Unilateral Action With Headcap

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INTRODUCTION AND REVIEW OF LITERATURE

In January, 1953 I read a paper before this society entitled "Construction and Use of Unilateral Headcap with Report of Cases". This created quite a discussion about whether or not there was more force exerted on the side to which the soldered joint was off-set. At this time I showed two cases where this unilateral headcap was used and the models showing the case in Class I molar relationship without the use of intermaxillary elastics.

If the previous paper did nothing else, it stimulated further research in the use and construction of the unilateral headcap for which I am grateful as I am sure that all of us will benefit from this further research.

The following January Dr. Arthur J. Block gave a report before this group entitled "An Analysis of Midline and Offcenter Extraoral force". His method was the recording of relative linear measurements of elastic pull required to counterbalance elastic traction applied to each of three types of extraoral headgear placed on a symmetrical base. This was a very good paper, it gave an analysis of the mechanics involved and the results obtained.

In January, 1955 Dr. Vernon R. Boman read a paper before this component regarding the use of off-center extraoral force; this was done using a mechanical base and elastics to measure the force at the end of the E arch. He found that when you bent one arm of the arch bar laterally you had more force applied on that side. He also had an assembly in which there was a swivel joint in one arm of the arch bar with the other arm bent laterally. He found that the pull on the opposite side was increased more than when only the arm of the arch bar was bent laterally.

In September, 1957 Donald C. Haack and Dr. Sam Weinstein presented a paper before the Central Section of the American Association of Orthodontists, entitled "The Mechanics of Centric and Eccentric Cervical Traction". This paper dealt with the forces applied to the molars in both centric and eccentric assemblies using a cervical strap and was computed according to mathematics and physical mechanics. This is a very comprehensive thesis with the forces measured on a mechanical device. They found that when the arm of the arch bar was longer on one side there was a greater force on that side and the difference depended on the difference in length of the arms. They also showed that when a rigid attachment such as a soldered joint was used, even though offset to one side, there was no difference in the pull if the arms were equal. Models of cases under treatment were also shown.

In the October, 1959 issue of the Angle Orthodontist there is a paper by Dr. E. W. Drenker, entitled "Unilateral Cervical Traction with a Kloehn Extraoral Mechanism". This well-written paper also deals with the physical mechanics and mathematics. By analyzing the forces on the molars, he found that by increasing the length of the arm of the arch bar approximately two inches on the side to be moved distally, and also displacing the arm of

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the arch bar three-fourths inch laterally on that side, you would have total, or almost total unilateral action. This has the disadvantage of simultaneously subjecting the dental arch to lateral force, which is undesirable in many cases.

Since all of the previously mentioned papers were done on mechanical devices based on mathematics and physical mechanics, or a combination of the two, I decided to try to accomplish the same things on a clinical basis.

I still was not convinced that an offset headcap exerted the same force on both molars because of past clinical experience. I had tried both lengthening the arm of the arch bar on the side which was to be moved distally and bending the arm of the arch bar laterally, and I had experienced clinically that it was more efficient than the unilateral headcap that I had reported on in my paper in 1953. However, I could not quite believe that the pull was even on the unilateral headcap I had described, since it worked clinically in a large number of cases.

Method and Material

This paper deals with the clinical aspect of the use of a headcap to obtain unilateral action; all measurements and clinical observations were made on one patient. Most of the work previously reported has been on a theoretical and mathematical nature and to my knowledge no direct clinical measurements have been taken from a patient.

