JCO-Online Copyright 2003 - VOLUME 33 : NUMBER 2 : PAGES (94-97) 1999

Effects of Head Posture on Headgear Force Application

PAUL DAVID JOHNSON, MA, DMD
YOSSI BAR-ZION, DDS
MARIE TAYLOR, RDH
TIMOTHY T. WHEELER, DMD, PHD

The type of headgear selected for a particular case depends on both the clinician's preference and the diagnosis, with major considerations including vertical face height, overbite, mandibular plane angle, growth pattern, and gingival display. Although the literature abounds with information on the biomechanical differences between headgear types, little has been reported on the actual force levels generated in vivo.1,2

Conventional wisdom and clinical observation suggest that the forces generated by different types of headgear depend on factors such as facebow design, vector of force application, and postural changes. However, no study has compared the change in force application of cervical and high-pull headgear as head and body posture is altered.

The present study was therefore conducted to address the following questions:

1. Is there a difference in the variability of force application between cervical and high-pull headgear?

2. Are the forces generated close to the forces anticipated by the clinician?

3. Does head and body posture appreciably affect force delivery?

Materials and Methods

We have developed a computerized timing headgear that is capable of making real-time force measurements while the patient is wearing it (Fig. 1). Both cervical and high-pull headgear have been equipped with force encoder probes on their right tension springs (Fig. 2). A data-capturing reduced instruction set computer (RISC) attached to the headgear strap samples the displacement of the tension spring at preset frequencies ranging from one-half second to several minutes, then stores each resistance value (as many as 32,000 measurements) in random access memory. Since the force generated by the tension spring and the resistance value recorded by the encoder probe are linear, the force application can be calculated from resistance using linear regression.

Other timing headgear designs have been used to monitor patient compliance,3-5 but because of their inability to record force application in real time, they are unable to monitor force applications, wear frequencies, or wear patterns. Extensive testing of our headgear design has confirmed the validity and reliability of this computerized measurement system for assessing force duration and amplitude in real time.

A patient was outfitted with the cervical timing headgear (Fig. 3), and the force was clinically set to 16oz per side, using a tension gauge, with the patient in natural head position (Frankfort horizontal parallel to the floor). The patient was then asked to orient the head in various other positions while standing–head up, down, left, and right–as well as in various head positions while lying on a hospital gurney–head flat (facing up), on a pillow, turned left, and turned right.

The data-capturing computer was set to sample at half-second intervals, which allowed about 100 readings per head position. The entire experiment was then repeated using a high-pull headgear (Fig. 4).

Results

The data from the headgears were uploaded for analysis by a personal computer. Linear regression was used for conversion of the voltage readings into ounces of force. The results from both types of headgear are illustrated according to body posture (Figs. 5 and 6.)

The data suggest that the forces generated by both types of headgear are affected by changes in head posture, but that high-pull headgear is much more consistent in its force delivery. The high-pull headgear demonstrated a force range of about 3oz for the various head positions, while the cervical headgear had a much wider range, exceeding 20oz.

During the experiment, we were able to see the force modules load and unload as head position changed. We observed more travel with the cervical headgear than with the high-pull. Additionally, it is interesting to note that although both headgears were calibrated immediately before the experiment at 16oz of force, the actual force delivery was slightly less than anticipated.

Discussion

A clinician's choice of headgear has been influenced by radiographic and clinical findings. This study indicates that the consistency of force application may also be a factor.

There is considerable confusion in the literature concerning optimal force levels when utilizing headgear: whether forces should be heavy or light, whether they should be continuous or intermittent, and the timing of their application. In addition, orthopedic and orthodontic effects are attributed to a multitude of different force types and levels. One reason for this inconsistency of recommendations may be that the forces generated by the appliances are variable, leading to inaccurate observations and conclusions.

Future studies may be able to more accurately monitor the outcome of headgear treatment, but our study has shown considerable differences between cervical and high-pull headgear in force variations with postural changes. By selecting an appliance that produces a more consistent force, the orthodontist may be able to accomplish more predictable results.

