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THE EDITOR'S CORNER

The Biomechanics of TADs

Ever since the invention of the first orthodontic appliance, an understanding of the physics of tooth movement has been a prerequisite for the successful practice of orthodontics. The science of biomechanics makes up a considerable portion of the curriculum in any orthodontic graduate program, and rightly so. It is the understanding of how the fundamental principles of biomechanics are applied that truly defines our specialty. In our graduate training, we learn about the application of appropriate levels of force, centers of rotation, centers of resistance, force couples, moments, moment arms, friction, and other principles that govern how we can achieve our treatment objectives. One of the most difficult concepts for an orthodontic resident to understand, however, is the clinical implication of Newton's Third Law of Motion, which states, "For every action there is an equal and opposite reaction." What this boils down to in practice is that it is extraordinarily difficult to move *only* the tooth or teeth that you want to move without moving the other teeth that you don't want to move. The concepts of "reciprocal anchorage" and "differential anchorage", along with the processes of "anchorage development" and "setting up the anchorage", have always been critical to the practice of orthodontics. Although that is not likely to change any time soon, the application of these principles has been altered dramatically with the development of temporary anchorage devices (TADs).

Complicated movements such as molar intrusion, arch intrusion, and retraction of anterior segments or protraction of posterior segments without reciprocal movement of the anchor segments have previously been managed through various "tricks" of force application, such as the manipulation of moment arms or pitting anchorage units with greater resistance against the tooth or teeth to be moved. Now, the development of TADs, for which we must give special credit to Korean orthodontists, has revolutionized the concept of anchorage. As a result, our understanding of orthodontic biomechanics, by necessity, needs to expand.

The fundamental principles still apply. Application of a force vector that does not pass through the center of resistance still results in a rotational movement. Centers of rotation are still defined by the moments about them and their investing resistance. For every action there is still an equal and opposite reaction. What has changed is where the equal and opposite reaction occurs. With TADs, the reaction forces are applied to the cortical skeleton and are distributed and dissipated there. This has resulted in new treatment possibilities: see, for example, recent articles on skeletal anchorage for molar intrusion (Bonetti and colleagues, JCO, April 2008; Lin and colleagues in this issue) and arch intrusion (DeVincenzo, JCO, March-April 2006). De Clerck and colleagues first described the biomechanical principles involved with extraction and nonextraction Class II treatment using skeletal anchorage in this journal two years ago (JCO, April-May 2006). Modified miniplates were used for anchorage in 137 extraction cases and 153 nonextraction cases to demonstrate the differences between conventional anchorage techniques and the application of temporary skeletal anchorage. The conclusion was that "in Class II cases treated with premolar extractions, skeletal anchorage reduces the need for extraoral devices and other auxiliaries such as Nance appliances and Class II elastics . . . . In addition, this approach will further reduce the need for premolar extractions to correct Class II malocclusions or to eliminate severe anterior crowding."

Based on Dr. De Clerck's findings, and those of numerous other authors, the field of Class II and high-angle orthodontic biomechanics has been revitalized. In this issue of JCO, Dr. De Clerck and his co-authors take us another step forward with an exploration of the biomechanics of orthodontic intrusion of either single teeth or dental segments.

The science of biomechanics remains a mainstay of clinical orthodontics. That field has been revolutionized with the advent of TADs. It is every orthodontist's responsibility to stay abreast of such developments. Dr. De Clerck and clinicians like him all over the world are providing us with the opportunity to do just that. RGK