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A Comparison of Indirect Lingual Bracket Placement by Practitioners and a Commercial Laboratory as it Relates to Height and Angulation

Steven F. Brizendine

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Abstract

A COMPARISON OF INDIRECT LINGUAL BRACKET PLACEMENT
BY PRACTITIONERS AND A COMMERCIAL LABORATORY AS
IT RELATES TO HEIGHT AND ANGULATION

by

Steven F. Brizendine

With the increase in use of lingual appliances a more accurate assesment is needed of exactly where the brackets are being placed. This study was undertaken in order to see if it makes any difference who places the brackets. Three groups of participants were selected. One, the commercial laboratory which offers a bracket placement service. Two, clinicians experienced with the lingual appliance, and three, clinicians with no clinical experience with the appliance.

Four sets of patient models were selected from eighty cases Ormco used in the original development of their lingual bonded appliance. These were duplicated and the four sets were sent to each of the participants for bracket placement.

The teeth were sectioned from the models and were photographed using a custom jig and thirty five millimeter camera equipted with a 1:1 macro lens. The photographs were traced and measurements taken with respect to height and angulation and then underwent statistical

analysis. Only two height measurements had results with significance at the $p < 0.05$ level. The maxillary lateral incisors and the mandibular first premolars had better placement by the commercial laboratory.

The rest of the height and angular measurements showed no significant differences. In taking the mean absolute differences of the height placements a ranking of the placements was noted with the commercial laboratory first, experienced clinicians second and, inexperienced clinicians third. The mean absolute differences of the angular placements gave a ranking of experienced clinicians first, commercial laboratory second and, inexperienced clinicians third.

In evaluating the time to set up cases, again no statistically significant differences were found among groups. There was a range of thirty-one to seventy-four minutes per case with a mean set up time of fifty-two minutes.

LOMA LINDA UNIVERSITY

Graduate School

A COMPARISON OF INDIRECT LINGUAL BRACKET PLACEMENT
BY PRACTITIONERS AND A COMMERCIAL LABORATORY AS
IT RELATES TO HEIGHT AND ANGULATION


by

Steven F. Brizendine

A Manuscript Submitted in Partial Fulfillment
of the Requirements for the Degree Master of Science
in Orthodontics

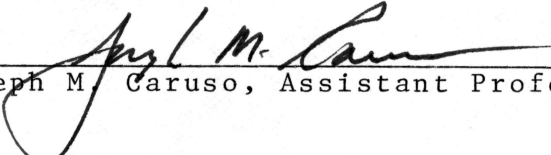
December 1985

Each person whose signature appears below certifies that this manuscript in his opinion is adequate, in scope and quality, in lieu of a thesis for the degree Master of Science.



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Norman S. Carter, Assistant Professor of Orthodontics

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INTRODUCTION

With an increased interest in adult orthodontics there has developed the technique of lingual braces for esthetic reasons. Month by month more practitioners are starting to use the appliance. Many of the initial problems of the appliance seem to have been overcome. Those questions of bracket retention, patient comfort, speech patterns, and patient selection seem to have been adequately addressed. 1,7,8 One of the questions that has not been thoroughly researched is the need for a sophisticated commercial laboratory set up for accurate placement of the brackets.

The history of indirect bonding seems to show that orthodontists seem to prefer direct to indirect bonding.² Part of this preference was the belief that direct bonded brackets had a lower failure rate than the indirect bonded bracket.^{3,10,11,12} This does not seem to be the case according to Aguirre et al, whose research showed a greater failure rate with the direct bonded bracket.⁴ If in fact the two techniques are so close in clinical use, why should an indirect method be used? 9,13

Number one, the morphology of the lingual tooth surface makes contouring of the brackets a necessity for an adequate fit and good adhesion. 5,6 Two, visualization of bracket heights and angulations is extremely limited compared to the labial surface.⁵ Three, bracket placement must be more accurate to insure less chairtime. Bends

placed on a lingual wire are more difficult to make, and tying in the wire takes more chairtime.⁵ And four, occlusal-gingival placement is critical because a small change in height can have a significant effect on the torque of the tooth.⁶

For the above reasons it is felt that a sophisticated laboratory procedure will more adequately fulfill the requirements demanded by the lingual technique. The purpose of this exercise is to see if the accuracy of the commercial laboratory is comparable with the orthodontist clinicians. And, if the amount of time spent in doing the set up is cost effective for the practitioner. In addressing these questions it is felt that a usefull bit of research data may have a very significant clinical application.

MATERIALS

Four non-extraction cases of moderate difficulty were selected from the patient records at Ormco Corporation. These cases were used in the original development of their lingual appliance. The criteria for selection was that: (1) they have present all permanent teeth from first molar to first molar in maxillary and mandibular arches, (2) there was adequate crown length on all teeth to allow placement of a lingual bracket, (3) the absence of severe rotations that would not allow ideal placement of a bracket, (4) the integrity of the occlusal surfaces without the presence of chips or fractures in order to facilitate accurate analysis of the height placement of the positioned brackets.

The next selection was that of determining who would place the brackets for analysis. The laboratory used was Ormco which commercially provides a lingual bracket placement service. These cases were run through their regular laboratory. This was done to simulate the type of service you would normally get if you sent cases into the commercial laboratory.

The doctors selected composed two groups. One group consisted of four doctors with hands on experience using the appliance. And, the second group of four doctors who have had exposure to the appliance but have had no real experience using it in a clinical setting.

The hardware for the experiment consisted of the duplicated models, brackets, adhesive, a custom jig for photographing the sectioned

teeth, and a thirty five millimeter camera with a 1:1 macro lens,
(figures 1,2,3) a Caramate projector, and tracing paper.

METHODS

Each of the participating orthodontists and laboratory were given a kit. The kit contained all of the material necessary for setting up the brackets on the duplicated models. Also included was a set of directions and a diagram of the ideal set up according to Ormco. The models had a key tooth marked, The right central incisors of the maxillary and mandibular teeth. The bracket height that the practitioner chose for these teeth governed the height that was chosen for placement of the remaining brackets.

After the set-ups were returned the teeth were sectioned and photographed in a custom jig. The slides were then projected on a Caramate projector and traced. The teeth had an original long axis on the labial surface to assist the people in setting up the brackets. These same long axis marks were then transcribed onto the lingual surface in order to check the amount of tip that the practitioner placed on the bracket. The long axis marks were traced along with a line passing through the center of the bracket slot, and a height measurement was taken from the center of the incisal edge to the center of the bracket slot. (Figure 4) The data was recorded and then underwent statistical analysis for comparison.

STATISTICAL ANALYSIS

The total sample size consisted of four selected cases which were set up by eight clinicians and a commercial laboratory. This gave a total of thirty six cases which were compared.

Simple correlation coefficients were calculated between pairs of teeth from similar cases. The various factors observed were; bracket placement height, and amount of tip or angulation.

A paired T-test was used in the comparison of the three pairs of distributions i.e., experienced orthodontists, inexperienced orthodontists, and commercial laboratory. Also the amount of time spent in doing the set ups was compared for differences among the three groups.

The height measurements consisted of eighty heights for each practitioner and laboratory. The angular measurements had eighty angulations for each practitioner and laboratory also.

The calculation of the height differences was derived by subtracting the ideal height placement from that actually placed. The same was done for the angular measurements.

From the calculation of the mean and standard deviation it was possible to rank the laboratory and practitioners. The lower the mean absolute difference the closer to ideal placement.

RESULTS

Comparison of Height Placements Among Groups

On the analysis of similar cases from different operators there was no significant differences between the groups of experienced versus inexperienced clinicians. There was however a significant difference in comparing the commercial laboratory with the clinicians as a whole. Figure 5 shows that the commercial laboratory had a better height placement accuracy on the maxillary lateral incisors, significance $p < 0.05$. Figure 6 shows greater accuracy noted on the mandibular first premolars, significance $p < 0.05$.

Comparison of Ideal Height Placements

Each clinician determined the height placement that he felt the brackets should be placed at with the central incisors as the keys to the rest of the set up. Looking at the deviations of the height placements among the groups it was found that overall the variation in height placements had a maximum deviation of 2.2 millimeters with an average deviation of 0.8 millimeters. The ranking among the groups with respect to the mean absolute difference placed the laboratory first, experienced orthodontists second, and inexperienced orthodontists third.

Comparison of Angulation Placement

There was no significant differences on angulation placement between any groups.

Comparison of Ideal Angulation Placement

On analysis of the angulation placements all groups had no significant differences with each other, but, in comparing the groups to where the brackets should have been placed ideally it is noted that all the groups had a significant deviation from ideal.

The ranking on angulation placement was; experienced practitioners first, laboratory second, and inexperienced practitioners third.

Comparison of Set Up Time Among Groups

The amount of time used to set up the cases was found to have a mean time of fifty two minutes per case with a range of thirty one to seventy four minutes per case. There was no significant differences among groups. Figure 7

These results showed no significant differences among participants. Although some had p values of 0.03 and 0.015 these would be significant if the alpha value was assumed to be 0.05 but due to the use of multiple tests the alpha value should be divided by the number of tests which were eight. Therefore a 0.05 should be divided by eight for a p value of 0.006. These values then do not indicate significance.

DISCUSSION

The accuracy of bracket placement in this study would seem to show that it makes little difference as to who sets up the case. The laboratory did significantly better on maxillary lateral incisors and mandibular first premolars, but in respect to the number of teeth on the total set up there is only a small difference. It would then seem that using a commercial laboratory would give as good a result as having the clinician set up their own cases.

The placement of brackets in regard to angulation shows no significant differences regardless of who set up the case. To consider in this study is that the cases selected had 1) minimal rotations and, 2) good occlusal-gingival height which would allow easier placement of the brackets and possibly is less critical to interpretation of positioning.

