Commentary: Reduced frictional resistances using Teflon-coated ligatures with various bracket-archwire combinations

George V. Corbitt, DMD

This article is certainly appropriate for *The Angle Orthodontist*. It is clear and thor ough in its purpose, description of methodology, and final conclusions. The subject manner has both scientific and clinical relevance because, as the authors state, the most common technique for moving teeth is sliding them along archwires.

The article explores the effect of ligation and bracket composition on the frictional forces for various bracket/wire configurations. The authors emphasize the use of esthetic brackets and ligation materials–specifically, an esthetic Teflon coating on ligature wires–and further investigate the effect of bracket composition on frictional forces. The researchers also compare ceramic brackets and metal brackets in regard to the frictional forces produced for various bracket/wire configurations. Although ceramic brackets and metal brackets are designed differently, the observed experimental results are probably primarily due to material differences.

One major flaw in the study is the absence of uncoated stainless ligature wire as a control to determine the effect of Teflon coating. Comparing Teflon coated wire and elastomeric rings does not elucidate the effect of Teflon coating; uncoated stainless steel ligature wire may have produced similar, lower frictional forces. The comparison of coated metallic wires and elastomeric material is only justified in that both are used as an esthetic means of tying the archwire into place. Given the esthetic exclusionary criteria, the authors justify the comparison. The clinician who questions which method of esthetic ligation results in lower initial frictional resistance may read the article and feel instructed to ligate brackets with Teflon-coated wires. Nevertheless, the more interesting and scientifically correct comparison is left unaddressed.

The study is, nevertheless, a significant improvement over previous studies in which the terms "friction" and "frictional force" were often used interchangeably. The authors correctly confine the term "friction" to the frictional coefficient between two materials and use "frictional force" to refer to the perceived resistance of movement of the bracket. In addition, the authors correctly indicate that frictional force is related to the frictional coefficient and the normal force between the two surfaces. Much published work on friction in orthodontic appliances incorrectly attempts to relate the frictional force and the surface areas in contact.

As noted in the article, frictional force is the product of the frictional coefficient and the sum of the normal forces in all planes of space. The study attempts to look at the effect of a second order angulation in the bracket and wire and arrives at the intuitive conclusion that angling the bracket increases the frictional resistance by increasing the normal force that the wings of the bracket make with the surface

of the wire. Yet comparing the effect of a metallic ligation material that is twisted to hold the archwire in place and an elastomeric material, which holds the archwire by its elastic material properties, may not be valid. No attempt was made to determine the force with which the ligation material held the archwire in place. An additional experimental control group of no ligature at all would have been helpful. The increased frictional force measured for elastomeric rings as compared with the Teflon-coated wires may have been primarily due to the elastic force the stretched ring places on the archwire. No estimate of the frictional coefficient difference is given. In fact, the study referenced in this article by Frank and Nikolai compared frictional resistances between elastomeric and steel ligation of equal force and found no difference. Although the same operator ligated around the bracket and was fairly consistent, every orthodontist may not tie similarly and could achieve different results. In addition, the elastomeric properties of the elastic rings are not stable, particularly in the aqueous environment of the mouth, and thus may not be clinically relevant.

Given the design constraints of esthetic ligation, immediate results, and other experimental difficulties, the study does make an interesting initial attempt to look at the factors in the important subject of frictional resistance.

G.V. Corbitt was an Assistant Professor of Orthodontics at the Medical College of Georgia, Augusta, and is now in private practice in Cumming, Georgia.