ACKNOWLEDGMENTS: The authors wish to acknowledge the AAO Foundation and National Institutes of Health grants DE08751 and DE07283 for support of this project. □

FIGURES

Fig. 1 Cervical timing headgear.

Fig. 2 Force encoder module.

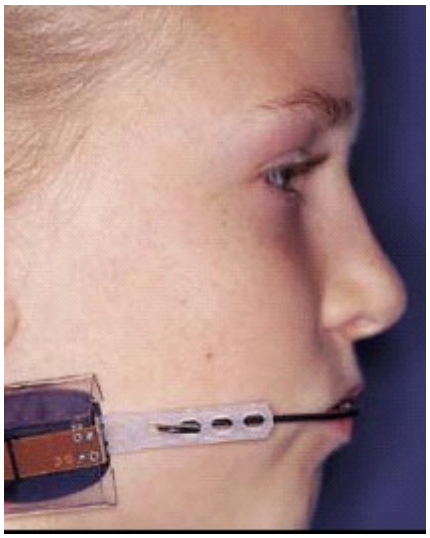

Fig. 3 Patient outfitted with cervical headgear in resting head position.

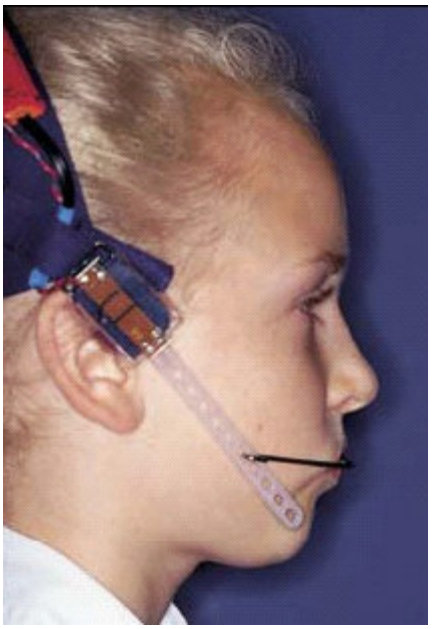

Fig. 4 Patient outfitted with high-pull headgear in resting head position.

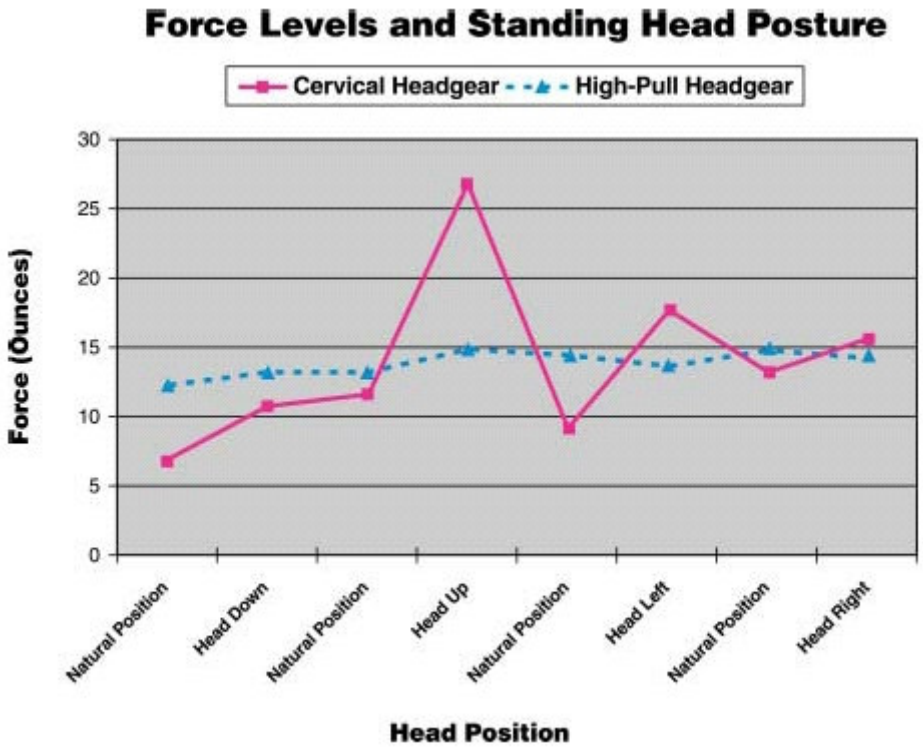

Fig. 5 Force levels of cervical and high-pull headgear with various standing head postures.

