# Comparative Changes In Mandibular Canine And First Molar Widths

Douglas C. Walter, D.D.S., M.S.
*Fort Lauderdale, Florida*



## Introduction

In a time when diagnosis has been advanced and even dominated by the cephalometricians, the study of plaster casts has been rendered less fashionable. A return to the study of plaster seems essential even though such research is unspectacular and undramatic.

The present investigation was motivated by an old question that comes up again and again and is never really laid to rest. It concerns the possibilities of dental arch expansion and the maintenance of such expansion. Even more specifically, the question has been reduced to two measurements, namely, can intercanine width and intermolar width in the mandible be increased and can such increase be sustained following removal of retention. In the borderline cases, where extraction or nonextraction is an issue, the answers to these questions become crucial.

Two previous reports dominated my thinking at the beginning. You will recall that Strang's paper has been cited time and again as the fountainhead of the idea that expansion through the cuspids could not be sustained. More recently, we were stimulated by Steadman's report in which he reviewed thirty-five cases. In view of the limited size of Steadman's[8] sample and further because Strang[1] did not cite the size of his in the 1949 paper which was so influential in shaping orthodontic opinion, it seemed worthwhile to repeat previous efforts.

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## Review of the Literature

Since the literature on this general subject has been reviewed in a critical manner by others such as: Strang[1], Barrow and White[2], Berger[3], Nance[4], Dewel[5], Woods[6], Howes[7], Steadman[8], Walter[9], Lewis[10], Sillman[11], Cohen[12], and Moorrees[13], further review would be redundant.

However, to establish a frame of reference it should be noted that previous pertinent studies can be divided into two categories, (a). Longitudinal and cross-sectional studies reporting on untreated cases; (Barrow and White, Woods, Lewis, Sillman, Cohen, and Moorrees.) (b). The second has to do with that type of investigation that measured the changes following orthodontic treatment and following removal of retentive devices; (Strang, Nance, Howes, Steadman, and Walter.)

## Materials

Chart 1 shows a summary of materials. Fifty nonextraction cases and fifty extraction cases were classified according to the Angle Classification. The nonextraction cases included 16 Class I cases, 25 Class II, Div. 1 cases, and 9 Class II, Div. 2 cases. The extraction cases included 36 Class I cases, 12 Class II, Div. 1 cases and 2 Class II, Div. 2 cases.

An appraisal of the orthodontic results showed that 82 of the 100 cases examined were considered a "good" result; 15 cases were considered as "fair"; and 3 were considered a "poor" result.

CHART 1. SUMMARY OF MATERIALS

| | 50 Non-Extraction cases | | 50 Extraction cases | |
|---|---|---|---|---|
| Angle Classification | Class I | 16 | Class I | 36 |
| | Class II, Div. 1 | 25 | Class II, Div. 1 | 12 |
| | Class II, Div. 2 | 9 | Class II, Div. 2 | 2 |
| Appraisal | Good | 40 | Good | 42 |
| | Fair | 9 | Fair | 6 |
| | Poor | 1 | Poor | 2 |
| Sex | Boys | 16 | Boys | 15 |
| | Girls | 34 | Girls | 35 |
| Average age to begin treatment | 11 years, 8 months | | 11 years, 9 months | |
| "Ample Period" | $2\frac{1}{2}$ years | | 3 years | |

The girls outnumbered the boys 69 to 31. The average age that treatment was begun was 11 years, 8 months.

The average "ample period" after retention devices were removed was 2 years 9 months.

## Method

Figure 1 shows the two mandibular widths measured, in tenths of millimeters, the intercanine width from the central-labial lobe of each canine and the first molar width from the summit of the mesiobuccal cusp to its respective mate.

