Orientation of Teeth in the Dental Arches*

CECIL C. STEINER, D.D.S.
Los Angeles, California

Looking back through the orthodontic history, one is impressed by the close relationship which has existed between the development of ideals of treatment in this science and the mechanical devices designed to accomplish them. It becomes clear, also, that each forward step in the development of orthodontic mechanism permitted advancement in ideals of treatment by increasing the possibilities of their accomplishment. Thus each advance has been a stimulus to the other.

Dr. Angle's edgewise mechanism was developed to meet the growing demands for anchorage which came into being with a better appreciation of the necessity of properly orienting teeth not only to each other but to all other parts of the body. With it, the roots of all teeth may be used to develop anchorage to tip the crowns forward or backward, a most useful virtue in the treatment of Class II and Class III malocclusions. The mechanism also possesses mechanical principles which permit the proper orientation of teeth in all directions of axial inclinations, probably better than any other previous mechanism.

Because of what the writer feels was faulty construction of the appliance in the past, much of the mechanical advantage which it possessed in this regard was lost. Probably because of that, little has been said or written regarding the possibilities which the appliance possesses in principle, to manifest in treatment the minor details of tooth placement which the growing knowledge of occlusion has dictated. It is obvious that attention to these details in treatment spells the difference between a straight set of teeth and a straight set of teeth with character. There is a difference.

With the recent developments in the construction of the mechanism, opportunity is given us to clinically manifest our knowledge and ideals of tooth placement. The appliance in its now exacting form will not place teeth where they belong unless it is properly adjusted to do so. On the other hand, because of its efficiency, in improper adjustment it will manifest correspondingly harmful results, for the margin of safety in now narrow. To those who have not used the brackets in their new form with stainless steel arches, the writer seriously suggests that they do so with much

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thought and careful watching for the appliance will continue to act over a long period of time and will manifest what is put into it—good and bad—to a surprising degree.

It is now more necessary than ever to study carefully individual tooth placement within the arch and it will be the purpose of this paper to bring to attention some of the common errors in this regard, which tend to produce that so-called "Orthodontic look" in finished cases.

Figure 1—Normal occlusion of the teeth.

Because the normal positions and relations of individual teeth are so well described in the recent orthodontic text book by Dr. Robert H. W. Strang, it is not here necessary or indicated to again present that phase of the subject beyond that which is necessary to point out common errors of treatment. Fig. 1, representing "Secretum Apertum" in all of its glory, of course tells us the entire story. With proper understanding of normal occlusion all deviations immediately become obvious and at the same time it furnishes the answers for their correction. We will refer to it again and again as a basis of comparison. Suffice it to say now that in addition to all of the mechanical and structural perfection which it possesses, it presents balance, grace and beauty because of the perfection of tooth placement as regards fine details and without this ultra fine placement this grace, beauty

Figure 2—Completed case exhibiting too much overbite.

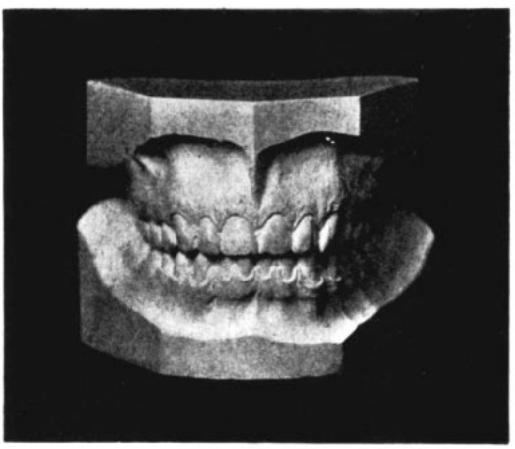

Figure 3—Lateral incisors with proper axial inclination but too prominently placed and extending too far occlusally.

and character would be lost and it would become merely a straight set of teeth. Furthermore the fine mechanical balance and efficiency in function would rapidly decrease with any and all deviation from this beautiful perfect form, normal occlusion.

Let us now consider, not in the sequence of importance but in the sequence in which the teeth occur in the mouth, what these details are and how they are commonly deviated from for each tooth. Space prevents more than a hasty and superficial discussion of some of the salient points.

Upper Central Incisor

The upper central incisors, because of their positions in the denture, are the most prominently displayed of all of the teeth. Their correct placement is therefore paramount. Fortunately, these teeth give less difficulty

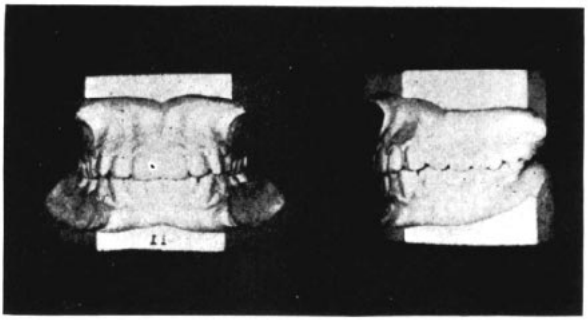

Figure 4—Lateral incisors with incorrect axial inclination.

in treatment than some of the others as judged by the final results achieved by the average operator. The error most often found is probably that of the incisal overbite and the resultant protrusion, because of the lower incisors striking the cinguli of the upper ones. Fig 2. The solution for this condition most often is in the axial inclinations of the posterior teeth. The baneful results of it are more mechanical than aesthetic, although both enter in.