In the original work on lingual morphology it was noted the great variation on the lingual as compared to the more regular labial surfaces. These problems of height were noted in the studies and there has been a tremendous amount of work put into the appliance to help alleviate some of the problems, such as; gingival impingement and occlusal interferences with the development of different bracket designs and various phases of the appliance. 14

From looking at the graphs it seems that all groups tended to under angulate the brackets. There was also a tendency to vary the heights more on the maxillary and mandibular first and second premolars

then on the other teeth. This height variation could possibly be explained. If a clinician selected too gingival or occlusal of a position for the key tooth in this experiment, by the time the premolars were reached there may not have been enough crown length to set the brackets at the desired position. By selecting the premolar or the tooth with the shortest crown length would be the way to avoid this type of problem. 14 This problem also points out again the importance of patient selection. Patients with short lingual cusps on the premolars, and short clinical crowns on the incisors are not the best candidates for this type of therapy. 15

The problem with height selection and the changes of torque with height placement has not been discussed, but, could be an area where very significant changes in the desired tooth positions in finishing could result. 6 Variations of bracket height on the labial surface will change the torque only a few degrees. However, a minor variation on the complex curvature and sloping surfaces of the lingual of the maxillary incisors can result in a dramatic torque change. 15

Perhaps the answer will be that eventually all casts will be sent to the commercial laboratory and a custom base and bracket will be made to fit each individual tooth and case.

The amount of time spent in doing set ups shows that there was a considerable range of times from thirty one to seventy four minutes. The laboratory times fell in the middle with an average of fifty four minutes. Figure 7

With these types of findings a few things to consider are: 1) The placement of brackets is either in the clinicians hands or the laboratories. This means if the practitioner chooses to use the service, preferences for placement other than the standard set up will need to be communicated to the laboratory for each individual case. 2) If the set up is done by the practitioner it would be immediately available to him/her. 3) Cost considerations would be the clinician doing his/her own set up and taking time away from chairside to do so. 4) The convenience of sending it to a laboratory and getting back a clinically acceptable set up.

With all these considerations each individual practitioner will have to weigh the advantages and disadvantages deciding which way will be the most acceptable for his/her particular type of practice.

SUMMARY

Lingual bonding has been presented from the aspects of an individual set up or a commercial laboratory set up. In this study the accuracy of placement in regard to height and angulation was done as acceptably by either the clinician or the commercial laboratory.

The only areas of significance were the placement of brackets on the maxillary lateral incisors and the mandibular second premolars. The commercial laboratory had a better height placement in both cases.

All set ups were significantly under angulated. This would tend to show that there needs to be some improvement in checking the angulation placement more accurately with some type of instrument.

From this study it is felt that a commercial laboratory service can give as good, if not better, set up then ones done by the average clinician.

Also, it can be seen the amount of time necessary to do a set up and the demands on the accuracy of placement and it's relationship to torque, height, and angulation. All these factors make the accurate placement of brackets a much more complex procedure then originally anticipated. Even with experience it is still difficult to place the brackets ideally.

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15. Scholz R, Swartz M: Lingual Orthodontics, A Status Report Part 3. Journal of Clinical Orthodontics 16: 812-820, 1982

APPENDICES FOR PUBLICATION

FIGURE 1- Custom jig for 35 mm camera with sectioned tooth holding jig.
Side view.

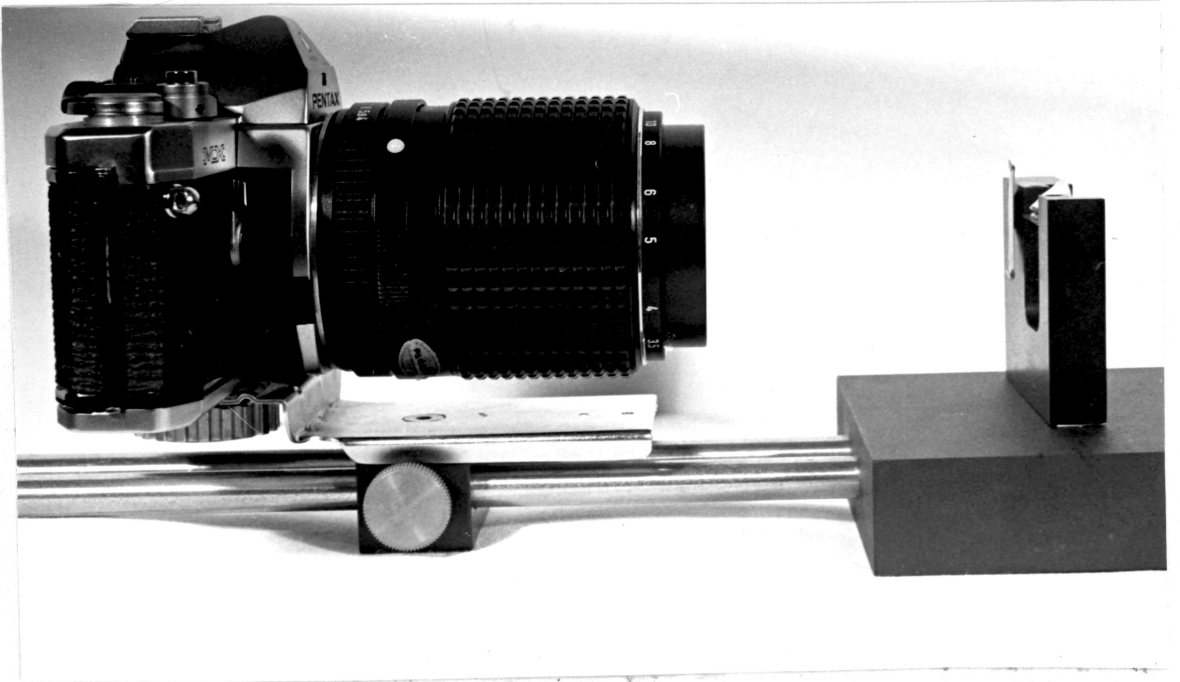


FIGURE 2 - Custom jig for 35 mm camera with tooth holding jig. Top view.