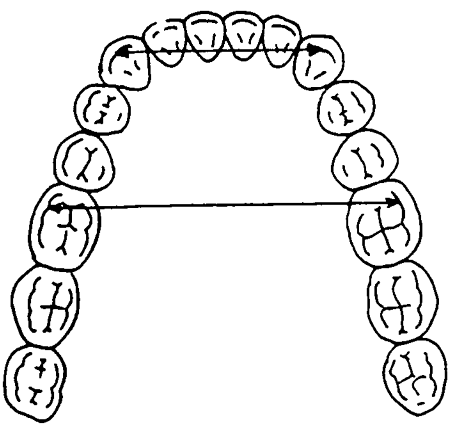


Fig. 1 Illustration showing measurements used.

These measurements were made before treatment, following completion of active treatment, and at least one year following removal of retainers (the "ample period"). In some cases the last measurement was made directly in the mouth.

## Findings

Chart 2 illustrates the different directions of tooth movement. The after treatment records were invaluable since they permitted a separation of the amount of active-treatment movement from the amount of adjustment which was produced by function and growth. Function and growth permitted determination and classification of tooth movements during active treatment, retention and after retention.

I. This first movement may be called ideal because it results in the placement of teeth in positions requiring no post-treatment adjustment.

II. This movement indicated that it was not sufficient to place the teeth in a position of final stability. Subsequent movements by natural forces were in the same direction as those induced by treatment.

III. This movement showed that the

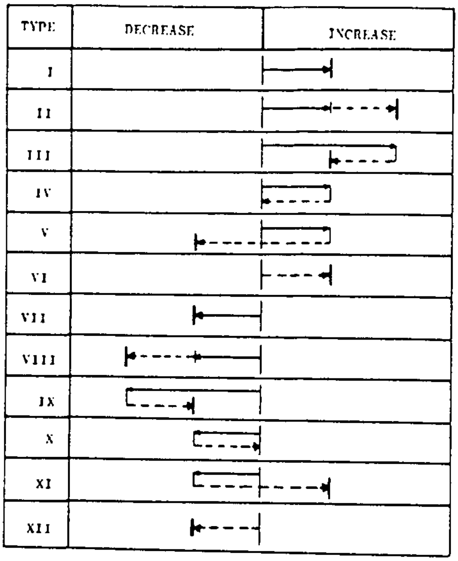



Chart 2 Illustration of different directions of tooth movement. Legend: The solid horizontal line represents the orthodontic movement. The broken line represents the adjustment which occurred as a result of growth and function. The space between the vertical starting line and the heavy vertical line in contact with the arrowhead represents the net movement or resultant.

teeth were moved orthodontically more than was necessary. Subsequent adjustment by natural forces tended to return them to or toward their original positions.

IV. In this case the net result reveals that the teeth involved should not have been disturbed. In other words, adjustment of growth and function returned them to their original position and cancelled the linear modification brought about by treatment.

V. This class represents the behavior of those cases in which, due to extreme crowding, the arch does not present its typical form. In the treatment of such cases it is frequently necessary to unlock certain teeth as a preliminary step to arch alignment. This would lead to a condition of overexpansion. The post-treatment behavior represents a modification of the arch form to one that is in harmony with other anatomical structures.

VI. This type of movement indicates a condition in which, although certain teeth have not been moved orthodontically, they have been brought into their proper relations with others that have been moved.

VII to XII correspond to I to VI respectively, except that the orthodontic movement was in the nature of contraction.

Table 1 shows the average orthodontic movement (O.M.), the adjustment (A), the resultant (R), and also

Table 1. Cases on which models were available before and at the end of treatment and following retention.

| | | No. Cases | Mean | | |
|---|---|---|---|---|---|
| 3-3 | Non-Extraction | 31 | O.M. +3.2 mm | A. -1.2 mm | R. +2.0 mm |
| | | 19 | O.M. +0.1 mm | A -1.1 mm | R. -1.0 mm |
| | Extraction | 32 | O.M. +2.7 mm | A. -1.3 mm | R. +1.4 mm |
| | | 18 | O.M. +0.9 mm | A. -2.2 mm | R. -1.3 mm |
| 6-6 | Non-Extraction | 36 | O.M. +2.4 mm | A. -0.6 mm | R. +1.8 mm |
| | | 14 | O.M. -0.4 mm | A. -0.5 mm | R. -0.9 mm |
| | Extraction | 15 | O.M. +2.3 mm | A. -1.0 mm | R. +1.3 mm |
| | | 35 | O.M. -1.9 mm | A. -1.0 mm | R. -2.9 mm |