The materials used in this project consisted of a regularly constructed E arch of .045 wire soldered in the center to an arch bar made of .059 wire (Fig. 1). Both the E arch and arch bar were constructed of stainless steel wire. The other E arch and arch bar, also steel and of the same diameters, were soldered off center one-half inch to the left. The elastic force was applied

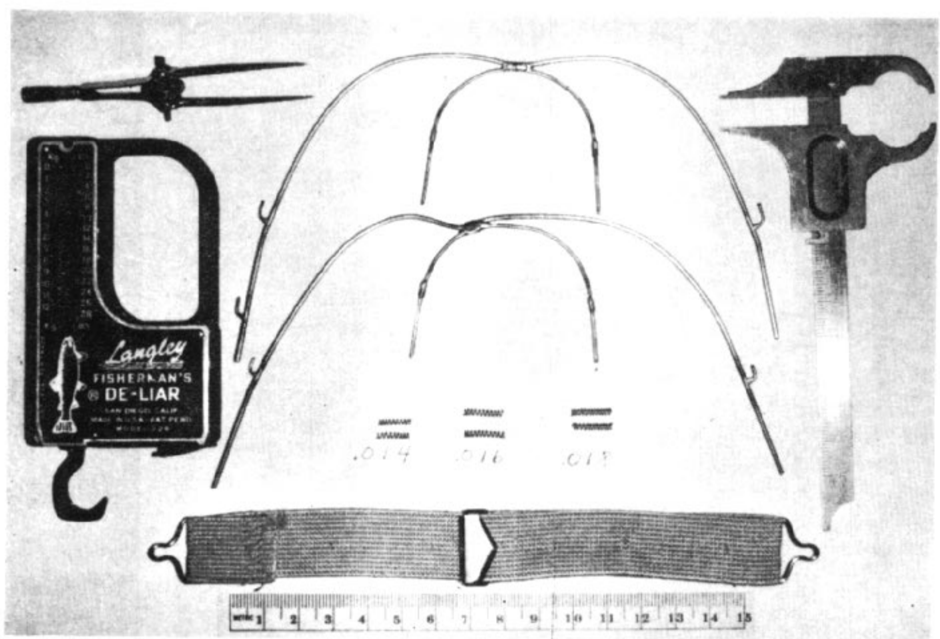

Fig. 1

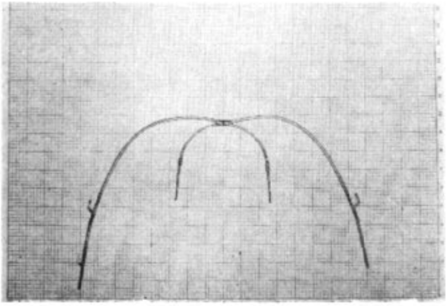

Fig. 2

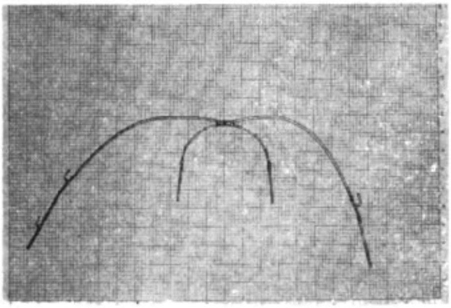

Fig. 3

through the use of an adjustable elastic cervical strap.

Tubes were soldered on the E arches to act as stops twelve mm in front of the molar tubes on both assemblies. The force exerted on the molar tubes was measured by using open coil springs made out of .014 and .016 round stainless steel wire and .018 round yellow Elgiloy wire. The pull on the elastic neck band was accurately measured by using a scale. The compression of the springs was measured in the mouth using a fine pointed divider, then final measurement was made from this by using a Boley gauge.

The sections of the E arches which engaged the molar tubes were reduced in size so that they moved freely through the tubes, thus eliminating as much friction as possible mechanically. These ends were then lubricated to further reduce this friction to the least possible amount.

The same center assembly of E arch and arch bar was used throughout the project, and changes in the length of the arms were accomplished by soldering hooks on the arch bar for attaching the cervical traction band (Fig. 2).

The left arm of the arch bar was also bent laterally so that it was three-fourths inch wider than the right arm, for the recordings in that position (Fig. 3).

The same procedure was followed for the E arch and arch bar assembly that was soldered one-half inch off-center (Fig. 4).

When the project was started with the centered assembly, each set of coil springs was placed on the centered E arch assembly, the neck band applied using one pound pull and measurements were taken of both sides. Then the springs were placed on the opposite side and, using the same pull, measurements were taken again; it was established that the measurements were equal within one-tenth of a millimeter which is within the realm of experimental error.