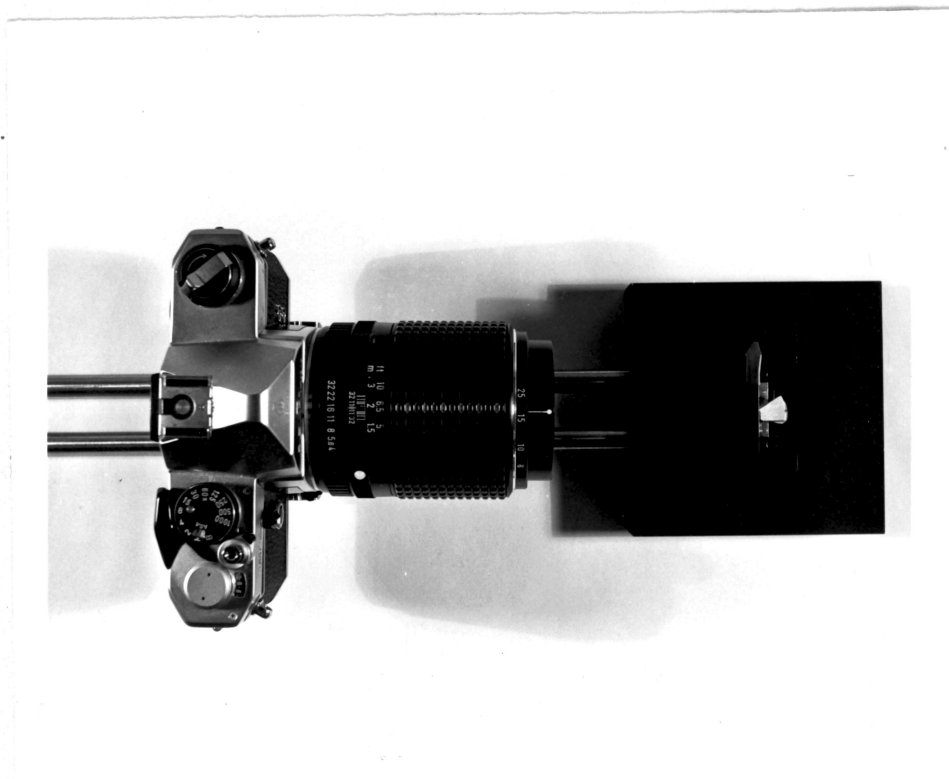


FIGURE 3 - Sectioned tooth holding jig. Front view

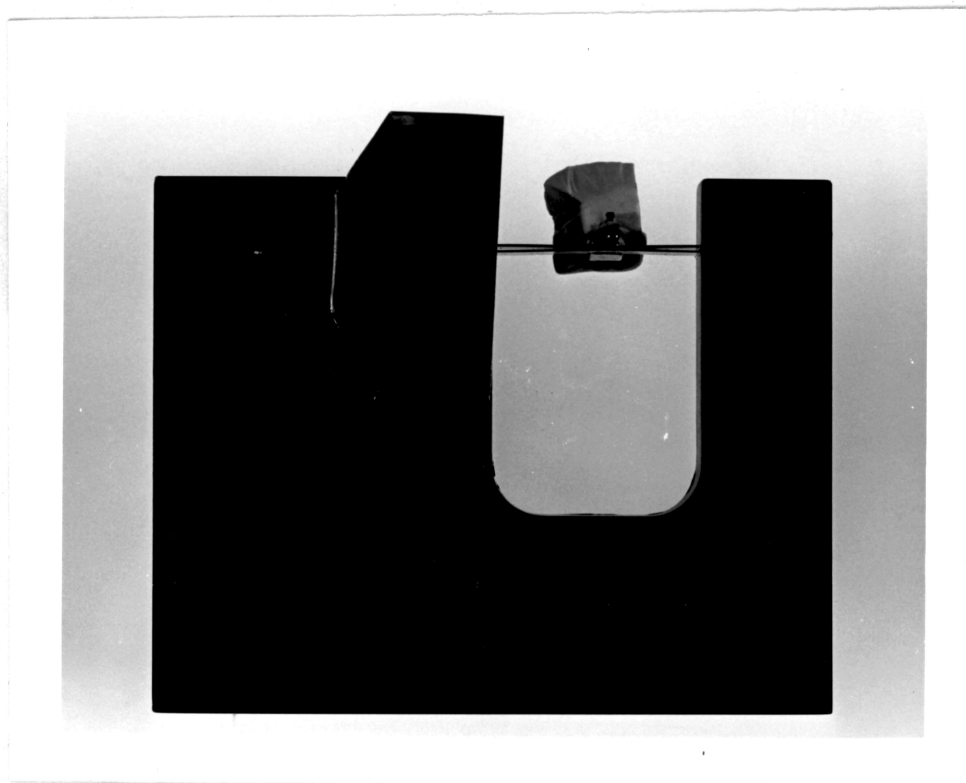
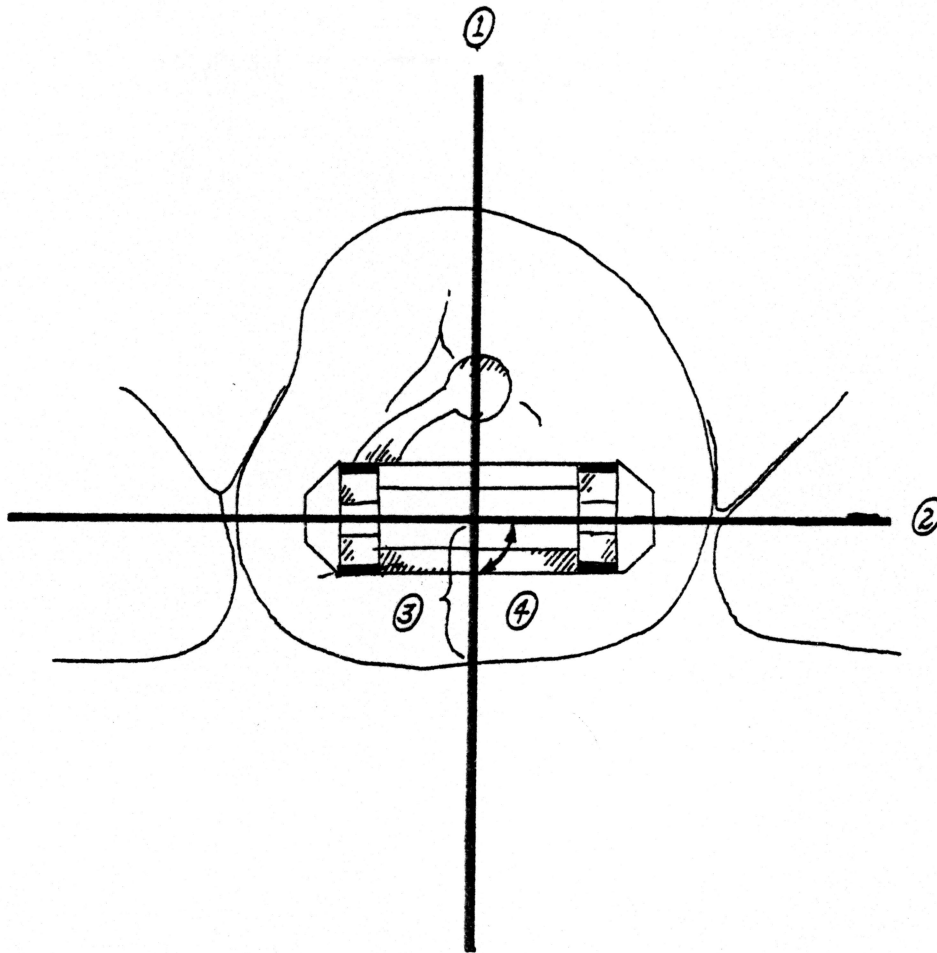
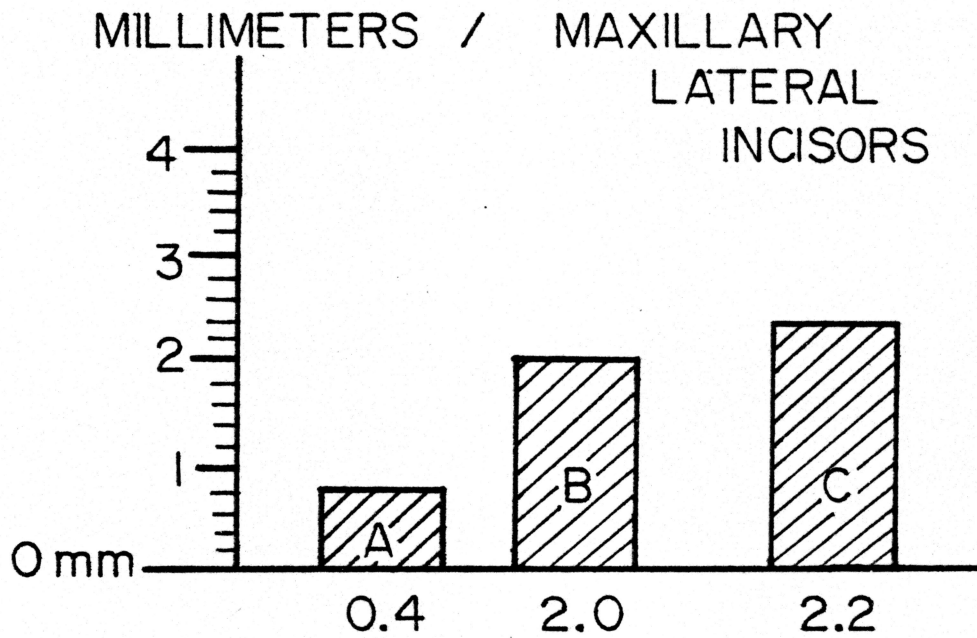


FIGURE 4 - Height and Angular Measurements



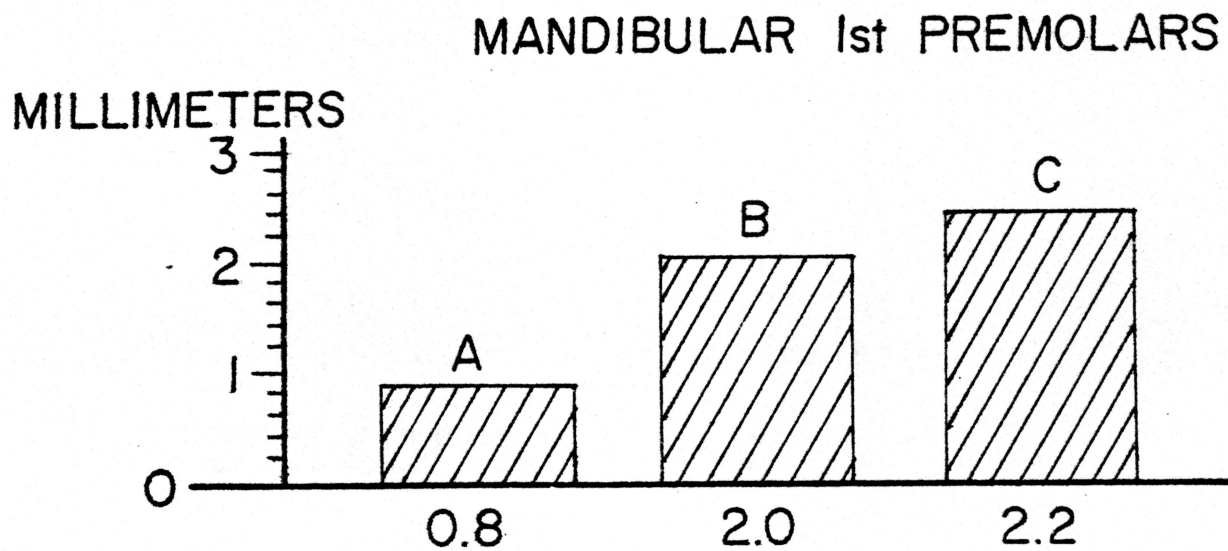
1) Vertical reference line 2) Horizontal reference line 3) Height measurement 4) Angular measurement angle

FIGURE 5 - Height placement of brackets on the maxillary lateral incisors by groups.



