대한치과교정학회지 : 제 2권 제 1 호
J. K. A. O. : Vol. 2, No. 1, Dec., 1971.

A BIOMECHANICAL STUDY ON THE EFFECT OF LIGHT WIRE TORQUING AUXILIARY

Kyung Jin Park, D.D.S.

Dept. of Orthodontics, Graduate School, Seoul National University

Director : *Assist. Prof.* **Hi Won Cho**, D.D.S., M.S.D., Ph.D.

Light wire torquing auxiliary의 효용도에 관한 생력학적 연구

서울대학교 대학원 치의학과 교정학 전공

(지도 : 조 희 원 조교수)

박 경 진

국문초록

저자는 교정환자 치료에 흔히 사용되는 Light wire torquing auxiliary의 반경의 크기 및 교합면에 대한 spur 각도의 증감에 따라 Light wire torquing auxiliary 에서 발생되는 힘이 어떻게 변화하는 가를 Dentiform typodont 위에서 측정 관찰하여 아래와 같은 결과를 얻었다.

1) Light wire torquing auxiliary circle의 반경의 크기가 감소할 수록 발생되는 힘의 크기는 증가하였으나, 반경의 크기에 반비례하지는 않았다.

   즉, Light wire torquing auxiliary circle의 반경을 20 mm. 에서 10 mm. 로 하였을때 발생되는 force는 2배로 나타나지는 않았다.

2) 교합 평면에 대한 spur의 각도가 감소할 수록 force는 증가하였다. 이때 교합 평면에 대한 spur의 각도를 감소시킨 상태에서 교합 평면과 치아가 이루는 각도를 증가시켜 줌으로써 항속적인 힘의 증가를 나타냈다.

INTRODUCTION

In the mechanotherapy of malocclusion, it is necessary to use the torquing auxiliary in many cases. In the 16 years since Dr. Begg first introduced his technique, there has been only a limited number of writings concerning the technique, particularly pertaining to force delivered by the Begg torquing auxiliary. Lingual root torque, in the Begg technique, had been achieved by means of an auxiliary arch wire containing vertical spurs which are torqued lingually in the end of the second stage and the third stage of

* 本 論文의 要旨는 1971年 11月 15日 第4回 大韓齒科矯正學會 學術大會에서 發表되었음.

the treatment. The torquing auxiliary is perhaps the most important mechanism in this system. This auxiliary provides the energy to move the maxillary anterior teeth from their extreme lingual inclination to the desired labio-axial inclination in the finishing stage of appliance therapy. Despite the critical importance of the forces applied by this wire to the success of treatment, the wire is usually fashioned in one certain way for most patients, with some modifications for the individual style of the operator.

The author tried to determine how the force magnitude generated by these auxiliaries changes upon (1) the diameter of the circle to which the torquing auxiliary is bent before it is opened and engaged in the brackets, (2) the angle which the spurs make with the plane of the auxiliary at rest.

EXPERIMENTAL PROCEDURE

All experimental procedures involve the measuring of forces delivered by torquing auxiliary under varying conditions in the Begg light wire technique.

The single set of measurements was made by pinning in a Begg torquing auxiliary on a Dentiform Typodont which had previously been equipped with orthodontic attachments on all teeth (Fig. 1).

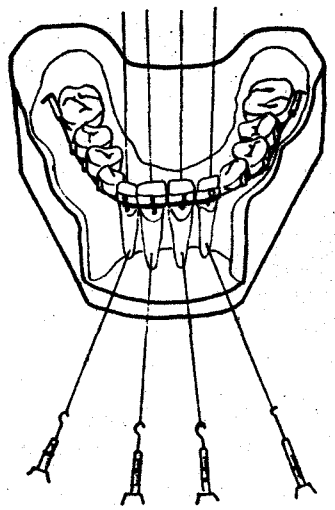

Fig. 1 Prepared dentiform for this study.

Six torquing auxiliaries with spurs of 4 mm. long were fashioned using 0.016 inch Elgiloy round wire. These six straight pieces of auxiliaries were classified by their inclination of spurs in two groups:

1) three circular auxiliaries with spurs oriented in the same plane as the circle of the wire.
2) three circular auxiliaries with spurs oriented at a 45 degree angle to the plane in which the circle of the wire lay.

Each of the three identical wires in each of the two groups was varied so that their circles were of three different diameter: 10, 15, and 20 mm. (Fig. 2).

All torquing auxiliaries were heat-treated at 950°F. for 15 minutes to reduce residual stress in furnace.

