A Radiographic Study Of Response To Torquing Spring Action

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Many appliances have been used to produce lingual movement of the apices of maxillary anterior teeth. Among these are Angle's pin and tube, ribbon and edgewise arch mechanisms, Case's double arch, the auxiliary bow soldered to a round labial arch, springs and spurs used with the McCoy open tube appliances, and the vertical spur bent into a light arch as shown by Begg. These have produced varying degrees of responses with varying degrees of difficulty of manipulation and control.

The following might be considered requirements to be fulfilled by an ideal torquing appliance:

1. Produce a gentle and long-acting lingual force on the apices of the maxillary incisors.
2. Provide for easy adjustment and activation.
3. Prevent labial tipping of the crown as a reaction to the lingual root force.
4. Provide an attachment for the high-pull headcap in order to take advantage of its retruding and intruding action.
5. Allow for the simultaneous closing of spaces.
6. Minimize any increase in the likelihood of damage to the enamel.

Disappointment with the edgewise arch in this area led to experimentation with various combinations of springs, loops, hooks and archwires. A combination appliance evolved which seemed to fulfill these requirements.

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This appliance consists of an archwire of .018 cobalt chromium steel (semi-spring Elgiloy) and has embodied in it reversed helical closing loops distal to the cuspid brackets (Fig. 1). This wire is light enough so that a twist may be introduced into it with a relatively small force, yet it is strong enough to resist excessive distortion from elastic or headgear pull. The purpose of the loop is to:

1. Prevent labial tipping of the incisor crowns.
2. Actively close spaces.
3. Keep spaces closed that previously were closed.

Soldered auxiliary attachments consist of finger springs of .018 cobalt chromium steel and hooks of .030 steel. The springs extend to the labiogingival of each incisor crown and touch the crown at a point in line mesiodistally with the center of the bracket. The last two or three millimeters of these springs are bent at right angles to the labial surface. The purpose of this bend is to minimize the accumulation of materia alba and to produce as small a surface contact with the enamel as possible. The hooks are soldered mesial to the cuspid brackets and extend in a gingival direction. The purpose of soldering the hooks to the gingival is to avoid deactivation of the torque in the main archwire when headgear or elastic traction is applied.

In construction the springs are adjusted so the tip of each spring is equidistant in a lingual direction from the archwire. At the time of seating, the

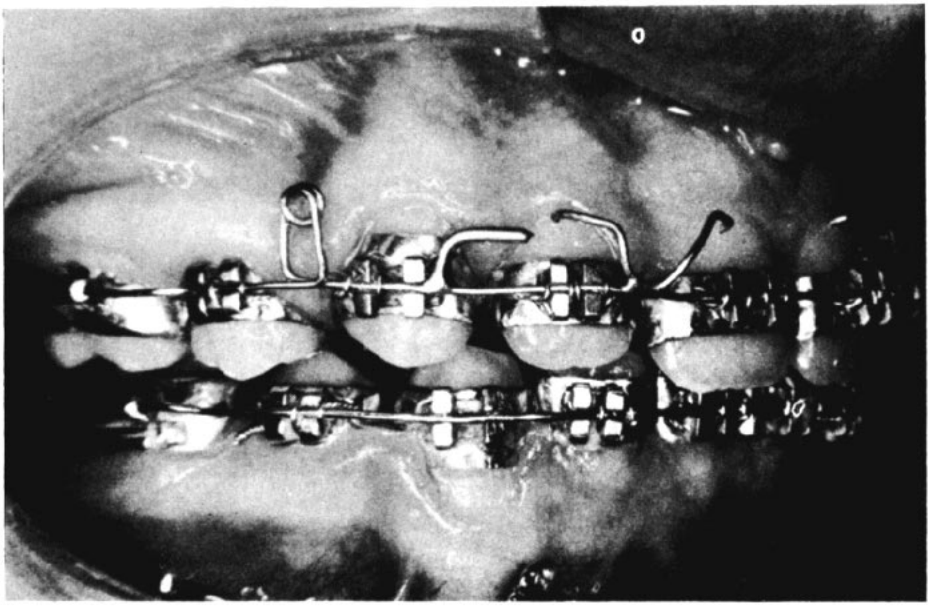

Fig. 1 Photograph of appliance.

springs receive a final adjustment so that they just touch the enamel as the archwire lies passively outside the bracket slot. The entire appliance is then heat-treated by passing it slowly several times through a semi-luminous flame.