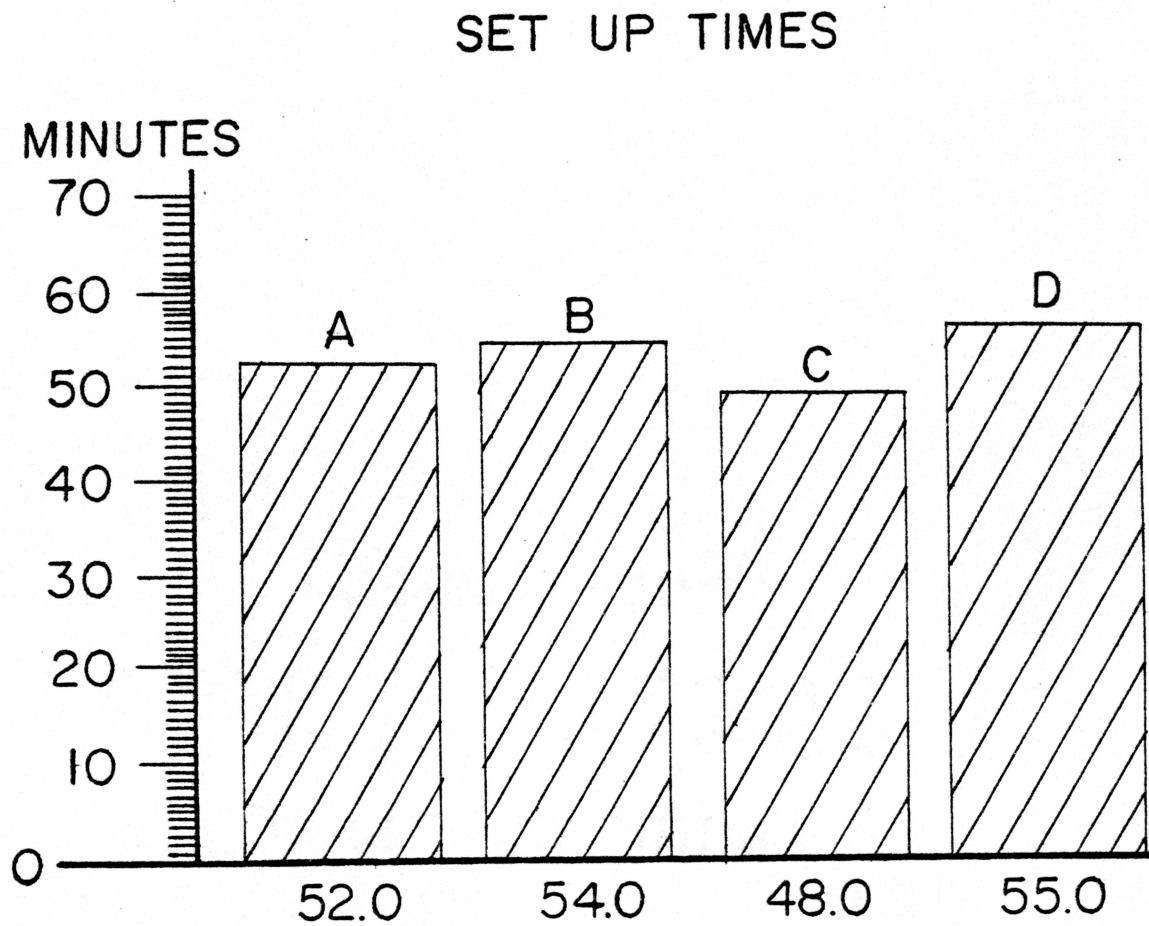
A) Commercial laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists.

FIGURE 6 - Height placement of brackets on the mandibular first premolars by groups.



A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists.

FIGURE 7 - Amount of time taken to set up a case, averages by groups.



A) Mean for all groups B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists.

TABLE 1
 PAIRED T TEST FOR EXPERIENCED AND INEXPERIENCED CLINICIANS
 COMPARED TO THE COMMERCIAL LABORATORY

Difference in Angulations	N	X diff.	S.D.	T	P
2	80	-0.58	4.16	-1.13	0.26
3	80	0.44	4.44	0.65	0.52
4	80	0.28	4.04	0.52	0.62
5	80	1.33	5.55	2.21	0.03
6	80	0.03	4.33	0.08	0.94
7	80	-0.44	4.55	-0.82	0.41
8	80	1.45	5.45	2.48	0.015*
9	80	1.43	5.35	2.11	0.016*

* If Alpha was assumed at 0.05 there would be significance, but this must be divided for multiple tests. Therefore the Alpha value for significance would be 0.05 divided by eight with a value of 0.006. Values 8 and 9 are therefore not significant.

TABLE 2

Height Placement Differences

	<u>A</u>	<u>B</u>	<u>C</u>
Mean (mm)	0.79	1.16	1.20
Standard Deviation	0.03	0.34	0.56
Ranking	1	2	3

A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

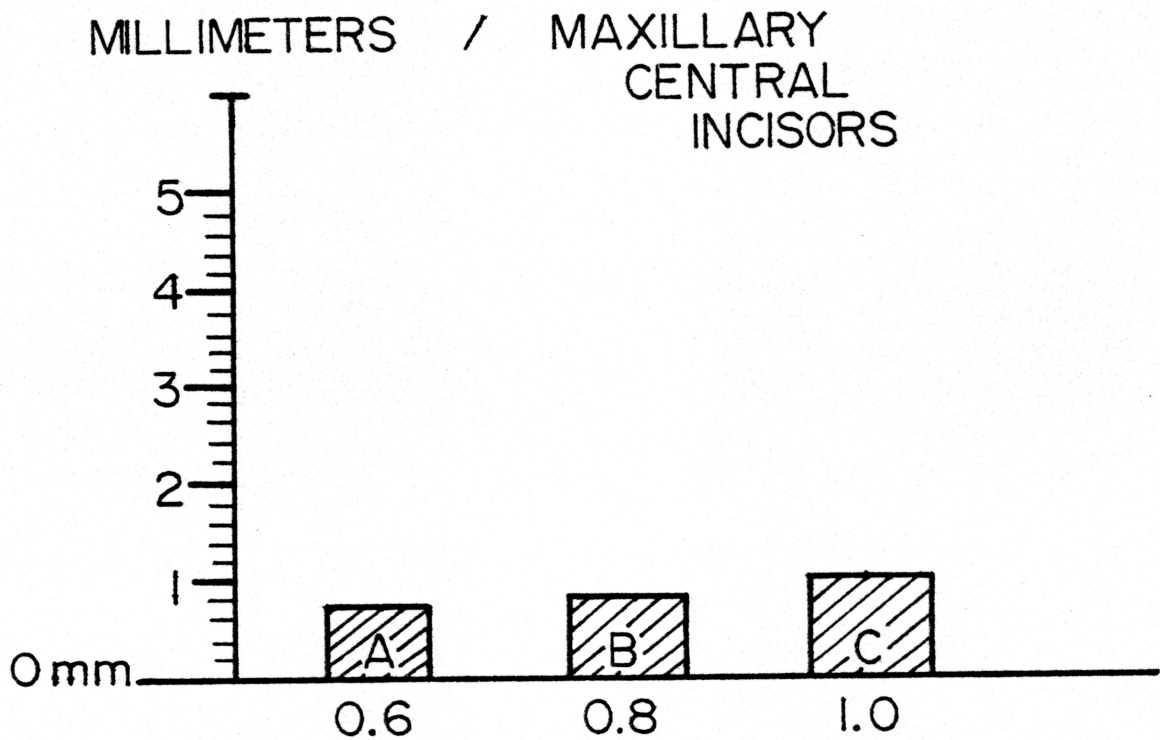
TABLE 3

	<u>Angular Placement Differences</u>		
	<u>A</u>	<u>B</u>	<u>C</u>
Mean (degrees)	1.65	1.60	1.95
Standard Deviation	1.28	0.97	2.09
Ranking	2	1	3

A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

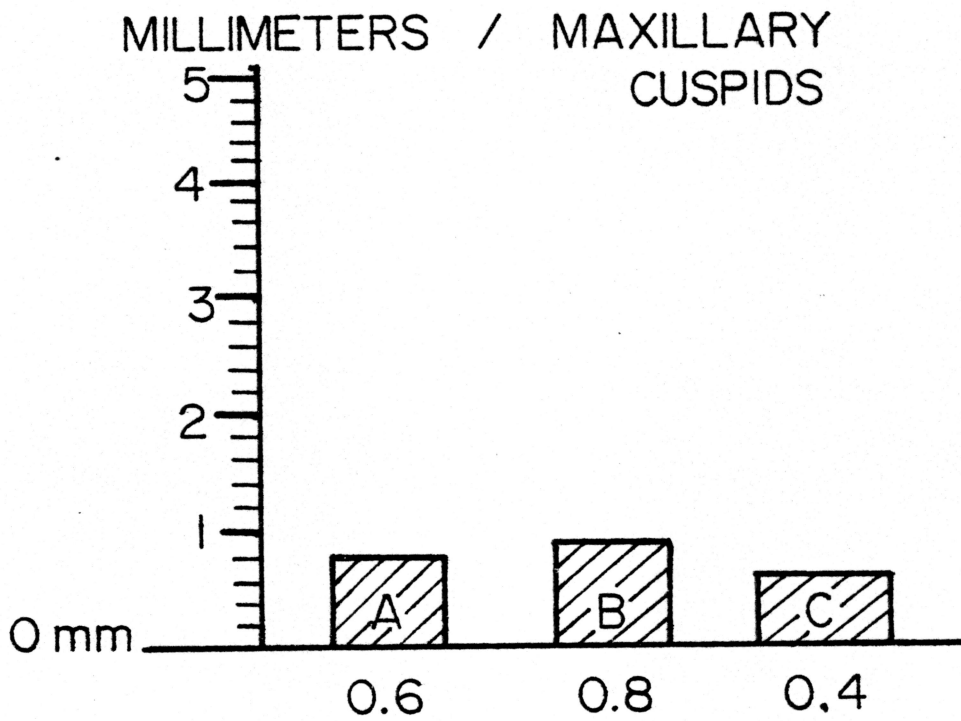
APPENDICES NOT FOR PUBLICATION

FIGURE 8 - Height placement of brackets on the maxillary central incisors by groups.