Space left between the central incisors is very displeasing aesthetically and unless there is abnormality and disharmony in tooth form elsewhere in the denture, this error can only result because of, or at least in conjunction with, some other compensating error. The failure of these teeth to main-

tain their positions when such a separation has been closed probably is often due to the failure of the operator to bring the roots into their proper positions, thus correcting the mesio-distal axial inclinations. Failure to correct rotations is also a common error and materially detracts from the beauty of the denture.

The Upper Lateral Incisor

The lateral incisors, upper and lower, are undoubtedly more often erroneously placed than any other teeth. Apparently too, character and beauty is dependent more upon their proper placement than any other teeth. The laterals are shorter than the centrals and are less prominent in the arch. They are very definitely inclined toward the median line. Fig. 3. Torsally, they are rotated so that the curve of the arch is well established by them.

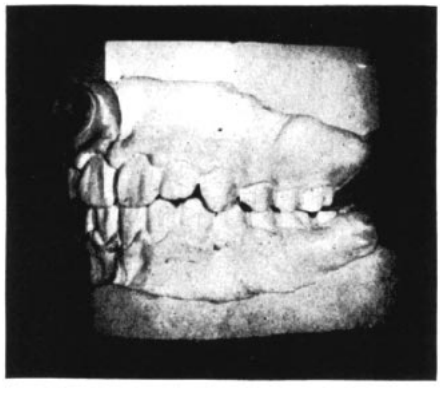

Figure 5—Lateral incisors too short.

Common errors in their placement are: first, failure to recognize their mesial inclination which detracts from their beauty and makes them appear as just another picket in a fence, Fig. 4; second, failure to properly rotate the distal portion far enough lingually, thus giving a broad, square appearance to the mouth; third, failure to properly torque the roots labially, especially where the laterals have been displaced a great distance lingually. This failure is probably responsible for the tendency of the teeth to relapse after this particular movement has been accomplished. Fourth, an over emphasis of Dr. Angle's admonition to place them shorter and less prominently than the centrals. Fig. 5. Let it be remembered that while it is true that the labial

surfaces of these teeth are less prominent, their lingual surfaces are aligned on an arc with the centrals and it only because of the fact that these teeth are thinner that their labial surfaces are less prominent. That being true, they are only as much less prominent than the centrals as the difference in the relative thickness of these teeth, which is but slight. It is also true that they are shorter than either the centrals or the cuspids beside them. This too for the reason that they are smaller teeth and as such function in their particular positions in the denture to advantage.

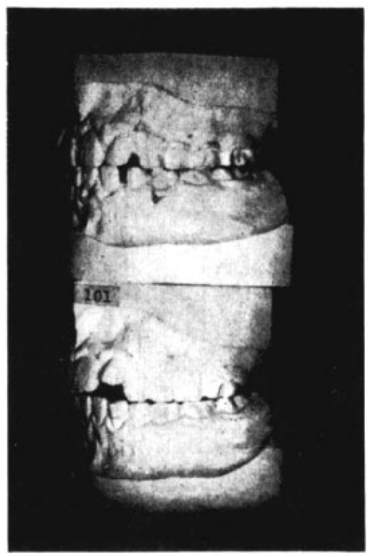

Figure 6—Excessive spacing subsequent to treatment.

They are often left too short, however, which gives a very displeasing effect. Many times their positions in malocclusion has been such as to wear their incisal edges excessively as compared to the centrals, in which case proper consideration should be given the condition and such corrective measures employed as are necessary to compensate for this wear. It is the writer's opinion that intelligent spot grinding of the surfaces of all teeth which have been deprived of their normal wear is a duty of the orthodontist before treatment can be considered complete.

Excessive spaces left between the laterals and cuspids are often attributed to lack of harmony in the amount of tooth structure in the upper and lower arches. Fig. 6. It is the writer's opinion that it is more often a lack of understanding of occlusion on the part of the operator, particularly in view

of the fact that the necessity for these spaces has greatly diminished in some strange way by the use of the edgewise appliance. Also, from the fact that nature generally manages to close these spaces after the retainers are removed without disturbing the normal tooth relationships.