Scale: 5 4 3 2 1 0 1 2 3 4 5 — 1 mm. (Decrease / Increase)

Table 1 Cases on which models were available before and at the end of treatment and following retention. O.M. — orthodontic movement or linear modification attained in active treatment. A. — adjustment or the linear modification which occurred in the interval between the termination of active treatment and the end of the ample period following removal of retention devices. R. — resultant or the linear change in position as determined by measurements taken before treatment and again at the end of the ample period following the removal of retention devices.

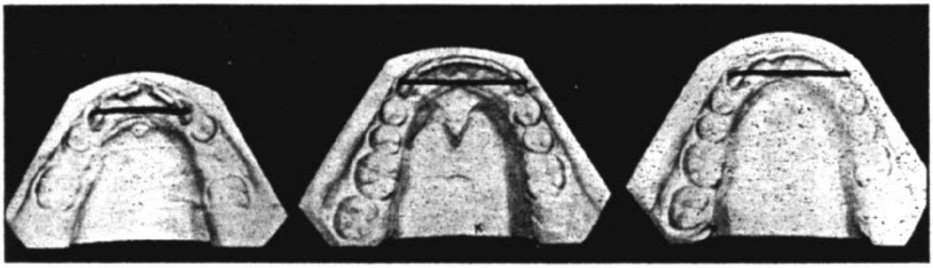


Fig. 2 Nonextraction case of intercanine width, two years out of retention, shows orthodontic movement of +5.8 mm; an adjustment due to function and growth of —0.9 mm; and a resultant increase of +4.9 mm. This is a Type III movement occurring in 52% of cases.

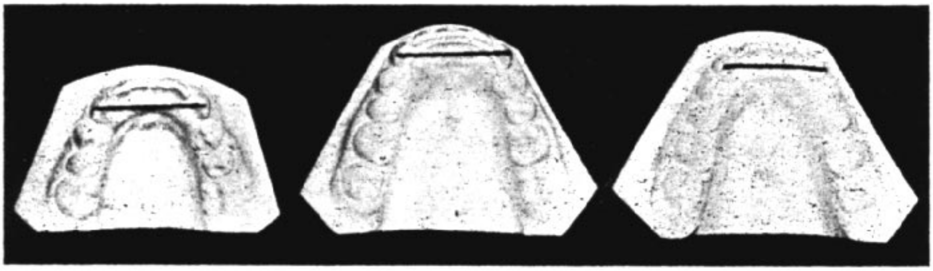


Fig. 3 Nonextraction case of intercanine width, three years out of retention, shows orthodontic movement of —1.2 mm; an adjustment due to function and growth of —1.8 mm; and a resultant decrease of —3.0 mm. This is a Type VIII movement occurring in 14% of cases.

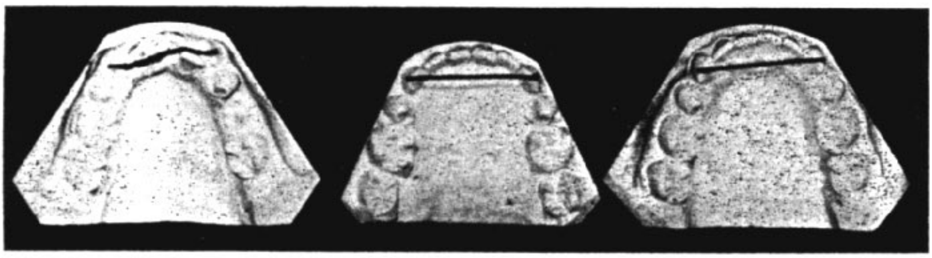


Fig. 4 Extraction case of intercanine width, four years out of retention, shows orthodontic movement of +6.0 mm; an adjustment due to function and growth of —1.0 mm; and a resultant increase of +5.0 mm. This is a Type III movement occurring in 56% of cases.

the extreme range of tooth movement in the nonextraction and extraction cases of the intercanine and intermolar width measurements.