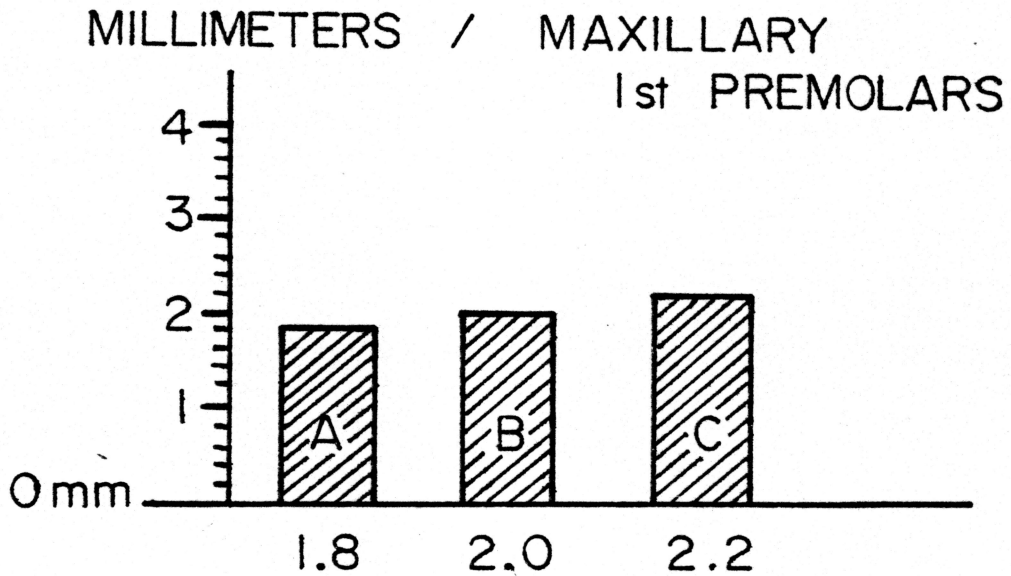
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 9 - Height placement of brackets on the maxillary cuspids by groups.



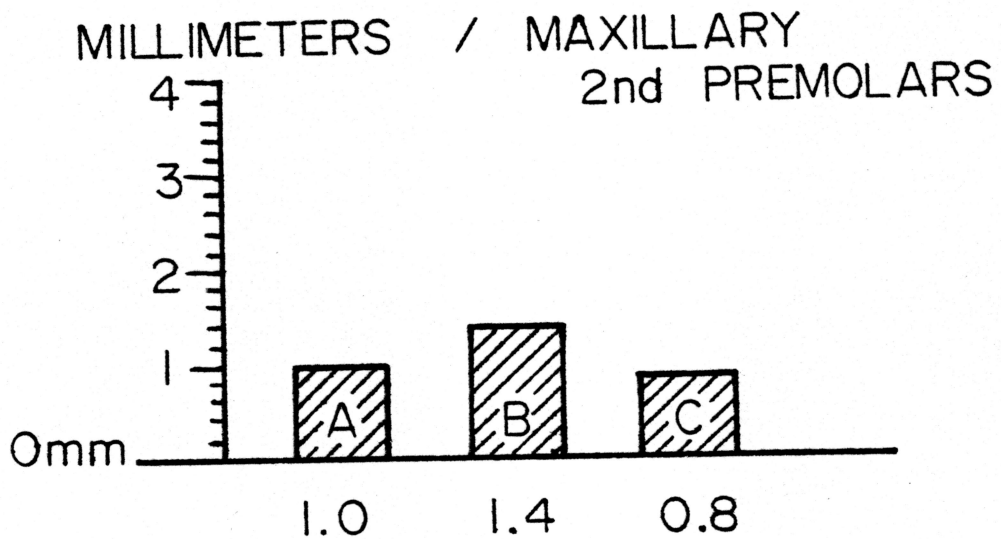
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 10 - Height placement of brackets on the maxillary first premolars by groups.



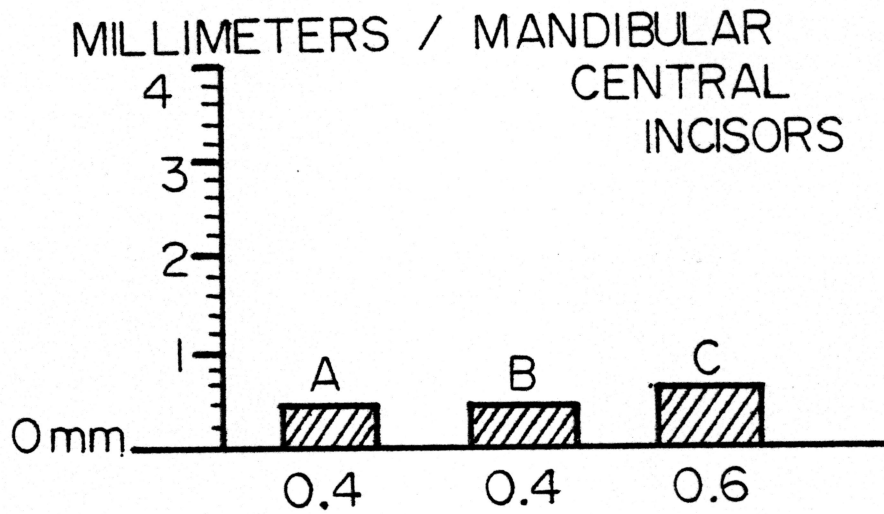
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 11 - Height placement of brackets on the maxillary second premolars by groups.



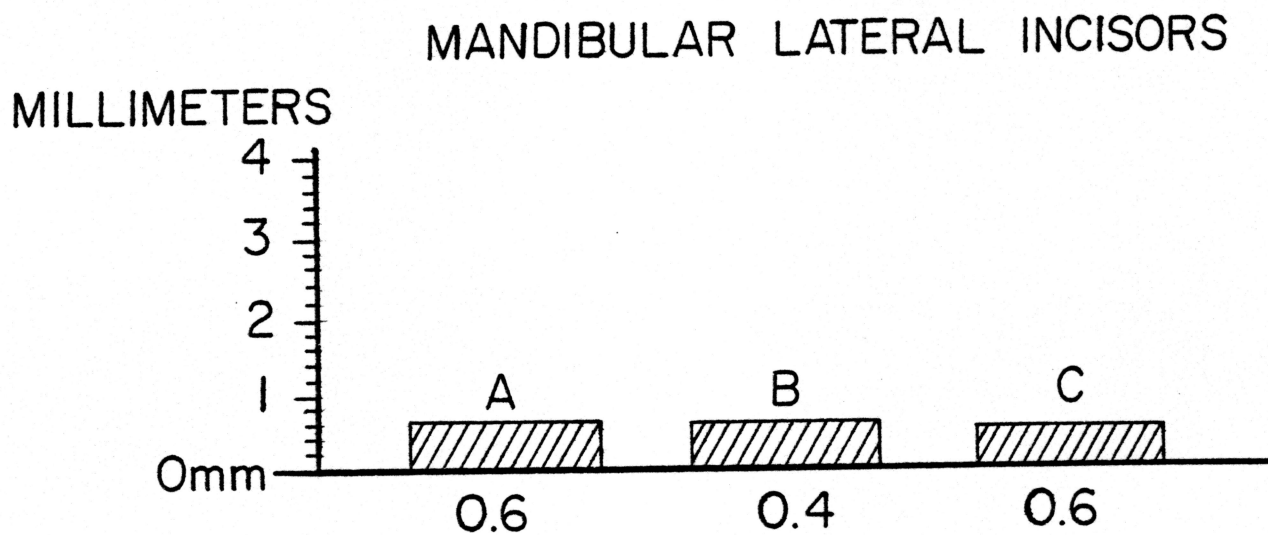
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 12 - Height placement of brackets on the mandibular central incisors by groups.



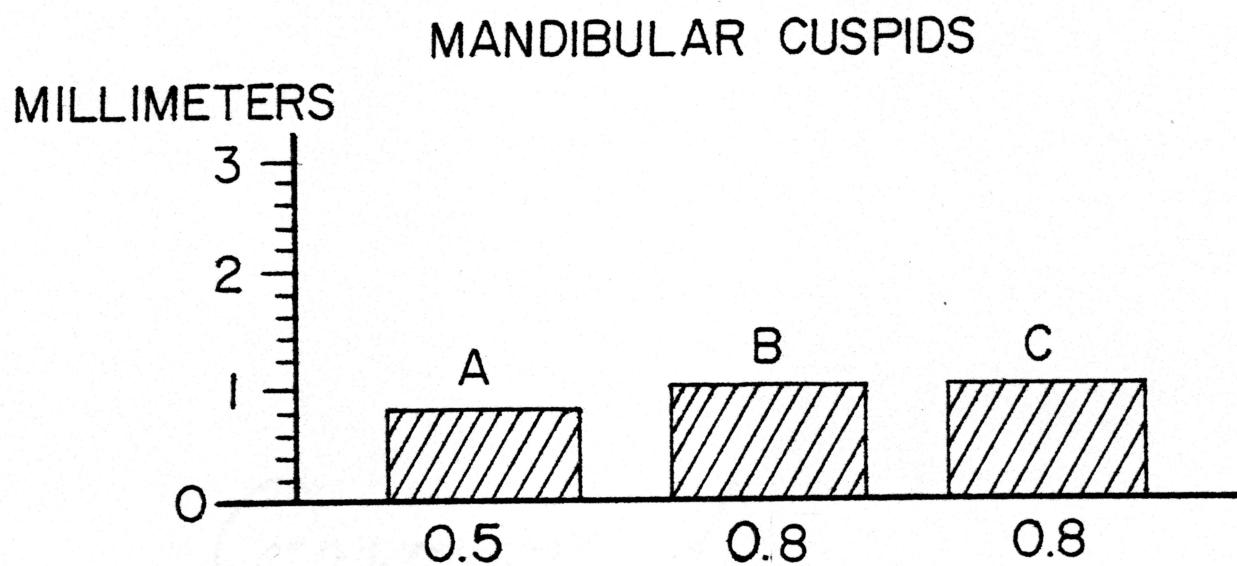
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 13 - Height placement of brackets on the mandibular lateral incisors by groups.



