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THE EDITOR'S CORNER

The Orthodontics of Bobsledding

I have been a devoted fan of the Olympics, both Winter and Summer, for as long as I can remember. One of the highlights of my younger life was trying out for the trap team in hopes of competing in the 1972 Munich Olympics. I didn't make it that far, but the thrill of the effort and even the possibility of participation is a wonderful memory that I will carry to the end of my days.

The modern Olympics have provided an international focus not only for the development of athletic prowess and personal discipline but for technological innovation as well. For example, during the recent competition in Sochi, Russia, one of the announcers pointed out that the bobsledders were working closely with metallurgists to develop materials that would minimize sliding friction and thus increase the velocity of their sleds—at least in theory. I couldn't help but wonder whether that process might correlate with the efforts of orthodontic inventors and manufacturers to reduce friction in bracket-wire systems. The intent is the same: decrease friction and thereby increase speed. I am willing to bet, however, that as the bobsled researchers progress, they may discover some of the limitations that orthodontic scientists realized not too long ago.

A quick Internet search on the physics of bobsledding reveals that the factors involved in determining sled velocity are similar to the forces involved in orthodontic tooth movement. According to an informative article titled "How Bobsledding Works", the physical properties acting on a bobsled include gravity, drag, wind pressure, and momentum, in addition to friction.[1] Gravity is the force that actually propels the sled down the track after the crew's initial running push. Drag, a result of the air passing over and around the sled, increases with the size of the moving object and also increases with the relative wind speed around the object. It is this force that mandates the aerodynamic morphology of the sled itself and is probably the most influential in determining its terminal velocity. Although teeth travel at a very low rate of speed along an archwire, the "drag" of the roots through the bone could be considered analogous to the drag imposed by the wind on a sled, making it by far the most important factor governing the rate of tooth movement. Momentum is the product of an object's mass and its velocity. The more massive an object, the harder it is to stop, which is why heavier sleds have an advantage over lighter sleds in overcoming the effects of friction and drag. Of course, with teeth traveling so slowly, momentum has no discernible impact on the rate of tooth movement.

Since there is very little friction between ice and smooth metal, friction is much less of a concern to bobsled engineers than either drag or momentum. Still, in Olympic competition—as in the practice of orthodontics—every possible edge counts, and considerable effort and expense have gone into minimizing metal-to-ice friction so as to maximize bobsled velocity. Similarly, much has been made of friction in orthodontics over the past 20 years. In the August 2007 issue of JCO, however, Dr. Mike Swartz pointed out that the steady-state methods used to measure orthodontic friction in vitro have probably resulted in an overestimation of its clinical significance.[2] One of the best overviews I have seen on the subject was written by Dr. Jack Burrow in 2009.[3] In my 2013 JCO interview of Dr. Burrow and his mentor, Dr. Bill Proffit, they noted that the effect of friction on tooth movement may actually be negligible when compared to the impact of bracket binding or archwire notching.[4] Citing the findings of Articolo and Kusy,[5] they concluded that binding influences the rate at which a tooth slides along an archwire so much that the effect of friction "can essentially be disregarded".

In summary, when it comes to determining the overall velocity of a moving object—whether that object is a tooth moving along an archwire or a bobsled plummeting down a track in Sochi—friction is only one factor to be considered. The reality is that it is probably much less important a factor than is presumed in either case. RGK

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