Figures 2 to 8 inclusive will show mandibular models, indicating the extremes of range of tooth movement.

Figure 2 shows the greatest increase maintained in the nonextraction intercanine width, a Type III tooth movement occurring in 52% of the cases (+4.9 mm).

Figure 3 shows the greatest decrease in the nonextraction intercanine width, a Type VIII tooth movement occurring in 14% of the cases (—3.0 mm).

Figure 4 demonstrates the greatest increase maintained in the extraction intercanine width, a Type III tooth movement occurring in 56% of the

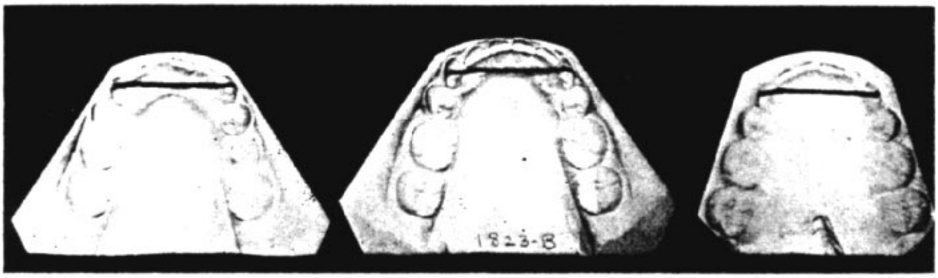



Fig. 5 Extraction case of intercanine width, one year out of retention, shows orthodontic movement of —0.5 mm; an adjustment due to function and growth of —1.5 mm; and a resultant decrease of —2.0 mm. This is a Type VIII movement occurring in 4% of cases.

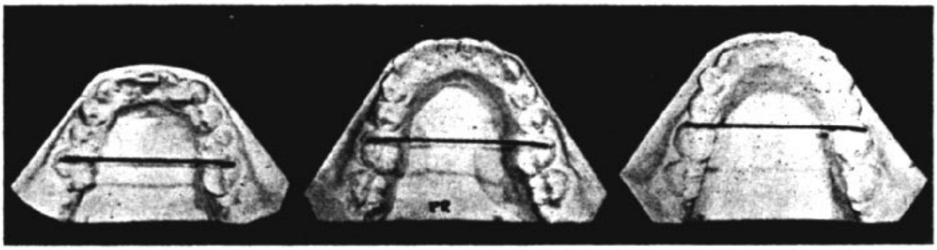


Fig.6 Nonextraction case of intermolar width, four years out of retention, shows orthodontic movement of +4.0 mm. an adjustment due to function and growth of +1.8 mm; and a resultant increase of +5.8 mm. This is a Type II movement occurring in 16% of cases.

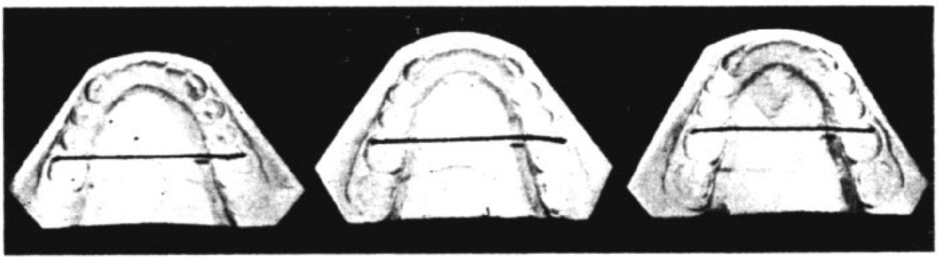


Fig. 7 Nonextraction case of intermolar width, two years after no retention, shows orthodontic movement of —0.5 mm; and adjustment due to function and growth of —2.0 mm; and a resultant decrease of —2.5 mm. This is a Type VIII movement occurring in 10% of cases.

cases (+5.0 mm).