Torquing auxiliary was pinned into the maxillary central and lateral brackets, with the distal sections of the wire running through the canine brackets and into the molar tubes. The apical ends of the four anterior teeth were allowed to move freely by the removal of anterior portion of dentiform so that the only point of attachment was at the

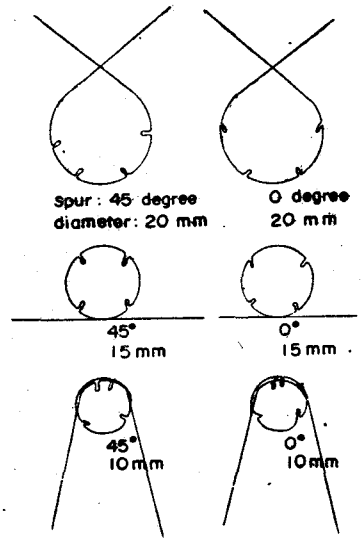

Fig. 2 Schema of various size and angle of torquing auxiliaries.

bracket slot. A piece of floss silk was attached to the apical end of each of the four anterior teeth at 15 mm. from the bracket slot. Each of the threads was pulled out radially so that the tooth was in a position of a certain static equilibrium and the tension exerted on the thread in this position was measured with a Dontrix gauge.

In the experiment, as one of its objectives, the author tried to correlate the amount of forces applied to each tooth with positional changes in longitudinal axis of the tooth as the root rotated around the main arch wire. To establish the position of the teeth during their changes of inclination, 0.011 inch Elgiloy round wires were attached to the lingual surfaces of the crown of each tooth. The range of measurement extended from 70 to 120 degree to the occlusal plane.

The 120 degree limit represented the way the teeth would appear before lingual root torquing auxiliary was applied. And the 70 degree limit represented the other extreme after lingual root torquing auxiliary was applied. This range is considerably greater than that which would be encountered clinically. Sum of incisor widths was 31.5 mm. and the inter-premolar width was decided as 38.5 mm. distance.

RESULTS AND DISCUSSION

The purpose of this experiment was to learn how the forces produced by a Begg torquing auxiliary are altered by changes in the construction of the torquing auxiliary itself.

In several changes of the construction of the arch wire, the length of the spur is limited by the amount of exposed crown from gingival margin to the bracket slot. Therefore, the force changes produced by the variation of length of spurs are clincally negligible. It was not easy to acquire the amount of crown necessary to place a long torquing spur for reduction in force. The torquing auxiliaries were divided into three groups with respect to their diameters: 10, 15, and 20 mm.

It was found that, all other conditions being equal, the smaller diameter configurations produced considerably greater force ; however, the changes in force were not in reverse proportion to the change in diameter, as described by the fact that the 10 mm. circular auxiliaries were not twice as strong as the 20 mm. auxiliaries. It was affected the magnitude of the moment produced at each tooth inclination that changed in the angles of the torquing spurs on the plane of the auxiliary at rest.

Table 1. The force values with the variations of the diameter and the spur angle of torquing auxiliary.

Teeth		CENTRAL INCISORS						LATERAL INCISORS					
Wire \ Inclination of tooth		70°	80°	90°	100°	110°	120°	70°	80°	90°	100°	110°	120°
20 mm.	0°	1.75oz	2.12oz	2.50oz	3.12oz	3.50oz	3.85oz	1.67oz	2.00oz	2.35oz	3.00oz	3.30oz	3.70oz
	45°	0.35〃	0.75〃	1.25〃	1.78〃	2.37〃	2.75〃	0.25〃	0.67〃	1.12〃	1.50〃	1.87〃	2.25〃
15 mm.	0°	2.50〃	2.75〃	3.10〃	3.37〃	3.75〃	4.12〃	2.25〃	2.50〃	3.00〃	3.12〃	3.50〃	4.00〃
	45°	1.50〃	2.42〃	2.75〃	3.25〃	3.62〃	4.00〃	1.37〃	1.95〃	2.12〃	2.75〃	3.20〃	3.62〃
10 mm.	0°	2.87〃	3.25〃	3.50〃	3.85〃	4.25〃	4.62〃	2.75〃	3.12〃	3.35〃	3.75〃	4.12〃	4.50〃
	45°	1.80〃	2.50〃	2.87〃	3.62〃	3.75〃	4.12〃	1.55〃	2.25〃	2.75〃	3.12〃	3.50〃	3.85〃