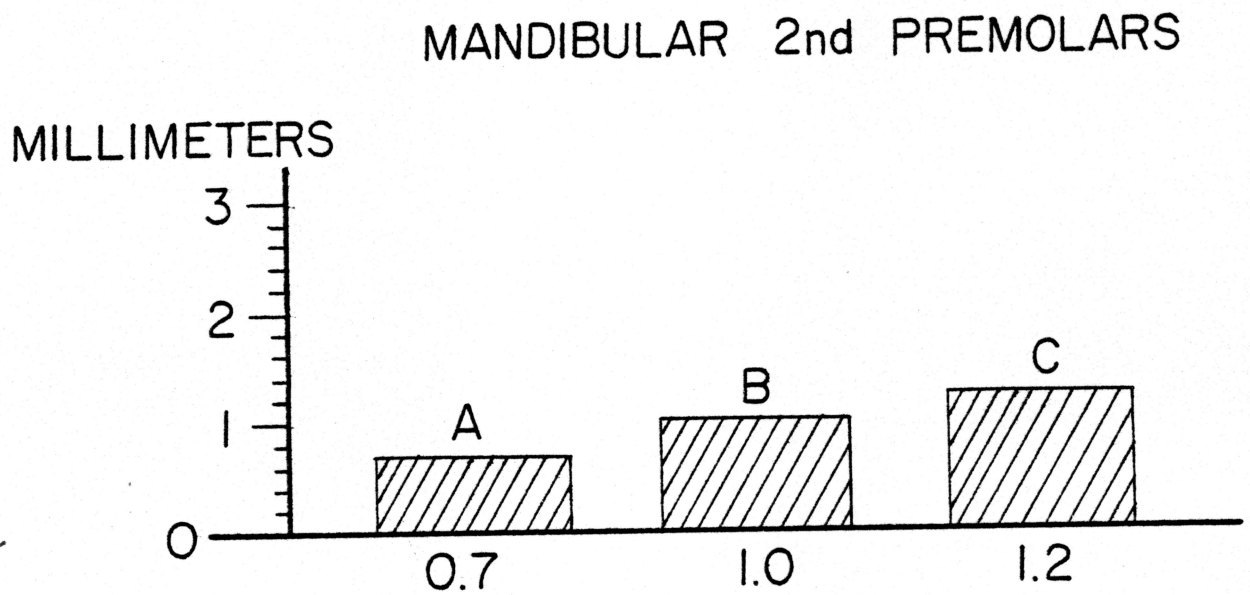
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 14 - Height placement of brackets on the mandibular cuspids by groups.



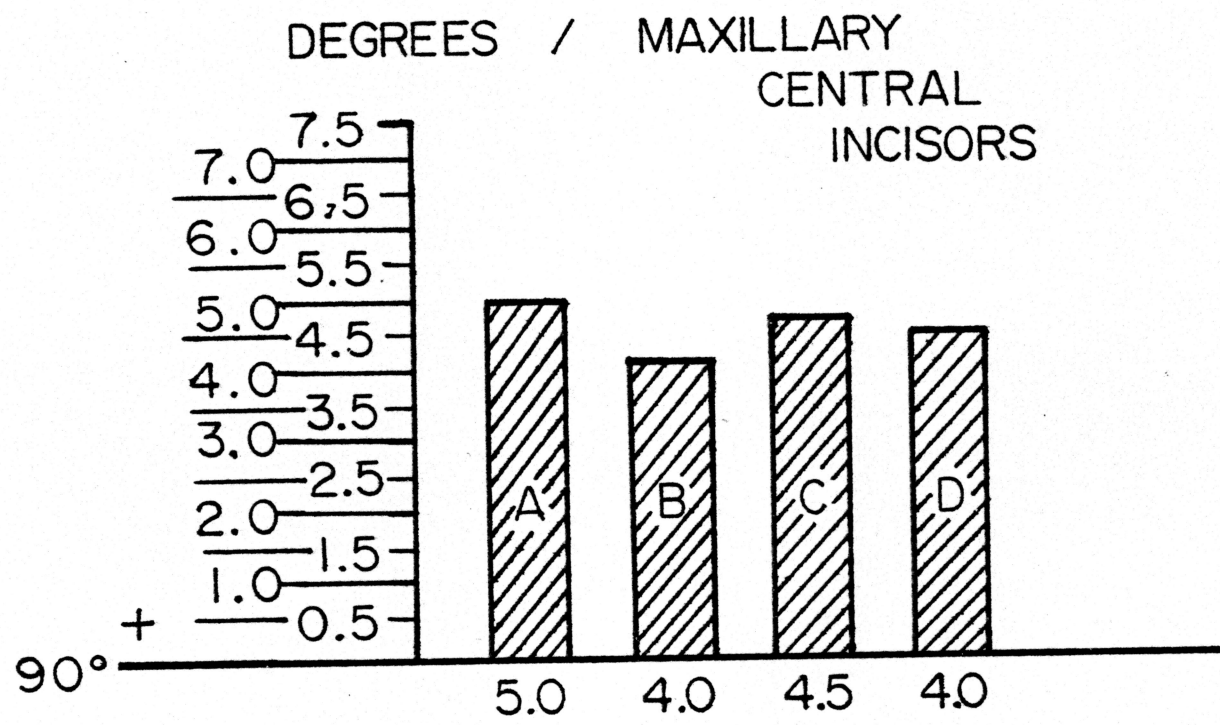
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 15 - Height placement of brackets on the mandibular second premolars by groups.



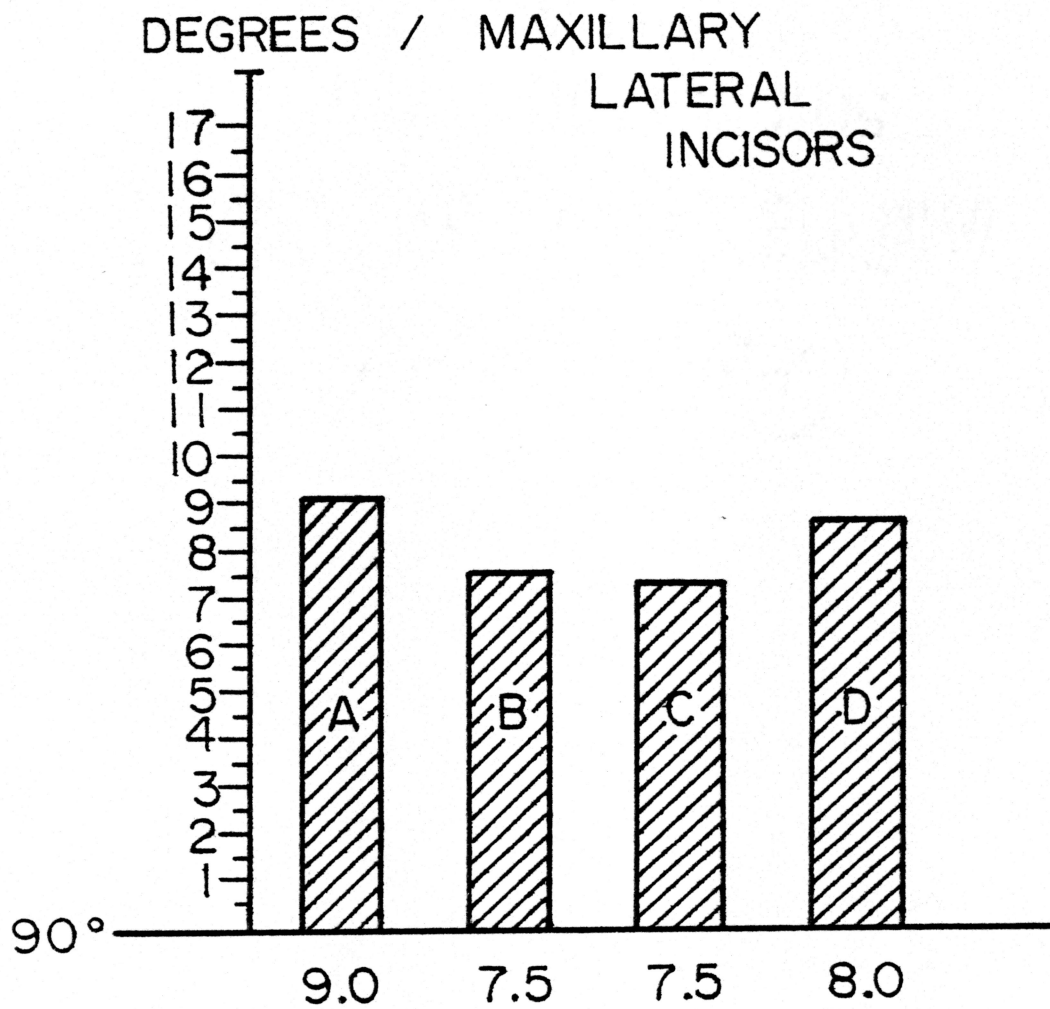
A) Commercial Laboratory B) Experienced Orthodontists C) Inexperienced Orthodontists

FIGURE 16 - Angular measurements of brackets placed on maxillary central incisors by groups.