Upper Cuspids

These teeth erupt at the corners of the mouth and form the dividing line between the anterior and posterior segments of the arch. The beauty of the denture is largely influenced by their proper placement. Stability of

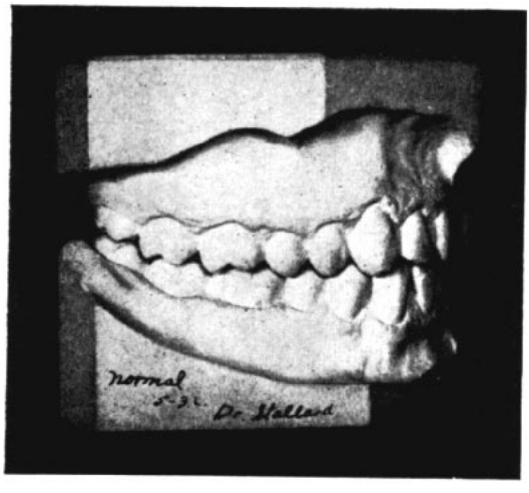

Figure 7—Normal position of maxillary cuspid.

arch form is greatly dependent upon them because of the positions they occupy in the arch. They stand out boldly with their roots well out buccally. Their crowns have a definite lingual inclination. They appear prominent in the arch because of the size and form of the crowns. Great variation is seen in the placement of these teeth by various well trained orthodontists. This is probably because of the varying ideals of arch form which exist in the minds of different men, for the placement of the cuspid is greatly influenced by variations in arch form and vice versa.

Common errors are, first, incorrect relationship of the cuspid to its antagonist in the opposite jaw, it being left much too often too far forward. Fig. 8. While it is true that the molars are the best index of the jaw relationship, the writer has found in his experience that if the upper cuspids are

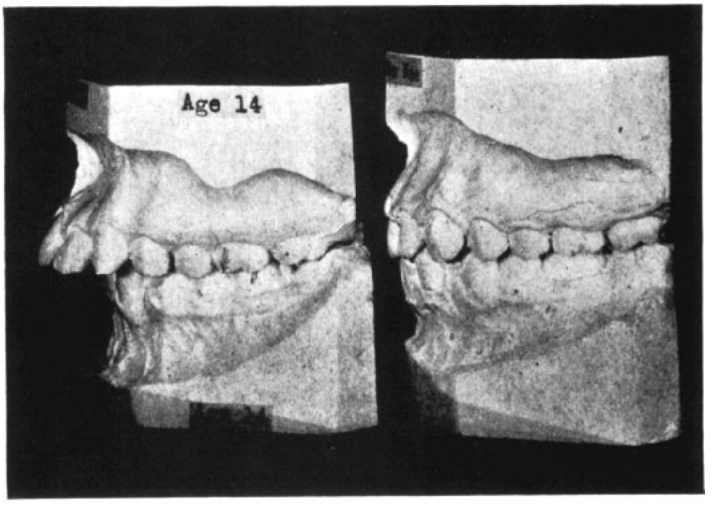

Figure 8—Cuspid too far forward following treatment.

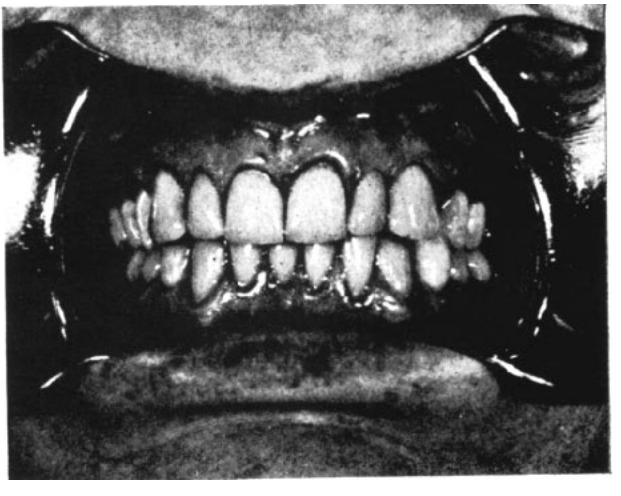

Figure 9—Left maxillary cuspid with distal aspect too far labially.

properly placed in relation to their antagonists in the opposite jaw, all teeth behind them must occupy their correct mesio-distal positions before this relationship can be accomplished.