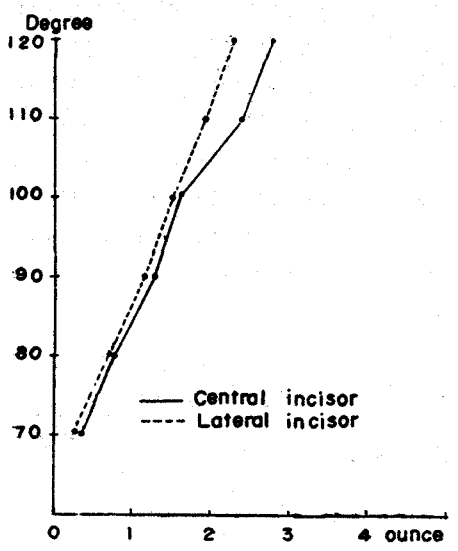

Fig. 3 Force increments of measurements for 20 mm. auxiliary circle and 45 degree spurs of 0.016 inch light wire.

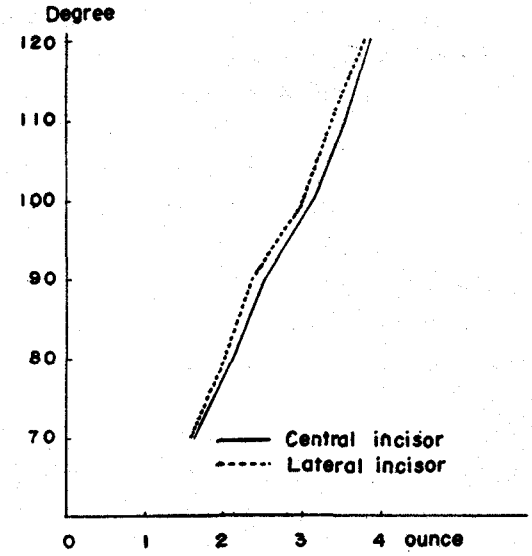

Fig. 4 Force increments of measurements for 20 mm. auxiliary circle and 0 degree spurs of 0.016 inch light wire.

The greatest moments produced at each increment of tooth inclination were associated with those auxiliaries that had spurs which lay in the same plane as the circle. The auxiliaries with spurs at a 45 degree angle than at a 0 degree angle to the circle produced less force. This seemed to indicate that the maximum force occurs when the spurs are in the same plane as the circle.

Changing the angle of the spurs to the plane of the auxiliary affects two different characteristics:

1) the amount of force produced at each tooth inclination,

2) the constancy of force variation through the range of activation.

But the smaller the circle diameter is, the more difficult to engage in the brackets. It is difficult to bend the torquing auxiliary so that each spur is at the exact required

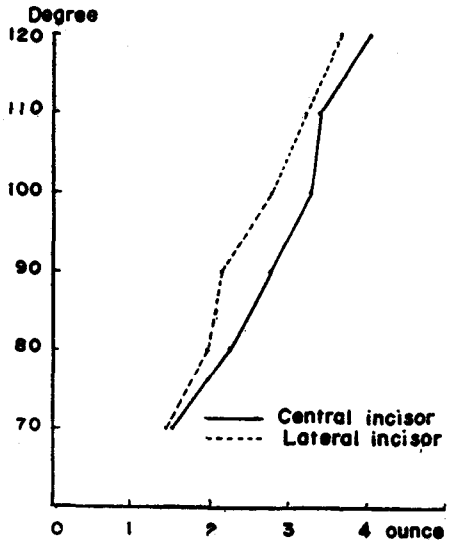

Fig. 5 Force increments of measurements for 15 mm. auxiliary circle and 45 degree spurs of 0.016 inch light wire.

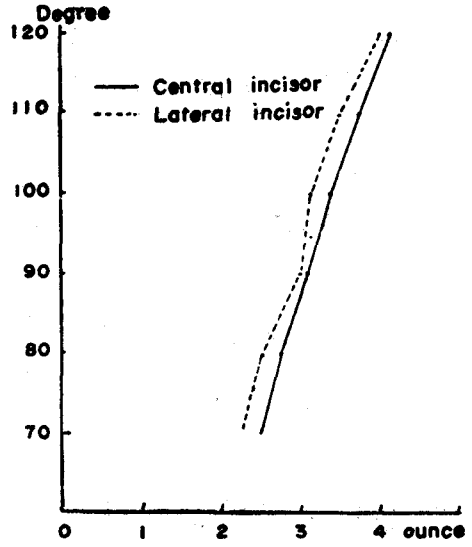

Fig. 6 Force increments of measurements for 15 mm. auxiliary circle and 0 degree spurs of 0.016 inch light wire