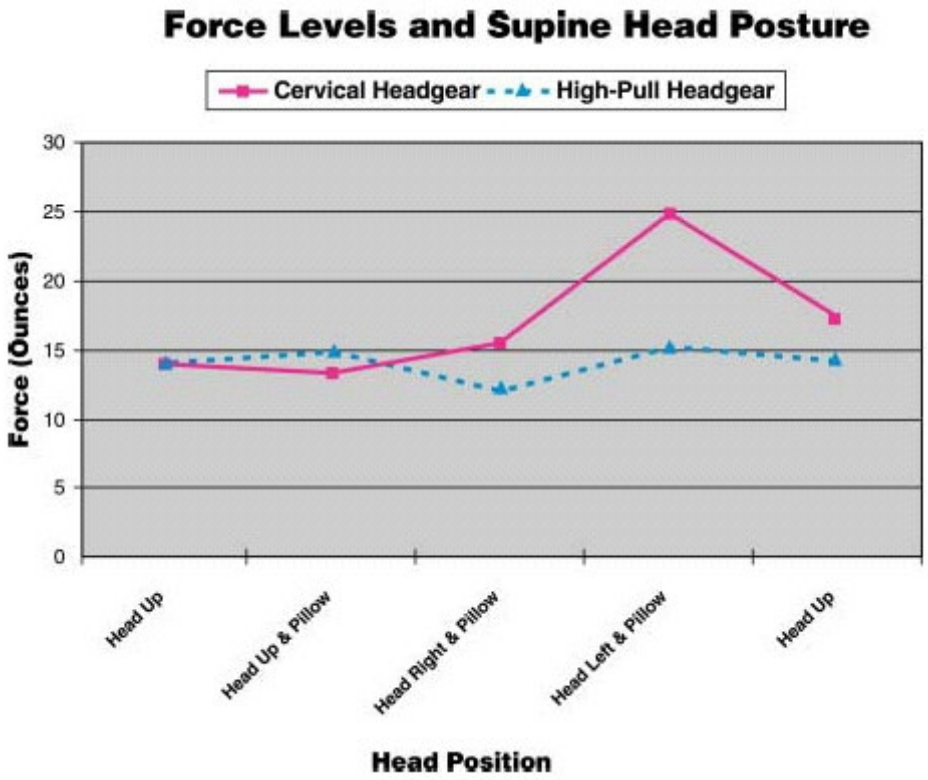

Fig. 6 Force levels of cervical and high-pull headgear with various supine head postures.

REFERENCES

1 Baumrind, S.; Korn, E.L.; Isaacson, R.J.; West, E.E.; and Molthen, R.: Quantitative analysis of the orthodontic and orthopedic effects of maxillary traction, Am. J. Orthod. 84:384-398, 1983.

2 Barton, J.J.: High-pull headgear versus cervical traction: a cephalometric comparison, Am. J. Orthod. 62:517-529, 1972.

3 Güray, E. and Orhan, M.: Selcuk type headgear-timer (STHT), Am. J. Orthod. 111:87-92, 1997.

4 Cureton, S.L.; Regennitter, F.; and Orbell, M.G.: An accurate, inexpensive headgear timer, J. Clin. Orthod. 25:749-754, 1991.

5 Northcutt, M.E.: The timing headgear, J. Clin. Orthod. 8:321-324, 1974.

FOOTNOTES

1 ETM Corp., 1332 S. Lone Hill Ave., Glendora, CA 91740.