In Figure 5 we have the greatest decrease in an extraction intercanine width, a Type VIII tooth movement occurring in 4% of the cases (—2.0 mm).

Figure 6 shows the greatest increase maintained in a nonextraction intermolar width, a Type II tooth movement occurring in 16% of the cases (+5.8 mm).

In Figure 7 is depicted the greatest decrease in the nonextraction intermolar width, a Type VIII tooth movement occurring in 10% of the cases (—2.5 mm).

Figure 8 shows the greatest decrease in the extraction intermolar width, a Type VIII tooth movement occurring in 48% of the cases (—6.5 mm).

An illustration is not available of the greatest increase in the extraction inter-

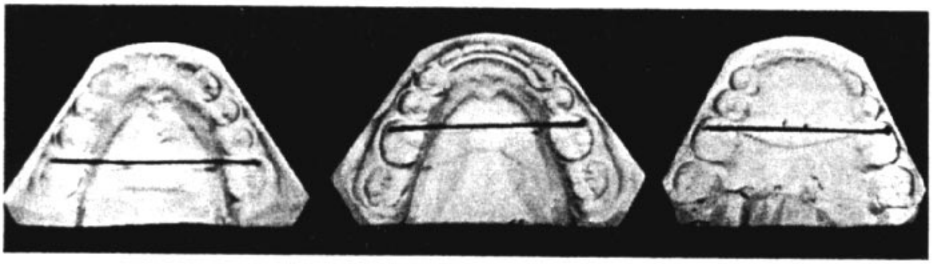


Fig. 8 Extraction case of intermolar width, four years out of retention, shows orthodontic movement of —6.0 mm; an adjustment due to function and growth of —0.5 mm; and a resultant decrease of —6.5 mm. This is a Type VIII movement occurring in 48% of cases.