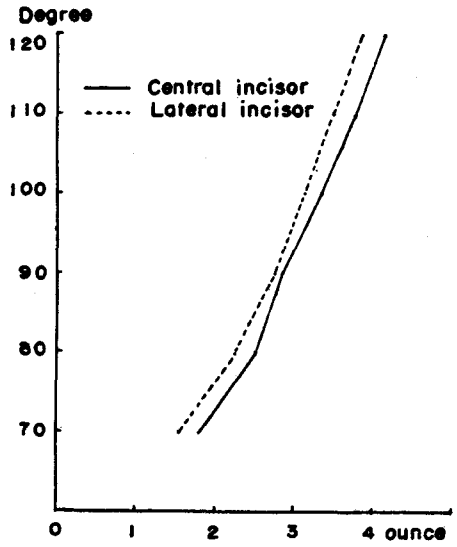

Fig. 7 Force increments of measurements for 10 mm. auxiliary circle and 45 degree spurs of 0.016 inch light wire.

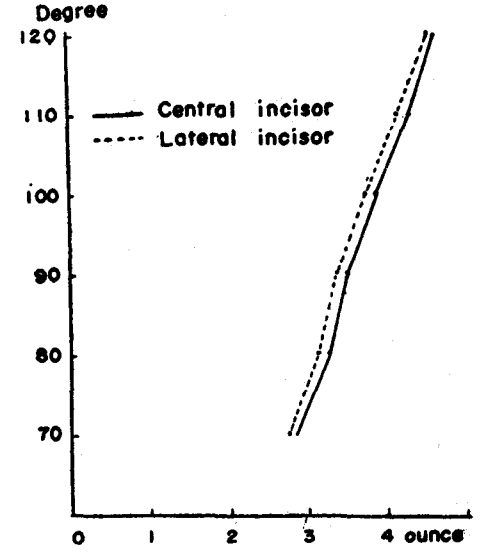

Fig. 8 Force increments of measurements for 20 mm. auxiliary circle and 45 degree spurs of 0.016 inch light wire.

inclination. The auxiliaries with spurs in the same plane as the circle provide both the highest moment values and the most constant forces throughout the range of the tooth movement.

CONCLUSIONS

The size of the circle of the torquing auxiliary showed an inverse relationship to the forces. Torquing auxiliaries with spurs oriented in the same plane produced the highest

forces at each tooth inclination and the most constant forces throughout the test range. These auxiliaries with spurs at 45 degree angle produced less force and a less constant force throughout the test range. The forces produced by an auxiliary became progressively less as the root of the anterior teeth moved lingually. It is believed that the Begg torquing auxiliary is basically well suited for the lingual root movement.

=ACKNOWLEDGEMENTS=

The author wishes to express his sincere gratitude to Prof. Chong Duck Yoo, Dept. of Oral Anatomy and Assist. Prof. Hi Won Cho, Chairman of Dept. of Orthodontics, College of Dentistry, Seoul National University, for their helpful supervisions during this study.

The author is also appreciated to Assist. Prof. Cheong Hoon Suh, Lecturer Won Sik Yang, Dept. of Orthodontics, College of Dentistry, Seoul National University, Assist. Prof. Il Bong Kim, Chairman of Dept. of Orthodontics, Kyung Hee Medical Center, Assit. Instructor Dong Suk Nahm and the members of Dept. of Orthodontics, College of Dentistry, Seoul Natonal University, for their cooperations in this work.

REFERENCES

1) Barrer, Harry G.: A Survey of Begg Treatment, Am. J. Orthodont. 49:494-506, 1963.
2) Begg, P.R.: Begg Orthodontic Theory and Technique, Philadelphiia, 1965, W.B. Saunders Company.
3) Cha, H.Y.: A study on the relationship between tooth size and dental arch size, J.K.D.M. 4: 33-42, 1969.
4) Lee, S.B.: An experimental study of the stress relief of orthodontic wire, J.K.A.O. 1: 9-14, 1970.
5) Neuger, Ronald L. : The measurement and analysis of moments applied by a light-wire torquing auxiliary and how these moments change magnitude with respect to various changes in configuration and application, Am.J. Orthodont. 53: 492-513, 1967.
6) Newman, George V.: A Biomechanical Analysis of the Begg Light Arch wire Technique, Am. J. Orthodont. 49: 721-740, 1963.