LETTERS FROM OUR READERS

To: Editor, *The Angle Orthodontist*

Re: Keles A, et al. Effect of varying the force direction on maxillary orthopedic protraction. *Angle Orthod.* 2002;72:387–396.

This article was of interest to me because it reported biomechanical cause and effect: in this instance orthopedic displacements produced from delivery of force, generated by stretched ''elastics'' anchored to protractive headgear. I write because of the implication in the title of the paper that unlike displacement-outcomes across two groups of patients were associated, solely or at least primarily, with differing directions of force.

An ''elastic'' stretched between just two sites produces a system of collinear, concentrated forces with orientation the same as that of the extended ''elastic.'' A concentrated force has several characteristics that influence the displacement intended or realized: direction (orientation and sense), location (''point'' of application), and magnitude. Together, direction (or orientation) and location define the ''line of action'' of the force, helpful toward predictions or descriptions of whole-body displacements.[1]

In this paper, Figures 2 and 5 partially depict the difference in the characteristics of the (bilateral) forces that are created (by activating the ''elastics'') to produce maxillary protraction. The authors describe the unlike average orthopedic displacements obtained from their two subsamples. As I view the two groups, and as my mind's eye superimposes and ''collapses'' the active forces onto the midsagittal plane in each instance, I ''see'' two results that may be close to parallel. The angulations of the two force-pairs are given in the paper, but individually with respect to different reference planes within the dentofacial complex. Notably, the angle between the occlusal plane and Frankfort horizontal may vary considerably across the population of second-grade boys. On the other hand, immediately in front of the face, the lines of action of the forces that produced the displacements differ in vertical position by—I am estimating—some 20 or so millimeters. Perhaps a key facet here is to understand that the facebow (shown in Figures 4 and 5), characteristic of the second group, is essentially a physical extension of the maxillary complex that, in fact, through the outer-bow ends, serves to provide relatively elevated bilateral contact sites for delivery of the ''elastic'' forces.

The potential for rotation of the maxilla from a sagittal perspective depends upon the proximity to its center of resistance of the line of action of the resultant active force.[1] In this instance, apparently the superoinferior/vertical locations of the points of application of the ''elastic'' forces had at least as important an influence, if not a greater impact, upon the displacement of the maxilla as did the sagittal-view directions of these forces. If this is so, then implying ''force direction'' alone as being responsible for the unlike displacement-formats in the two groups seems to be incomplete and only a partially correct key-phrase in the title of the article.

Robert J. Nikolai, Ph.D.

Professor of Biomechanics in Orthodontics
Center for Advanced Dental Education
Saint Louis University
St. Louis, MO

REFERENCE

1. Smith RJ, Burstone CJ. Mechanics of tooth movement. *Am J Orthod.* 1984;85:294–307.