A second common error is for the cuspids to be left with their labial surfaces faced too far anteriorly. Fig. 9. This gives an excessively broad, square appearance. If the centrals, laterals and cuspids are aligned with their cutting edges on a symmetrical arc according to the Bonwill-Hawley chart, the amount of rotation for the cuspid as well as the other anterior teeth

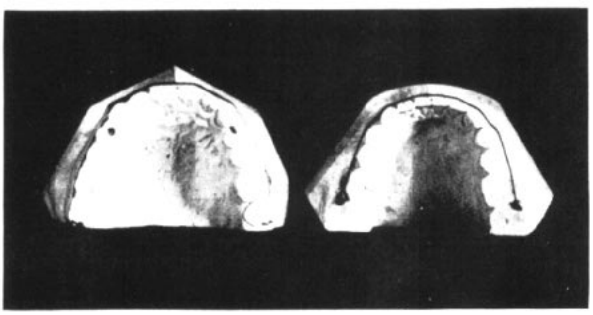

Figure 10—Illustrating the location of the archwires during treatment.

will be found to have been established in such a way as to be most pleasing in appearance and probably will be in harmony with the line of occlusion. By aligning the cutting edges in harmony with this arc, it will be found that the labial surfaces do not align with a common arc but that each then occupies a position which is correct for it. If so aligned, it will then be found that the labial surfaces of the laterals are somewhat lingual to the centrals while those of the cuspid stand boldly out, both because of the forms and sizes of the respective teeth.

Failure to torque the roots well out and the crowns well back, is probably responsible for the difficulties sometimes experienced in properly harmonizing these teeth with their neighbors and their antagonists of the opposite jaw.

Upper First and Second Bicuspids

Much has been said and written on the question of whether or not the buccal teeth occupy positions in harmony with a straight line from cuspid to the molar. Careful study of the question will quickly disclose the fact that both are correct, depending upon what portions of or what positions upon the teeth we judge by. Because in the study of arch-form we are concerned with those portions of the teeth which carry the brackets, these are the portions which we must consider. Fig. 10. Because the buccal surfaces of the first and second bicuspids are convex and bulging, they both stand out buccally to a straight line from cuspid to molar in the "bracket plane." In other words, instead of a straight line from cuspid to molar in the "bracket

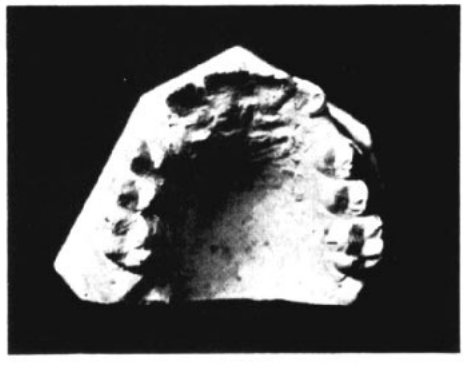

Figure 11—Left bicuspids with uncorrected rotations.

plane" the buccal surface forms an arch slightly convex buccally. The amount of convexity of this arch can be determined by a study of the contact points of the various teeth mentioned and their relation to each other. It will be found that the tips of the buccal cusps more closely align in a straight line from cuspid to molar.

The most common errors in the placement of these teeth are undoubtedly failures to recognize and correct rotations. Fig. 11. Secondly, failure to expand second bicuspids. Fig. 12. This is particularly true in the use of the Ribbon Arch. Third, failure to correct the axial inclinations, particularly in the buccal-lingual dimension where a great amount of expansion has been nec-

essary. It is the writer's opinion that the retention period in such cases can be materially reduced if the roots are carried well buccally, as well as the crowns and that failure to accomplish this root movement is many times responsible for the almost insurmountable difficulties sometimes experienced in these cases.

The Upper First Molar

Undoubtedly more has been written and said about the positions of the first molars than any other tooth, or even, perhaps, all other teeth put together. Fig. 13. In spite of that, probably their proper positions are harder to

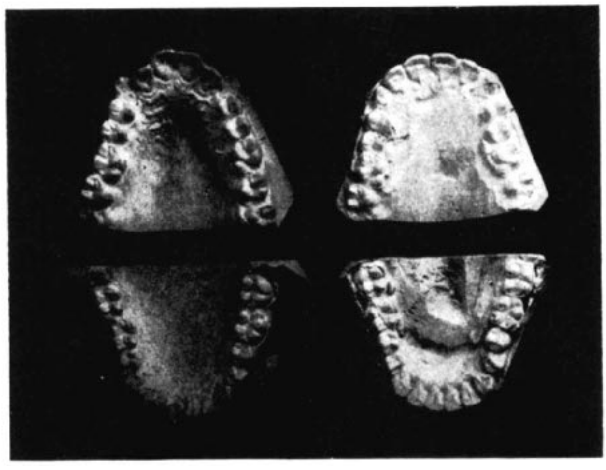

Figure 12—Second bicuspids with insufficient buccal movement.

judge correctly than any other tooth. We are taugh that the mesio-buccal cusp of the upper first molar articulates in the buccal groove of the lower first molar. This by no means establishes the correct position for the upper first molar, even though the lower one is in its proper place. Not until the axial inclinations are also considered is this information of value.