The neck band was always checked by running the finger between neck band and the neck to be sure it was as free as possible, so that the pull would be equalized with the least possible friction.

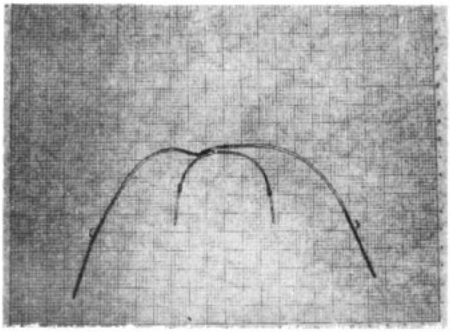

Fig 4

Table I

Pull on Cervical Band	.014 spr. 10 mm		.016 spr. 12 mm		.018 spr. 12 mm	
Symmetrical arch bar	R	L	R	L	R	L
1 lb. Arms even	7.0	7.0	11.0	11.0	11.0	11.0
1" longer on left	6.5	5.8	11.0	10.3	11.1	10.0
2 lbs. Arms even	6.2	6.2	10.1	10.1	11.0	11.0
1" longer on left	6.5	5.8	10.5	9.5	11.5	10.5
2 lbs. Arm ¾" wider on left						
Arms even	7.2	5.5	10.5	9.6	11.0	10.2
1" longer on left	7.1	5.3	10.5	9.5	11.2	10.0
2 lbs. Arch bar ½" off-center			9.5	9.5	10.0	10.0

The same procedure was followed with the E arch and arch bar assembly that was soldered one-half inch off center.

Findings

Using the symmetrically centered assembly and .014 round steel coil spring 10 mm long with the arms of the arch bar even and one pound pull on the cervical band, the springs were compressed to 7.0 mm on the right side and 7.0 mm on the left side (Table I). When the left arm was one inch longer than the right arm of the arch bar, the spring was compressed to 6.5 mm on the right side and 5.8 mm on the left side.

When the amount of pull was increased to two pounds on the cervical band with the arms even, the springs were compressed to 6.2 mm on right side and 6.2 mm on the left side. With the arm of the arch bar on the left side made one inch longer, the springs were compressed to 6.5 mm on the right side and 5.8 mm on the left. When two pounds pull was exerted on the cervical band and the left arm of the arch bar was bent laterally so it was three-fourths inch wider than the right arm with the length of the arms even on the center assembly, the springs were compressed to 7.2 mm on the right side and 5.5 mm on the left side. When the arm of the arch bar on the left side was one inch longer and three-fourths inch wider laterally, the springs were compressed to 7.1 mm on the right side and 5.3 mm on the left side.

Using the symmetrically centered assembly and .016 round steel coil springs 12 mm long with one pound pull on cervical band and the arms of the arch bar even, the springs were compressed to 11.0 mm on the right side and 11.0 mm on the left side. When the pull was one pound and the left arm of the arch bar was one inch longer than the right arm, the springs were compressed to 11.0 mm on the right side and 10.3 mm on left side.

With the arms of the arch bar even and the pull increased to two pounds on the cervical band, the springs were compressed to 10.1 mm on the right side and 10.1 mm on the left side. When the pull was two pounds and the left arm of the arch bar was one inch longer than the right arm, the springs were compressed to 10.5 mm on the right side and 9.5 mm on the left side.

When the pull was two pounds and the left arm of the arch bar was bent laterally so that it was three-fourths inch wider than the right arm and the arms were even, the springs were compressed to 10.5 mm on the right side and 9.6 mm on the left side. If the left arm of the arch bar was constructed one inch longer and three-fourths inch wider than the right arm and a two pounds pull, the springs were compressed to 10.5 mm on the right side and 9.5 mm on the left.

With a pull of two pounds on the cervical band and the E arch and arch bar assembly soldered one-half inch off-center to the left and using .016 round coil springs, the springs were compressed to 9.5 mm on the right side and 9.5 mm on the left.

