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THE EDITOR'S CORNER

The Intelligence of Archwires

The ultimate goal in treating any orthodontic case is to provide the patient with optimal occlusion, function, and esthetics in a reasonable amount of time. Historically, the average orthodontic case has taken about two years, plus or minus a few months. Extraction cases seem to take a little longer; Class I nonextraction cases generally require the least amount of time, roughly 18 months in my practice. While maintaining or even improving the quality of treatment outcomes is always a goal for any clinician, reducing treatment time has for decades been a prime concern of orthodontists. First and foremost, shortening treatment is unquestionably in the patient's best interest. A number of studies have shown that longer treatment correlates with increased root resorption. In addition, as treatment extends beyond the expected time, the patient's compliance with dietary, hygiene, and other instructions tends to decline. The frequency of missed appointments also seems to increase the longer treatment drags on.

Prior to the advent of pre-programmed brackets, essentially all the "information" on 2nd- and 3rd-order movements had to be contained within the archwire. Learning to be an orthodontist involved extensive practice in bending wires to produce tipbacks, beauty bends, and customized torques. But since our best means of viewing the dentition in all three dimensions involved the tedious process of taking impressions and pouring models—no small feat when the appliance was already in place—the orthodontist generally had to rely on clinical judgment to make the required bends during treatment. Unless new plaster models were produced, it was impossible to see the full occlusion and proximal contacts of each tooth; lingual or cross-sectional views were out of the question. Based on what limited visual information was available, the doctor had to make decisions about how to bend the wire to produce the desired tooth movements. Excellent treatment results were certainly obtained, but the learning curve was steep.

Straight-Wire Orthodontics was an attempt to address the shortcomings of traditional edgewise mechanics by

pre-programming the information on 1st-, 2nd-, and 3rd-order tooth movements into the brackets themselves. The "prescription" of each preadjusted appliance—essentially a standardized sequence of in-outs, tips, and torques—was based on the developer's notion of what would be ideal for all patients. Customization was limited to slight variances in the prescription to accommodate extraction vs. nonextraction treatment plans or similar diagnostic parameters. In the end, however, to achieve optimal results, it was almost always necessary to bend the finishing wires, based on the same limited visual information as before. Preadjusted brackets undoubtedly represented a tremendous advance in clinical science, providing outstanding treatment results while achieving some reduction in treatment time, but there was still room for improvement.

Computer-generated, three-dimensional imaging of the dentition, both in and out of occlusion—the technology behind the Invisalign system—may have been the biggest leap forward in orthodontic diagnostic science during the 20th century. Utilizing a "destructive scan" of plaster models, this technology allowed the clinician to view the dentition from all aspects and to manipulate the images as needed to get a comprehensive view of the occlusion and to project treatment outcomes. Today, 3D imaging of live patients using cone-beam radiography has eliminated the need for intermediary plaster models entirely. The images are becoming more and more precise, and the day is fast approaching when we will be able to work up an accurate, detailed diagnosis and treatment plan from the images and information generated by just one cone-beam scanning session. The possibilities are mind-boggling.

In this issue of JCO, Dr. Randy Moles describes an orthodontic technology that combines the advantages of digital imaging with the capabilities of new superelastic alloys. Using robotic devices with extremely precise tolerances, the SureSmile system brings us full circle by placing the information required for individual tooth movements back into the archwires. No specific appliance system is needed; straightwire or conventional brackets work equally well. Furthermore, intraoral scanning is coupled with cone-beam imaging to produce virtual images of the patient that allow complete digital articulation of the dentition, not only from all external aspects, but from micro-sliced cross-sections as well. This provides direct visualization of occlusal interferences that previously were detectable only through the use of articulating wax or paper. Without plaster models, the orthodontist can perform an incredibly exact diagnosis of the case, shifting the emphasis from chairside archwire manipulation to careful advance planning. Because of the three-dimensional visualization allowed by the imaging technology, any required finishing wires can be produced to the same precise standards. The end result, as Dr. Moles demonstrates, is that treatment times are greatly reduced.

To be sure, SureSmile's innovation has involved an amalgamation of currently available orthodontic technologies, but the key step was to turn from the smart bracket to the smart archwire. The elusive goal of reducing treatment time without sacrificing treatment results can now be achieved by any orthodontist, for virtually any patient. I urge you to read Dr. Moles's first-hand account of how the system can be incorporated into an existing practice. RGK