Let us imagine the apex of one of the roots as a fixed point around which the rest of the tooth swings. The mesio-buccal cusp then would travel a great distance as the axial inclination changes. In like manner, if we establish the mesio-buccal cusp as a fixed point, the roots would change their positions greatly as the axial inclination changes. Let it be remem-

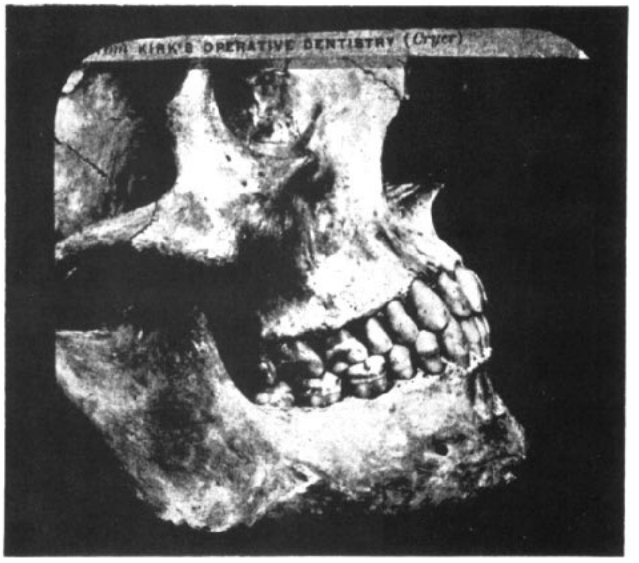

Figure 13—The maxillary first molar, in normal occlusion of the teeth.

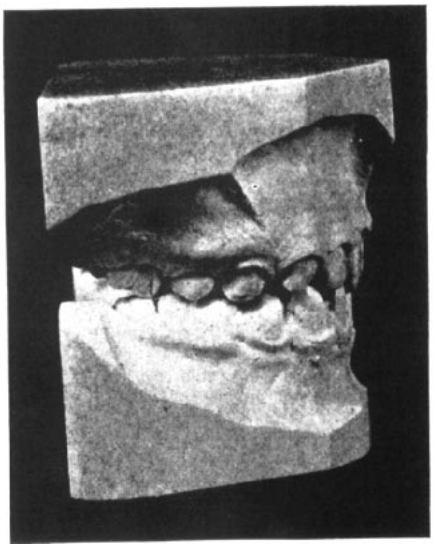

Figure 14—Maxillary molar with a faulty axial inclination.

bered that normally the upper first molar inclines well mesially in such a way that the tooth appears to sit not on top of the disto-buccal cusp of the lower one, but well on the back of it, and in so doing the mesio-buccal cusp of the upper articulates in the buccal groove of the lower. Because the first molars are used greatly for anchorage and because change in their relationship is accomplished largely by tipping, their positions are often judged erroneously by cuspal relationships without regard to axial inclinations. Fig. 14. During the retention period or following it, tipped molars make a strenuous effort to erect themselves. This erecting is not all accomplished in such a way that the cusps are fixed points. The contrary is more nearly

Figure 15—Rotated molars subsequent to treatment.

true. Therefore, correct axial inclinations as well as cuspal relationship, must be accomplished or compensating allowance must be made in cuspid relationship for the error in axial inclination when circumstances dictate a compromise. Undoubtedly, the most common error of treatment in the molar regions is lack of lateral expansion. Examination of numbers of finished models show that actual contraction often occurs, probably the result of expansion of the anterior regions without proper attention being given where the anchorage for this expansion was being secured.

Another common error in the placement of the upper first molar is rotation, Fig. 15, which also allows error in the correct positioning of the

tooth, even though the mesio-buccal cusp apparently maintains its position in the buccal groove of the lower first molar. Let it be remembered that the buccal cusps of the molars do not align with the buccal cusps of the first and second bicuspids and the cusp of the cuspid. Instead, the molar is so rotated that a decided lingual curve in the dental arch is established by it. Failure to recognize this fact, particularly in those cases where the second permanent molars have not erupted apparently is also common.

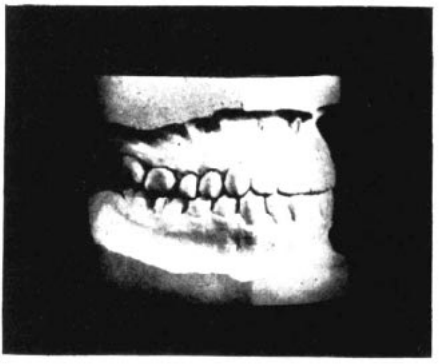

Figure 16—Second molar buccal to normal position.

Second Molar

All that has been said of the first permanent molar also applies to the second one. Beyond question, the most common error seen in treatment of these teeth is that of leaving them buccally to the line of occlusion, many times beyond their normal cuspal influence. Fig. 16. It is well to remember that they form in their crypts with their occlusal surface faced distally and buccally, and that they come into positions by their crowns swinging downward, forward and inward. Because of their positions before they come into the line of occlusion, they are generally crowded buccally when the first molars are carried distally as is often the case.