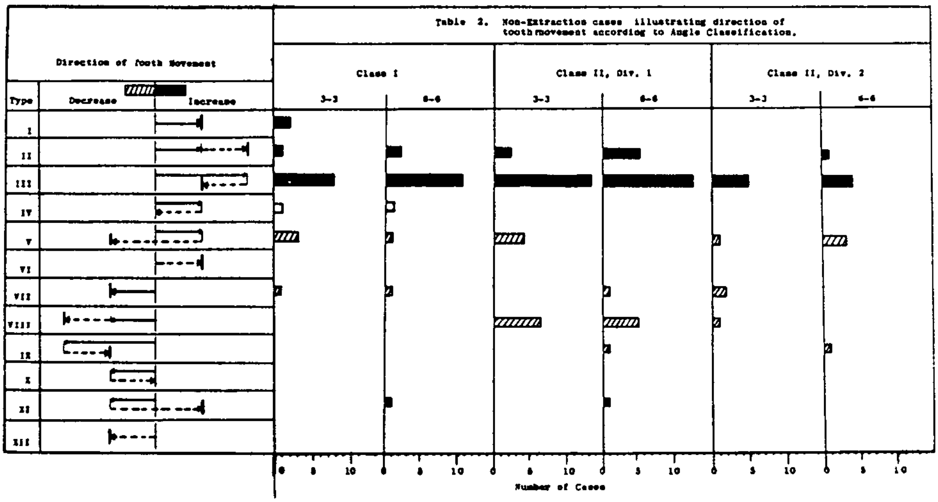



Table 2

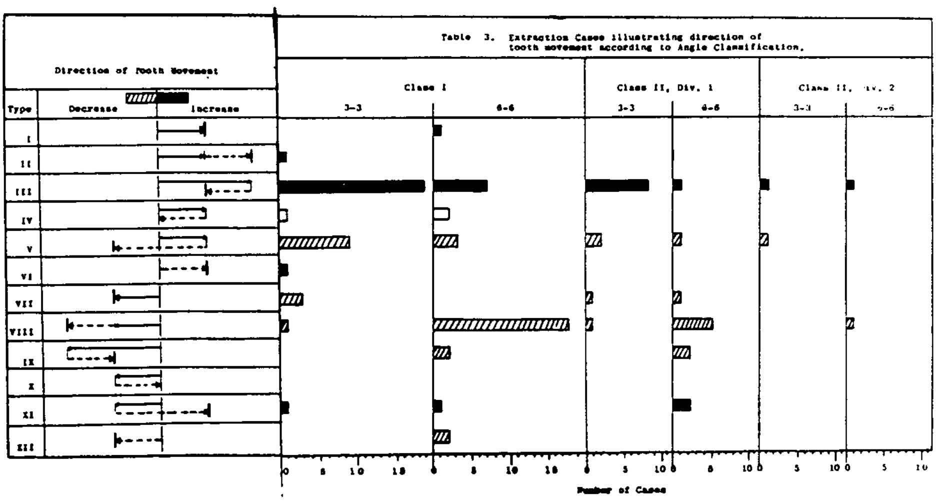



Table 3

molar width. It was a Type III tooth movement occurring in 18% of the cases (+2.3 mm).

Table 2 shows the nonextraction cases illustrating the direction of tooth movement in the Angle Classifications. In 52% of the cases the type of tooth movement is Type III which means that the canines and molars were moved orthodontically more than was necessary and that the forces of function and growth tended to return them to or

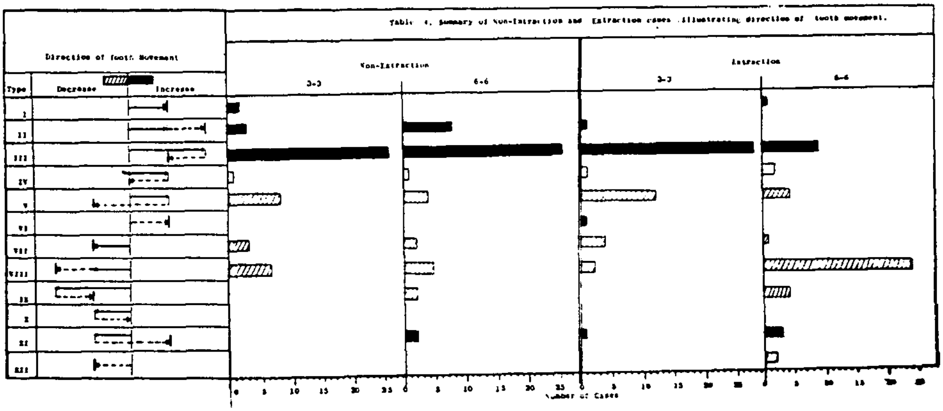
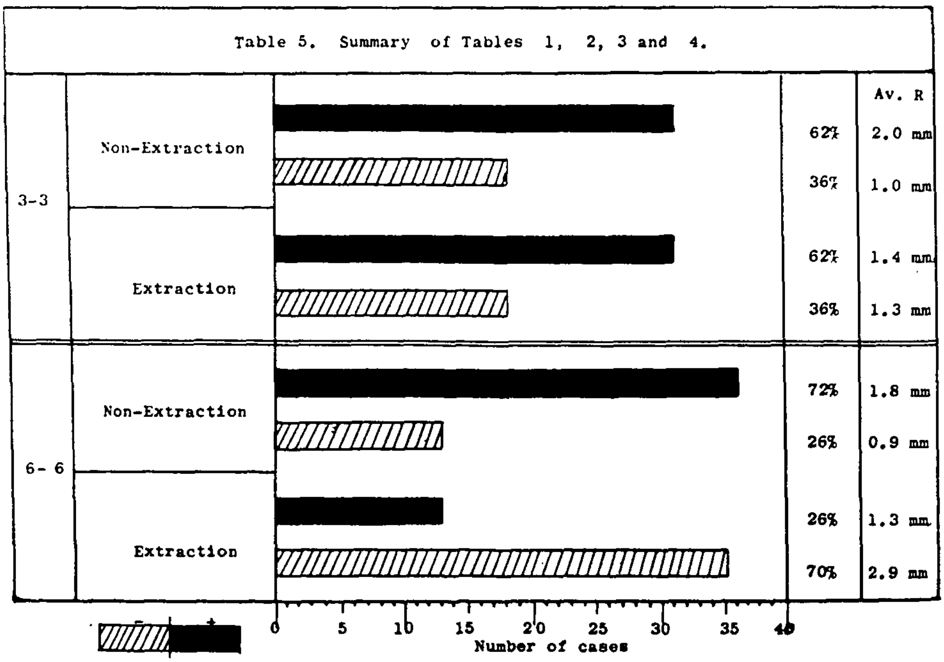