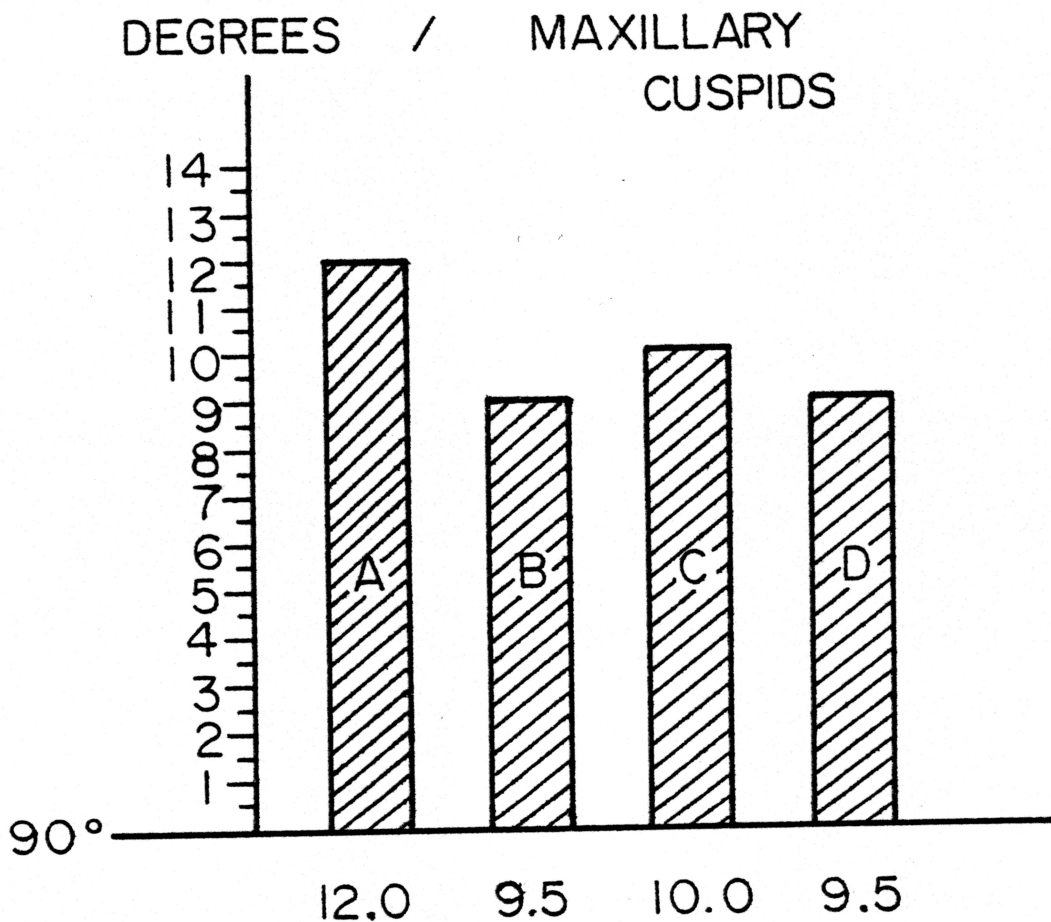
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 17 - Angular measurements of brackets placed on maxillary lateral incisors by groups.



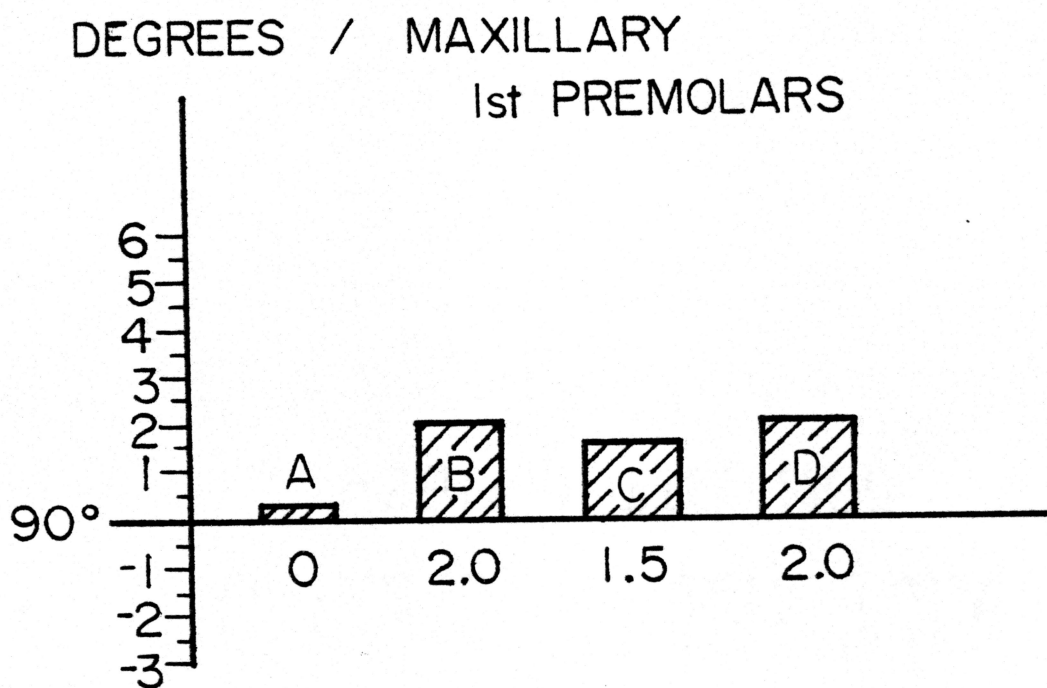
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 18 - Angular measurements of brackets placed on maxillary cuspids by groups.



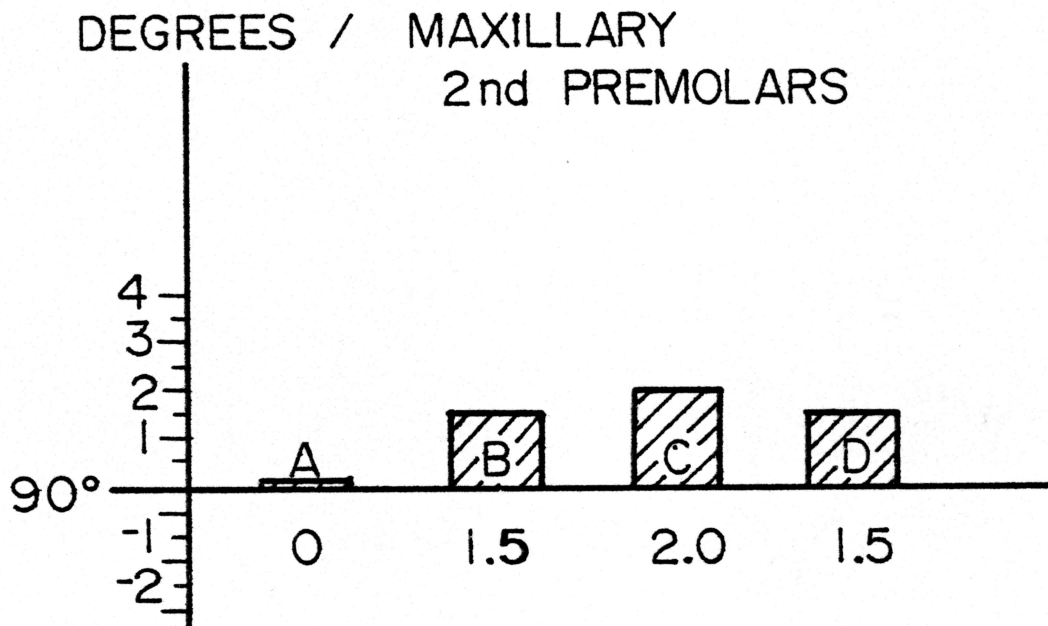
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 19 - Angular measurements of brackets placed on maxillary first premolars by groups.



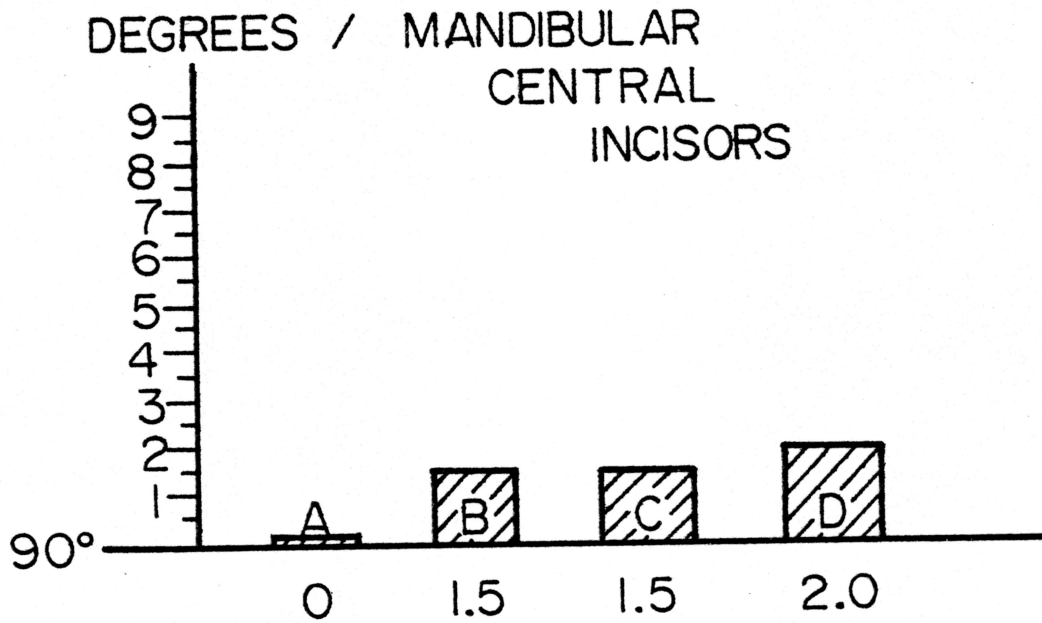
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 20 - Angular measurements of brackets placed on maxillary second premolars by groups.