Third Molars, Upper and Lower

With the full knowledge that the statement may not be popular it is the writer's opinion, and he makes it without apology, that the commonest error in the treatment of the third molars, and one which is relatively a

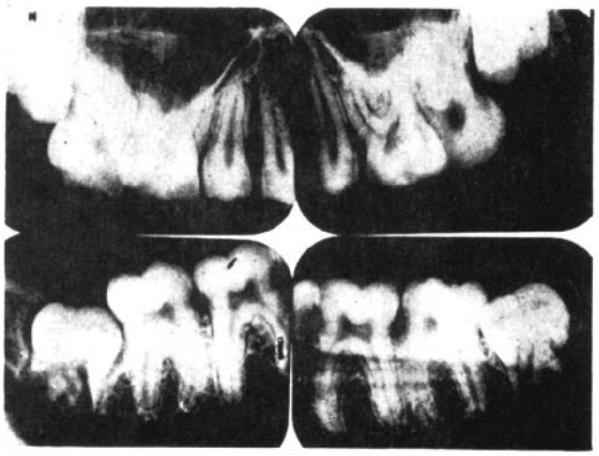

Figure 17A., B.—Two sets of radiograms of the same mouth, taken on consecutive days.

serious one, is failure to have these teeth removed at the proper age if they are impacted and when little or no room exists for them at the age when it should have appeared. It seems significant that so many naturally normal mouths suddenly develop malocclusion at about the time of the normal eruption of these teeth. It is further significant and enlightening to check from the charts of general practitioners the history and life expectancy of third molars in the average adult mouth. In this regard I wish to give a word of warning relative to passing judgment upon whether or not there is sufficient room for these teeth without proper and carefully taken X-Rays. As evidence of the fact that the usual radiogram of this area is misleading, I offer the following slides made of the same mouth on consecutive days. Fig. 17, A and B.

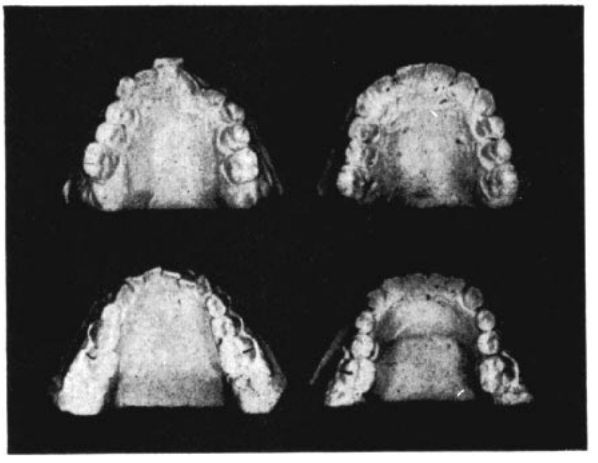

Figure 18—Mandibular incisors moved too far forward in treatment.

Lower Central Incisors

Apparently the commonest error in the placement of incisors, which error applies to the other mandibular teeth, is that of leaving them too far anteriorly to their proper positions in the mandible. Fig. 18. Undoubtedly the very common difficulty experienced in maintaining the width of the lower six teeth of the mandibular arch is due to the fact that these teeth have been "dragged" forward to their proper positions in the mandible, and therefore are also forward to their proper relationship to the muscles and the forces which they create. Even though the teeth may be properly aligned

in correct axial inclination, all too often a shelf of bone may be demonstrated lingual to the lower six anterior teeth, which tells a graphic story. Due to this forward drifting, lower centrals are often left leaning anteriorly. Rotations of course are common and detract greatly from the appearance of the mouth.

Lower Lateral Incisors

Lower lateral incisors in malocclusion are nearly always displaced lingually and toward the median line. In treatment, particularly with the ribbon arch mechanism, too often the crowns are brought into position without

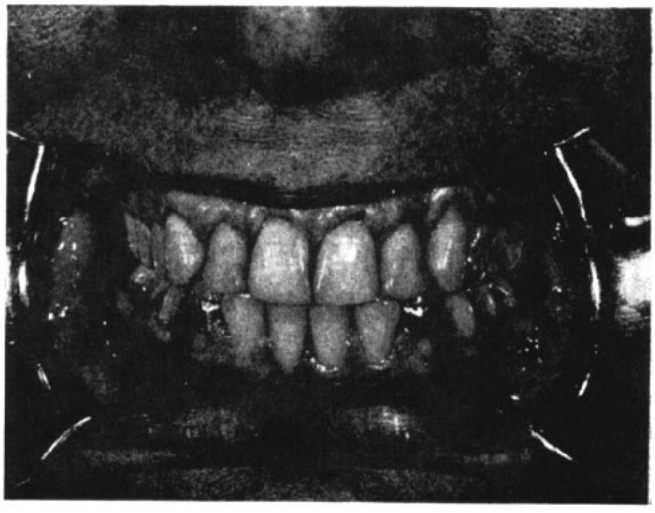

Figure 19—Mandibular lateral incisors with distal sections too far labially.