Table 4




Abbreviations: Av.R - The average Resultant in millimeters or the linear change in position as determined by measurements taken before treatment and again at the end of the ample period following the removal of retention devices.

Table 5

toward their original positions. An increase in width was obtained and maintained.

Table 3 demonstrates the extraction cases illustrating the direction of tooth movement. In 56% of the cases the intercanine width was a Type III tooth movement, as in the nonextraction cases. In the intermolar widths 48% of the tooth movement was Type VIII which means that the molars were not sufficiently placed in a position of final stability, and subsequent movements by natural forces were in the same direction as those induced by treatment, namely contraction.

Table 4 is a summary of Tables 2 and 3.

Table 5 is a summary of the previous tables and shows that in 31 or 62% of the nonextraction cases an increase of +2.0 mm of intercanine width was obtained and maintained. And in the extraction cases 31 or 62% showed an increase of +1.4 mm of intercanine width which was also obtained and maintained.

Of 36 or 72% of the cases in the nonextraction group an average increase of +1.8 mm was obtained and maintained in intermolar widths. Conversely, in the extraction intermolar widths, 35 or 70% of the cases demonstrated a contraction or decrease of —2.9 mm. Only in 13 or 26% of these widths was there an increase in width which averaged +1.3 mm.

## Discussion

There is one limitation inherent within the sample of extraction cases studied that warrants critical examination. One may ask if this sample truly represents the complexion of extraction cases as noted throughout the country. This cannot be answered without a more extensive survey of regional groups or those who are followers of a specific dogma.

It might be observed in criticism of this work that the practitioners represented herein are an inbred group and of a given generation. But, I think a more cogent criticism may be derived from the fact that the extraction sample is heavily loaded with Class I cases, 36 out of 50.

What does this mean? It could mean that we are dealing with two kinds of malocclusions. (a) Frank arch length discrepancies wherein the canines are often blocked out buccally, and outside the trough of the alveolar process or, (b) double protrusions with a minimal number of broken contact relations. I can't answer this question for I did not see the original records and examined only the measurements provided.

Let us assume that the majority of the Class I extraction cases represented were of the first variety, the frank arch length discrepancies with blocked-out canines. How would this influence our measurements? Obviously, orthodontic correction in which blocked-out cuspids are brought into alignment would result in contraction of intercanine widths.

On the other hand, if our sample of extraction cases was dominated by double protrusions or by Class II, Division 1 cases, wherein the lower incisors were procumbent, the character of the measurements would change. In such instances the canines would be retracted from a narrow segment of the arch to a wider segment. This statement would further assume that molar anchorage was preserved to the fullest.

Other variants not considered might include first bicuspid versus second bicuspid extractions, general arch form, inclination of teeth, indeed the entire gamut of variables included in modern-day diagnosis.

It appears that the ultimate study is yet to be done. Such an investigation would perforce include an analysis of all the important variants gleaned from casts and from cephalometric films. If the present investigation has done nothing else, it has, at least, pointed out these limitations in the present and previous reports.