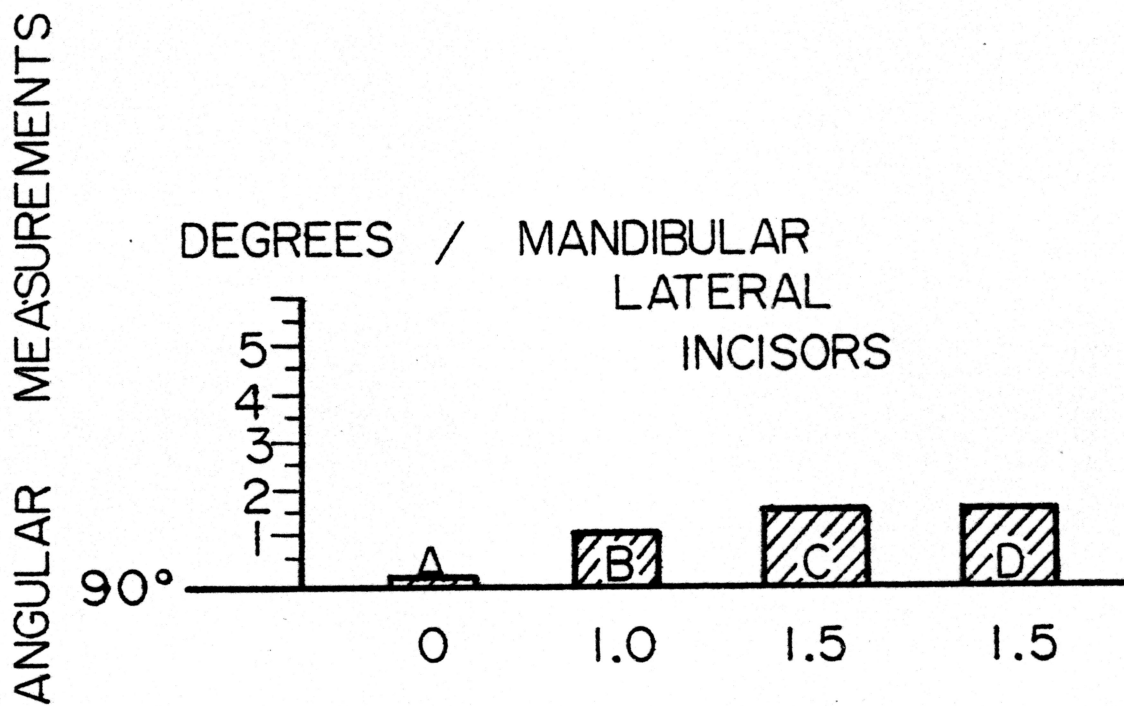
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 21 - Angular measurements of brackets placed on mandibular central incisors by groups.



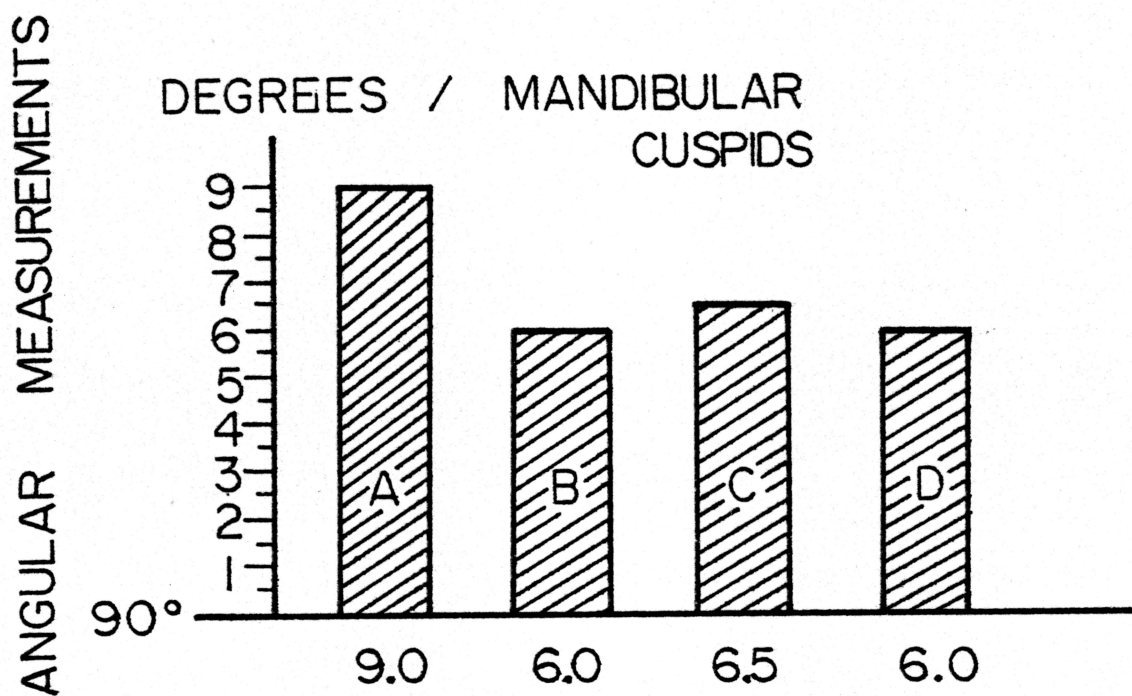
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 22 - Angular measurements of brackets placed on mandibular lateral incisors by groups.



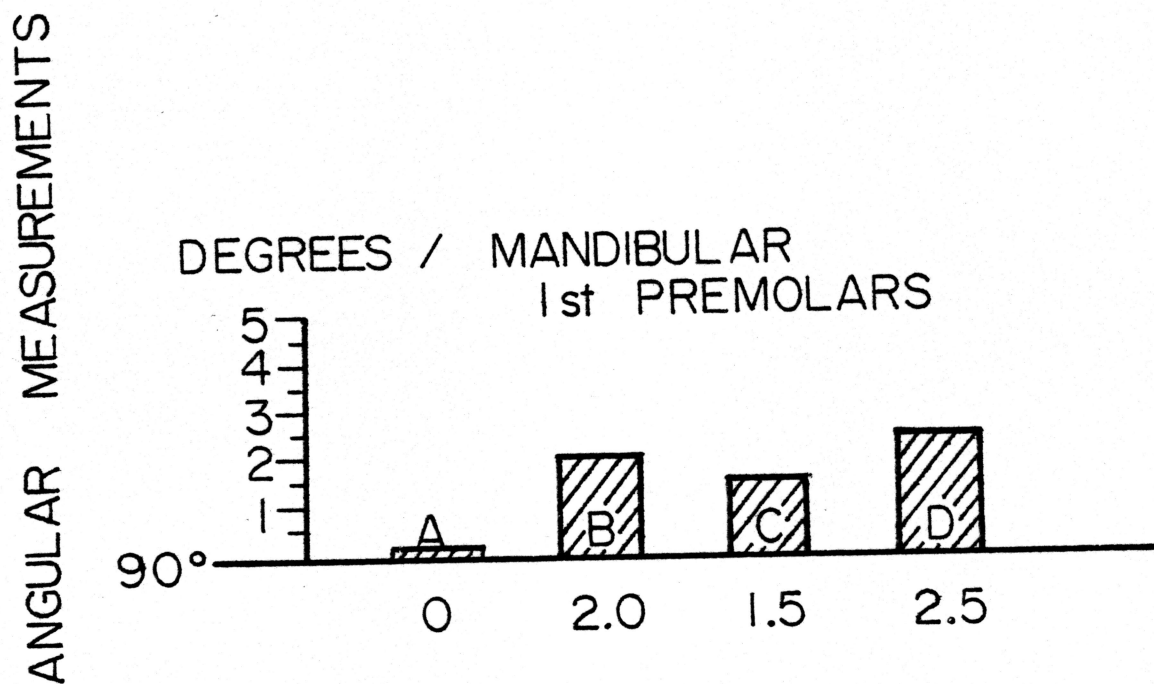
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 23 - Angular measurements of brackets placed on mandibular cuspids by groups.



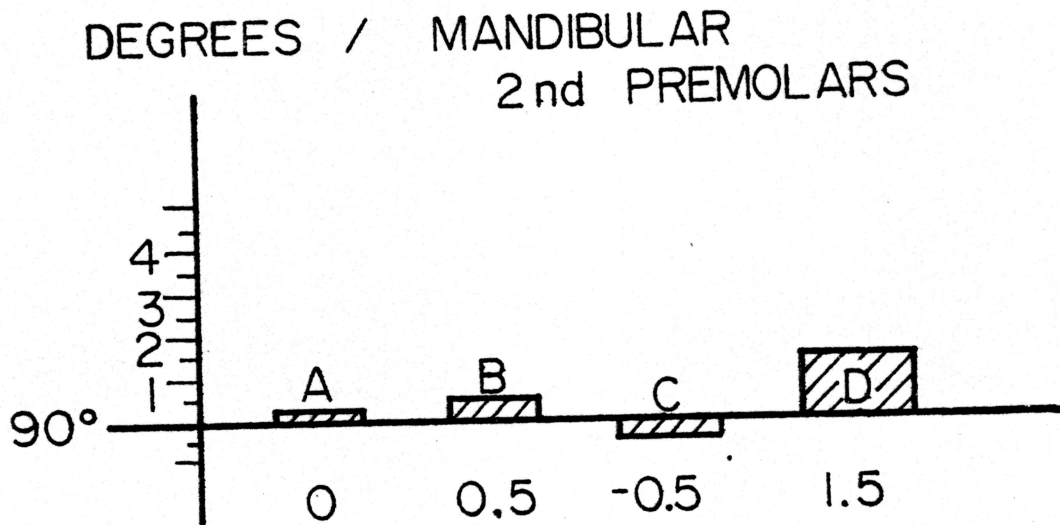
A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 24 - Angular measurements of brackets placed on mandibular first premolars by groups.



A) Ideal Angulation B) Commercial Laboratory C) Experienced Orthodontists D) Inexperienced Orthodontists

FIGURE 25 - Angular measurements of brackets placed on mandibular second premolars by groups.



A) Ideal Angulation B) Commercial Laboratory C) Experienced
Orthodontists D) Inexperienced Orthodontists