bringing the roots far enough distally and buccally, thus leaving the lower front teeth fanned out with their roots converging to a common center. Perhaps the experience of not being able to conform a retaining wire to the lingual surfaces of the lower four incisors without putting special bands in the wire to conform to the lingual surfaces of the laterals may recall to mind cases in which these teeth have not been properly axialated. Undoubtedly because of failure to properly axialate these teeth and also failure to properly rotate them, the contact between lower laterals and cuspids is more often left unharmonious than any other dental contacts in the mouth. Fig. 19. Partially, at least, because of that these are points in which the continuity of the dental arch breaks first if relapses take place.

Lower Cuspids

It is a well known fact among Orthodontists, that if that section of the lower arch, lower cuspid to cuspid inclusive, can be held in proper relationship, it will go a long way towards supporting and maintaining the rest of the denture in proper position. It is also well known that this area is generally the first to show signs of relapse. In treatment, therefore, it is highly important to place these teeth so that they are harmonious with and resistent to the forces that act upon them. Lower cuspids at the

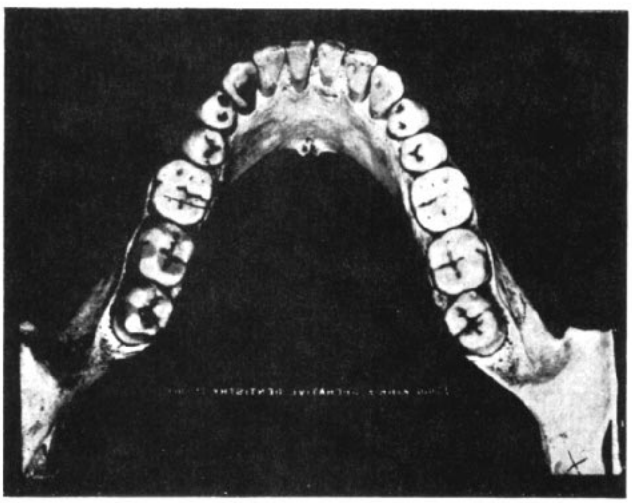

Figure 20—Position of mandibular cuspids in the arch form.

bracket level are tucked well in lingually. They are by no means aligning in a straight line with the bicuspids and molars. Fig. 20. Unless properly placed the lateral movements of the mandible cause the lower cuspids to catch the full thrust of the movement with the result that they are not only traumatized but pushed and pounded out of harmonious relationship. The writer seriously urges that consideration be given the relationship of these teeth to their antagonists of the opposite jaw during lateral excursion of the mandible, as well as centric occlusion before their positions are finally determined.

There has been a very strong tendency to over-expand and overly square this section in an effort to resist the relapse that so often tends to take

place. Fig. 21. A study of the mechanics of mechanical arches has shown that such treatment not only fails to accomplish this purpose but actually invites failure by destroying the principles of the arch mechanically and also by so displacing the cuspids toward the muscular walls of the lips and cheeks, as to increase the muscular pressure upon them. Furthermore, a study of the mechanical arch reveals the fact that failure to properly arc or round this segment destroys its ability to resist the forward tendencies of the posterior teeth through points of contact in such a way that forward drifting

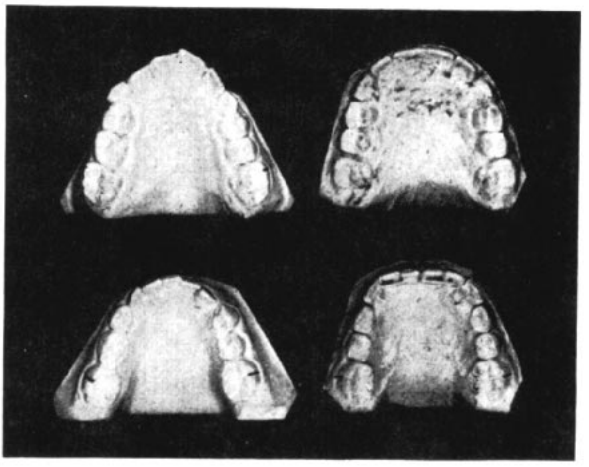

Figure 21—Faulty arch form due to "squaring" the anterior segment.

is permitted, which leads to that evil but inevitable day of finding crumpling in the anterior segment.