When using the symmetrically centered assembly and .018 yellow Elgiloy coil springs 12 mm long with one pound pull on the cervical band with the arms of the arch bar even, the springs were compressed to 11.0 mm on the right side and 11.0 mm on the left side.

If the pull was one pound and the left arm of the arch bar was one inch longer than the right arm, the springs were compressed to 11.1 mm on the right side and 10 mm on the left side.

By increasing the pull to two pounds on the cervical band with the arms of the arch bar even, the springs were compressed to 11.0 mm on the right side and 11.0 mm on the left side. With a pull of two pounds and the left arm of the arch bar one inch longer than the right arm, the springs were compressed to 11.5 mm on the right and 10.5 mm on the left.

When the pull on the cervical band was two pounds and the left arm of the arch bar bent laterally three-fourths inch wider than the right arm, with the arms of the arch bar even, the springs were compressed to 11.0 mm on the right side and 10.2 mm on the left. With a pull of two pounds and the left arm of the arch bar one inch longer and three-fourths inch wider than the right arm, the springs were compressed to 11.2 mm on the right side and 10.0 mm on the left side.

When the pull was two pounds on the cervical band and the E arch and arch bar assembly soldered one-half inch off-center to the left and, using the .018 round Elgiloy coil springs, the springs were compressed to 10.0 mm on the right side and 10.0 mm on the left.

Discussion

It will be noticed from the preceding findings the compression of the springs was equal on both sides when the arms of the arch bar were even when all three size springs were used.

If the arm of the arch bar on the left was one inch longer, the compression of the spring on the right side was equal or less, than when the arms were even, except in cases of the .014 coil spring at the one pound pressure and when the arm of the arch bar was one inch longer and three-fourths inch wider with one pound pressure. In all cases, with all three springs the compression was greater on the left side when the left arm of the arch bar was one inch longer.

The compression of the springs was greater on the left when the arm of the arch bar was three-fourths inch wider, both when the arms were even and when the arm on the left was one inch longer and also three-fourths inch wider.

It would appear from the findings that possibly the .014 steel coil springs were not of sufficient strength to give as accurate a recording as were the .016 steel springs and the .018 yellow Elgiloy springs.

It was noticed that all the springs had a tendency to remain slightly compressed after continued use since the same coil springs of each size were used throughout all the measurements.

This is noticeable particularly on the measurement of the one-half inch off-center assembly with a cervical pull of two pounds, as this was the last measurement taken and it will be noticed that the measurements are even on both sides, but that it is less than when the two pounds pressure was placed on the centered assembly with the arms even. This slight change in length of the coil springs after continued use can probably be attributed to the fact that they were made from regularly stocked wires, were not tempered and also to the fact that all open coil springs tend to shorten slightly in length after continued usage.

It was also evident when evaluating the forces exerted when the left arm of the arch bar was bent laterally three-fourths inch wider than the right arm that, after use, when the assembly was checked, the left arm did not remain three-fourths inch wider than the right arm.

For the above reason I am of the opinion that the size of the wire for the arch bar should be increased from .059 to .070 or .075 inches as suggested by Haack and Weinstein, especially if you plan to move one arm laterally to increase the width, thereby increasing the force on that side.

Summary

1. The results of these clinical measurements made on a patient with different types of unilateral E arch and arch bar assemblies used showed that you can get definite unilateral action by increasing the length of the arm of the arch bar on the side where you want to move the molar distally.
2. You can also increase the force by bending the arm of the arch bar laterally on the side where you wish to have more distal movement.
3. By lengthening the arm of the arch bar and bending it laterally it is possible to increase the force on the side where you desire more movement. The force will be greater than when either one is used alone.
4. When the E arch and the arch bar are rigidly soldered one-half inch off center and the arms of the arch bar are even, the force is equal on both sides. The probable reason for this appliance working as a unilateral headcap, as I reported in a previous paper, was that the arm on the side to which the joint was offset, was probably wider from the midsagittal plane. I found in forming the off-center assembly that it was difficult to get it symmetrical.
5. No attempt was made to measure the definite amount of force exerted on the molars by the compression of the coil springs or the biological response of the tissues to these forces.

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