It might be said here that double edgewise brackets or some other attachment that will prevent possible rotation of these teeth should be used. Also, to minimize loss of control due to a loose ligature, both wings of the double bracket should be tied individually.

After observing the response of maxillary anterior roots to the lingual force supplied by this "torquing spring" appliance, it seemed that it would be of interest to make a timed study of this response. Therefore, a series of three headplates was made at three-month intervals on fifty patients wearing this appliance. Two of the appliances did not include the reversed helical closing loops. Most of the patients were instructed to wear a high-pull headgear attached to the soldered hooks from eight to twelve hours a day. About half of the patients were instructed to wear Class II intermaxillary elastics during at least part of the six month period.

A template was made of the profile of the maxillary central incisor and a cross mark made at the apex and incisal edge. This template was placed on each headplate in each series and a full composite tracing made. Because of the short time span the amount of growth in most cases was small and superimposition of sella, nasion, floor of the nose and palate was quite accurate. In the few cases showing a slight vertical growth, the tracing was dropped to superimpose on the floor of the nose and palate keeping the S-N lines parallel. The position of the cross mark at the apex and incisal edge of the template was registered on the master tracing by means of a pin prick.

Figure 2 shows a typical full tracing illustrating the position of the central at the initial seating of the appliance and at the two following three-month

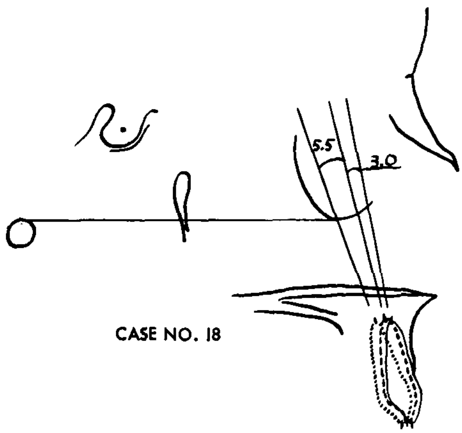

Fig. 2 Typical composite tracing.

intervals. Figure 3 is the composite tracing showing the movement of the centrals of the fifty cases. This composite shows that in every case the apex moved lingually.

If each central had simply rotated about the bracket, the incisal edges would have moved labially. In twelve cases the incisal edge did move labially; but in the other thirty-eight cases it remained stationary or moved lingually.

This shows that in these thirty-eight cases the tooth moved lingually bodily in addition to the lingual root movement.

It is interesting to note that the movement was not always uniform in the two periods. In some cases the apex moved more in the first and in others more in the second. The movement of the incisal edge was more erratic in that it often changed directions between the two periods or moved during one and remained stationary during the other.

The distances between the pin holes at the apices and between the pin holes at the incisal edges were measured at right angles to the original long axis. Also the change in the angular relation of the apical point to the original long axis was measured using the incisal point as the apex of the angle.

The average lingual movement of the apex in each three-month period was slightly over 1.5 millimeters, the average for the six-month period being 3.5 millimeters.

While the main purpose of this study was to measure movement of the apex, it was also important to measure the movement of the incisal edge. If the tooth simply rotated about the bracket, pure torque so to speak, the incisal edge would be expected to advance .7 millimeters with a lingual movement of the apex of 3.5 millimeters. This is because the incisal edge is approximately one-fifth the distance from the bracket that the apex is. The actual movement of the incisal edge was an average of .25 millimeters lingually. Therefore, it moved lingually practically one millimeter from where it would have been as a result of pure torque. This points out that the movement of the apex was not due to labial tipping of the crown, but was accomplished in spite of the fact that the incisal edge also moved lingually. The two cases #22 and #43 which showed the greatest labial movement were those two that did not have the reversed helical closing loops incorporated in the archwire. Had these cases not been included, the average movement of the incisal edge to the lingual would have been greater. Although only two cases are represented, they do indicate the importance of the closing loop in preventing labial tipping.