Lower Bicuspids

While it is true that the cutting edges of the buccal cusps of the lower bicuspids almost align with the mesio-buccal cusps of the molar and of the cuspid, it will be noted that at the bracket line, the buccal surfaces of the bicuspids extend decidedly buccal to a straight line from cuspid to molar. Fig. 22. So aligned they carry some of the burden of the muscular pressure of the cheeks and lips instead of it all falling upon the cuspid as so often happens if the teeth are improperly aligned. Undoubtedly no teeth in the denture are so often left rotated as lower bicuspids.

Lower First Molar

All that has been said of the upper molar, particularly as regards axial inclinations, also applies to the lower ones. Because these teeth are pivotal points around which the denture balances and act as landmarks by which occlusion is judged, full cognizance must be taken of the fact that cuspal relationship means nothing unless the teeth are properly oriented to the mandible particularly as regards inclinations. Here also, too often the lower molars are improperly rotated in such a way that their buccal cusps align

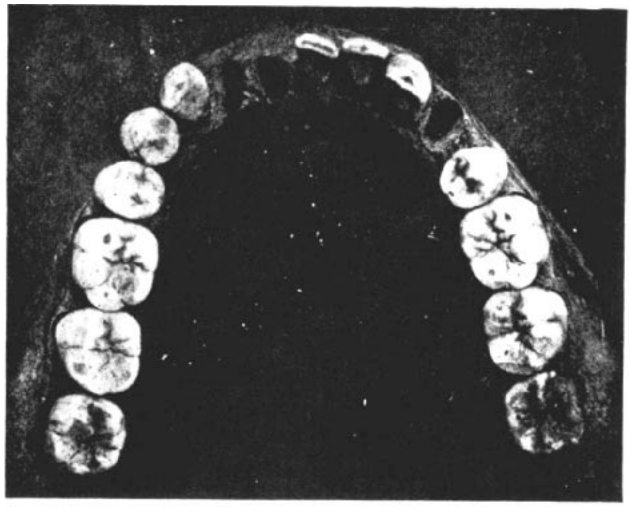

Figure 22—Position of buccal surfaces of bicuspids in relation to the labial surface of the cuspids.

with the buccal cusps of the bicuspids instead of creating a decided bend lingually in the arch contour.

Lower Second Molar

The most common error in the treatment of lower second molars is probably failure to band and use them for anchorage and stability, particularly in the treatment of older Class II cases. Occurring distal to the teeth which are most often treated, the firm attachment to the mandible which they possess is largely lost unless they are banded and it is a rare case where this anchorage is not useful.

Considering the teeth collectively exclusive of general arch form, too little attention seems to be paid to those axial inclinations and cuspid heights which determine the curve of Spee. Fig. 23. Failure to properly har-

monize the teeth with the curve of Spee as well as failure to create proper arch form in the horizontal dimension immediately causes disharmony in the lengths of the two arches. It is the writer's opinion that a large amount of the supposed disharmony in tooth form and tooth substance between the two arches is traceable to these errors. Failure to accomplish proper arch form is undoubtedly responsible for much of the difficulties encountered during the retention periods, for let it be remembered that there is only one place

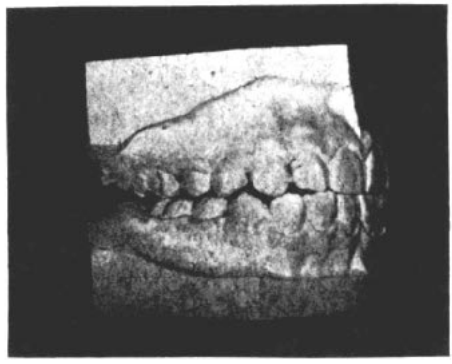

Figure 23—Absence of curve of Spee in treated denture.

that a tooth can be maintained in position and that is its correct position. These correct positions can only be accomplished by, and in, proper arch form.

Great characteristic variations are seen in the placement of teeth by the various well trained orthodontists. It is too often true that the finished results of one operator are sufficiently characteristic of him to brand them as being his, to those who are familiar with his work. It is not logical to suppose that he may have accumulated in his practice only those individuals who required that special treatment of their cases. It therefore becomes obvious that unless there is one mechanically perfectly patterned arch form, which because of its mechanical perfection best meets the average requirement for arch form for all individuals and also that such an ideal arch form, because of mechanical imperfection, best permits nature to work out from it, through function, individual arch form for the individual, it is obvious, that there is no excuse for such universal treatment of all cases. A study of the results of various well trained operators discloses the fact that this

condition generally exists. This makes it appear probable that it is beyond the ability of the average operator to fully judge the typal requirement for each case. It would seem logical, therefore, to seek mechanical perfection in arch form which is attainable, in the hope, and I might say with the knowledge born of experience, that nature through the agency of function, will create from it those individual characteristics for each particular denture. This will be true in direct ratio to the perfection of tooth placement as regards fine details which we are able to accomplish in our treatment.

1014 Roosevelt Building,