	+10
U.T.-L.T.	+10	+8	+12

Thus, in using these newer values, Martinek's criteria of 7 mm. discrepancy between U.B.-U.T. as the extraction limit could be reduced to about 4 mm. which correlates much more closely with Nance's limit of 5 mm.

Rees' sample consisted of "twenty normal non-extracted cases," which does not describe his sample in much detail; this may be the factor accounting for the difference in our findings.

Bolton's percentage relationship of lower tooth material to upper tooth material compares exceptionally well with the percentage found here.

	Bolton	*Ideals and Normals*
Mean	91.3	91.04
Standard deviation	1.9	1.90
Range	87.5-94.8	87.2-94.6

For the anterior percentage relationship the ideals came very close to Bolton's figures. Conversely, the normals did not correlate with his figures.

	Bolton	*Ideals*	*Normals*
Mean	77.2	77.55	78.59
Standard deviation	1.65	2.72	2.37
Range	74.5-80.4	72.5-81.7	73.9-83.3

Neff used six hundred malocclusions and arrived at a mean of 79 per cent which would not agree with our mean of 77.55. The mean of 77.2, found by Bolton on excellent occlusions is in agreement with our figure. This is gratifying in view of the fact that both samples were similar; that is, both were samples of normal occlusions.

It is obvious that the percentage relationship of the lower to the upper anterior tooth size is a vitally significant consideration to make when attempting to harmonize tooth material.

Conclusions

A statistical test was applied to fifty-eight cases of ideal and normal occlusions to note the validity of Pont's, Howes', Rees', Neff's, and Bolton's analyses.

In Pont's analysis there was a significant correlation existing between the combined incisor widths and the molar and upper premolar widths in the ideal occlusions, but not in the normal occlusions.

Howes' analysis showed the mean per cent of canine fossa to tooth material to be 43.43, with a standard deviation of 2.74 and a range of 37.5 to 51.5, which compares favorably with his figure of 44 per cent.

Rees' figures should be changed to—

	Mean	*Minimum*	*Maximum*
U.B.-U.T.	+ .5	—3.5	+ 4
L.B.-L.T.	+3	0	+ 6
U.B.-L.B.	+7	+4.5	+10
U.T.-L.T.	+10	+8	+12

Bolton's percentage relationship for lower tooth material to upper tooth material of 91.3 agrees with that found here. The anterior percentage relationship of 77.55 also compares favorably with what was found by him.

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