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THE EDITOR'S CORNER

The Question of Friction

Friction in orthodontic biomechanics is a complicated matter. While Webster's Dictionary defines friction simply as "the force that resists relative motion between two bodies in contact", this definition leaves much to be desired in clinical practice. In his excellent Overview on "The Clinical Relevance of In Vitro Steady-State Friction Studies" (JCO, August 2007), Contributing Editor Michael L. Swartz observed, "Orthodontics involves sliding friction—the interaction between the archwire and the bracket or the bracket-archwire retaining mechanism. The archwire and the bracket are in intermittent contact, and the frequency of that contact is unknown and highly variable. Not only is there freedom of movement between the two bodies as a result of the size difference between the archwire and the bracket slot (as well as other bodies such as the ligature wire), but the two bodies themselves can move." Swartz went on to point out that in addition to the archwires sliding along the bracket interface, the teeth themselves move during mastication and parafunctional contacts in response to occlusal forces. To further complicate matters, the archwires flex in response to both chewing and therapeutic forces, resulting not only in intermittent contact between the archwire and the bracket face, but also in direct binding, in which a corner of the bracket slot impinges on the flexed wire.

In short, while friction at the archwire-bracket interface is a measurable force that impedes sliding mechanics, exactly how that force is expressed is almost unknowable because of the confounding variables acting on the force system in question. Swartz took a pragmatic approach, defining "friction" as "resistance to sliding".

This topic has received a great deal of attention in orthodontics over the last few years. Manufacturers presume that reducing friction in an appliance system will result in more rapid tooth movement and, thus, in shorter treatment times. Entire appliance systems, most of them self-ligating, have been designed to reduce orthodontic friction. In fact, the most important difference between the two main categories of self-ligating brackets—active and

passive—is whether the archwire is forced into a bracket slot by the movable gate, thus employing friction when desired (active systems), or is free to slide without being forced into a friction-generating situation (passive systems).

Several attempts have been made to reduce effective friction in conventional brackets. In an August 2005 JCO article, Drs. Arturo Fortini, Massimo Lupoli, and Vittorio Cacciafesta introduced the Slide ligature, with occlusal and gingival ligation loops separated by a flat section of a low-friction polyurethane material that, in effect, forms the fourth wall of the rectangular bracket slot. This design purportedly provides all the friction-reducing benefits of a self-ligating bracket without the disadvantages, such as failure to realize full torque expression, excessive bracket bulk, and frequent breakage of the self-ligating bracket clips.

As with the extraction vs. nonextraction debate, it is doubtful that the question of orthodontic friction will ever be fully resolved in the literature. In this issue of JCO, I have the privilege of interviewing one of my own mentors and role models, a man who may well be the greatest living authority on orthodontic biomechanics, JCO Associate Editor Ravindra Nanda. Dr. Nanda enters the fray with the bold statement that "the concept of a frictionless bracket is a myth. It can only be frictionless if there is no wire in the bracket!" He goes on to point out that "it's mechanically impossible to do a majority of tooth movements without friction. Most of the time friction works in our favor." Although this opinion may be discomfiting to many advocates of "frictionless" orthodontics, it exemplifies the straightforward approach that makes Dr. Nanda's presentations, papers, and books so appealing to the practicing orthodontist.

In our interview, Dr. Nanda also covers such topics as protraction headgear, orthodontic force levels, and rapid maxillary expansion. I am certain that our readers will enjoy and benefit from reading this interview as much as I did from conducting it.

RGK