The change in the position of the apex was also measured by drawing a line from it to the original incisal edge and measuring the angle formed with the original long axis. This angle increased a little under four degrees for each three month period, the total being 7.78 degrees. This angular measurement is but another way of evaluating the lingual movement of the apex. However, it might also serve as an aid in treatment planning. As an example,

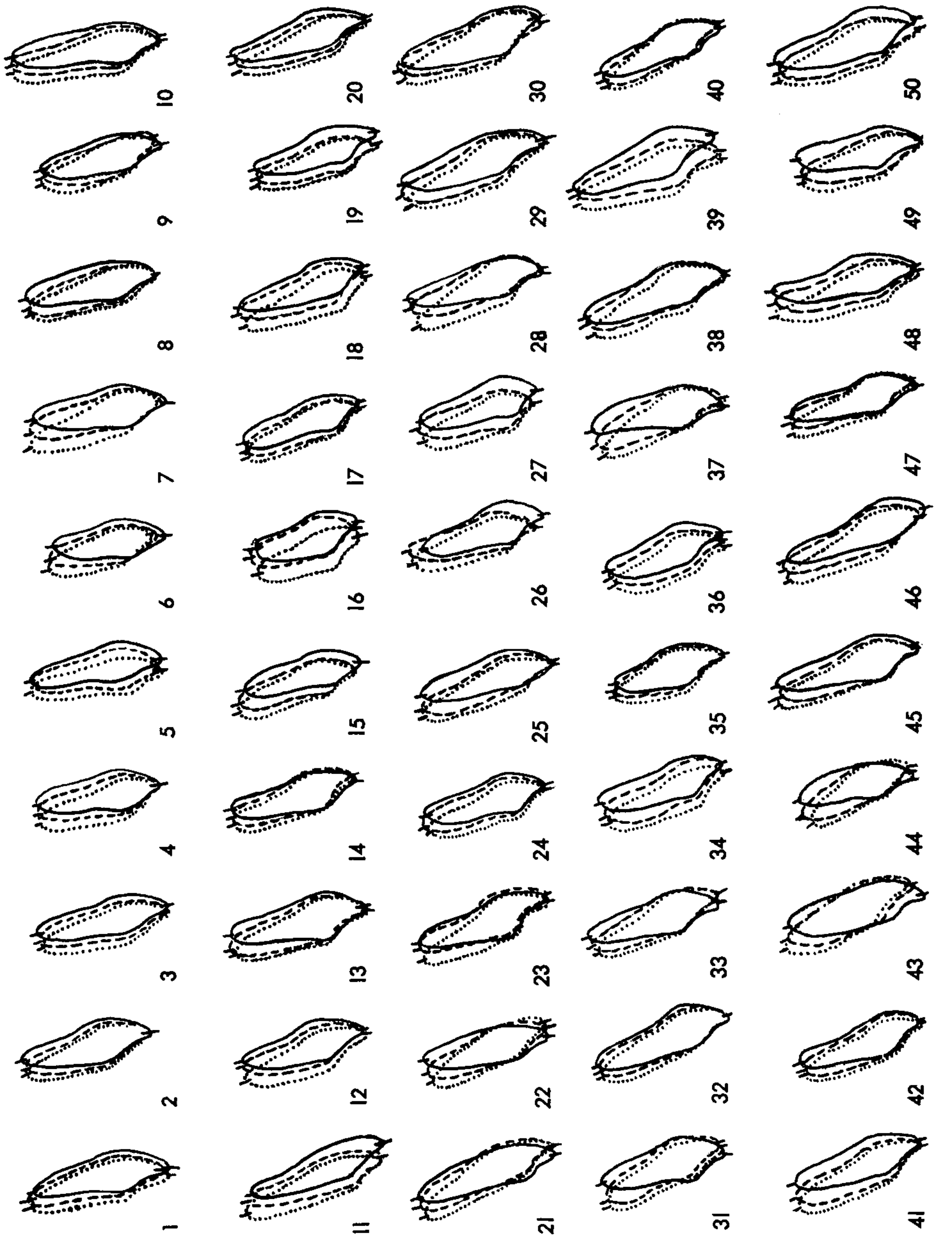

Fig. 3 A composite tracing of the fifty cases.

using it as an average expected response, one could estimate the time required to correct faulty axial inclination of maxillary incisors.

SUMMARY

1. The movements of the maxillary centrals of fifty patients wearing torquing spring appliances were studied over a six-month period.
2. The presence of an active closing loop in the archwire seems important in the prevention of labial tipping of the incisal edge as a result of the lingual force at the apex.
3. In each of the fifty cases, maxillary anterior teeth moved in response to the force supplied by the torquing spring appliance.
4. This movement was not always uniform either in magnitude or direction.
5. The apices moved lingually an average of 3.5 millimeters.
6. The average incisal edge was restrained from moving labially and was, in effect, moved one millimeter lingually from where it would have been as a result of pure torque.
7. The axial inclination changed an average of 7.8 degrees.

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