*370 S.E. 2nd St.*

ACKNOWLEDGMENTS

This work would not have been possible without the generous supply of cases long out of retention made available to me by the following orthodontists: Dr. Allan G. Brodie, Dr. Chester F. Wright, Dr. William B. Downs, Dr. Abraham Goldstein, and Dr. Arthur B. Lewis.

It should be noted that the interpretations and discussions of these records are mine and should not be misconstrued as necessarily reflecting the judgments or opinions of the above named men.

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## *Discussion*

### *Sherwood R. Steadman*

Dr. Walter is to be complimented for the splendid report and material which he has presented here. The results of a similar study which we presented before this group a year ago are much like those of Dr. Walter. The intercanine distances behaved the same in the nonextraction and extraction cases: the intermolar distances of the nonextraction cases tended to increase and those of the extraction cases to decrease. Unfortunately we had only nine extraction cases in our study. Dr. Walter's Table 5 shows that the intercanine distances behave the same in nonextraction and extraction cases. As for the intermolar distance 72% of the nonextraction cases showed an *increase* of the intermolar distance while 70% of the extraction cases showed *decrease*. Furthermore, the average decrease in intermolar distance is 2 mm more in the extraction cases than in the nonextraction cases. Even the average increase of intermolar distance is 0.5 mm less in the extraction cases than in the nonextraction cases. Thus the great difference between the extraction and nonextraction cases lies in the final narrower intermolar distances of the extraction cases.

In his discussion Dr. Walter suggested that the extraction sample may be "loaded" with buccally blocked canines.

In these cases the intercanine distance would have to be decreased during treatment. In Table 5 36% of the cases had a decrease of intercanine distance in *both* nonextraction and extraction cases. Thus, even if the sample were loaded with buccally "blocked out canines", it would be inconsequential. As for double protrusion "loading" these cases would require moving the canines posteriorly into a wider part of the dental arch, thus increasing the intercanine distance. Table 5 shows that an increase of intercanine distance occurred in 62% of not only the extraction cases, but also of the nonextraction cases. Thus the extraction and nonextraction cases behaved alike as to changes in intercanine distances and so any "loading" is inconsequential.

Also in his discussion, the essayist mentions that his sample seems "loaded" because there are 36 Class I cases out of the total of 50 extraction cases. Table 3 shows that the two highest percentage groups of intercanine measurements fall in Types III and V for Class I, Class II, 1 and Class II, 2 and these constitute 80% of the cases. So the Class I cases behave no differently from Class II, 1 and Class II, 2 cases, in regard to intercanine measurements. Similarly, the two highest percentage groups of intermolar measurements fall in Types III and VIII and these constitute 66% of the cases. Again any loading is inconsequential.

It is interesting to note that of the extraction cases (Table 3, adding all Types except I and VII) 92% showed change of intercanine distance following treatment and 96% a change in intermolar distance; Table 2 showing nonextraction cases (adding all types except I and VII) 90% showed a change in intercanine distance following treatment, and 96% a change of intermolar distance. Thus in over 90% of the cases, both nonextraction and extraction, the intercanine and/or intermolar distances changed following treatment; in other words only 10% of the cases or less stayed as treated. So, cuspids and molars seldom remain where they are moved during treatment.

Finally, there is mention of the importance of the trough of the alveolar process. May I remind you that the alveolar process is part of the tooth and moves wherever the tooth moves; if this were not so, orthodontic treatment would be impossible. The alveolar process does *not* determine the position of the tooth. The basal bone is a guide for the positioning of the apex of the root of the tooth but does not determine the position of the crown. The position of the crown is determined normally by the muscular function of the tongue, lips, and cheeks, and the Anterior Component of Force. The alveolar process merely attaches the root of the tooth to the basal bone and supports the tooth during function. Only as changes in position and size of basal bone alter the direction and force of muscle tension does basal bone alter the crown position of the teeth. Thus the "alveolar trough" is the *result* of crown position, not the *cause* of crown position.