Guest Editorial

From the guillotine to the plastic re-evolution

In the late 1760s, a beautiful preadolescent girl, Maria Antonia Josepha Johanna Von Habsburg-Lothringen, happily passed her afternoons playing in the gardens of the Schönbrunn Palace in Vienna, with her friend and music instructor, one Wolfgang Amadeus Mozart, only 2 months younger than her, albeit already being a musical phenomenon. One evening, she was summoned by the governess of the imperial children and was informed of an uncanny decision, conceived by loving relatives, obviously without her consent. To her astonishment, due to a political arrangement, she was to be married by proxy to another child, a 15-year-old named Louis Auguste, whom she was to eventually meet a month after the ceremony. However, there was one serious problem to be resolved to materialize the plan; despite her beauty, Marie suffered from severe dental crowding. Under such urgency, the most renowned pundit was brought all the way from France to the palace and consulted for a solution to unexpected esthetic circumstances that threatened the political stability of Europe. The dentist, Pierre Laveran, had developed expertise in the use of Pierre Fauchard's "BANDEAU," published 40 years earlier in the treatise "Le Chirurgien Dentiste," for the alignment of crowded teeth. Thanks to Dr. Laveran and Fauchard's Bandeau, Maria and Louis were married 2 years later, eventually becoming the notorious Louis XVI, King of France and Navarre, and his faithful consort, Marie-Antoinette, whom in unfortunate circumstances would play a calamitous but pivotal role in one of the most critical episodes of modern history, the French Revolution.

Accepting, although somewhat capriciously, for the sake of the present contemplative exercise, that Fauchard's Bandeau is the proud precursor of our cherished companion, the BRACKET, would mean that it took almost three centuries of creative genius to give birth to the versatile instrument around which our orthodontic specialty revolves, permitting us the luxury of alleviating malocclusion and to contribute, through procurement of esthetics and function, to modern individual's well-being. These inquisitive minds of the early enlightenment paved the road for modern orthodontics' most prolific innovator and leader, Dr. Edward Angle, who presented the definitive refinements to the tooth moving system that would embolden our specialty to this day. His work also inspired a new era of innovation during the 20th century, fueled by smart questions, proposed by smart people, concerned with WHY, WHEN, and WHAT to treat (cephalometric and occlusal diagnosis, facial growth, and development) and HOW to treat (orthodontic biomechanics, treatment protocols, and systems based on appliance development and innovation).

Without a doubt, at this very moment, there are innovative bonded orthodontic appliances that patiently wait for a signal from consumer demand to be launched to the market. Surely they will have the capability of registering individual and net force systems exerted on teeth by the archwire, as well as being programmable to modify these force systems, on demand. The microtechnological and computer applications and the alloys required to produce this orthodontist's dream of an "intelligent" system capable of executing a predetermined sequence of orthodontic actions have been available for years and have surely converged in some secretive laboratory, into a functional solution.

In the late 1990s, an intriguing newcomer interrupted the world orthodontic scene. As is usually the case with these occurrences in technological innovation, elaborating upon a simple observation, along with privileged curiosity and the capability of putting together the precise team of experts, two Stanford University MBA students achieved the technological convergence required to successfully resuscitate an old idea, proposed prematurely by Harold Kesling in June 1945 issue of the American Journal of Orthodontics and Oral Surgery. When they connected emerging three-dimensional (3D) printing technology with digital imaging software and thermoformed plastics, these two young innovators achieved Kesling's frustrated dream of modifying tooth position in a predictable and safe manner, using sequential, removable, plastic aligners. Under these almost "*serendipitous*" circumstances, Zia Chishti and Kelsey Wirth gave birth to Invisalign, the disruptive world leader in aligner orthodontics research and development, and with it, a flourishing of new companies seeking participation in the competition for a new generation of patients not willing to use traditional fixed appliances. With the massive use of these new appliances, the initial aligner revolution soon revealed the biomechanical deficiencies inherent to the systems, fueling much needed research, mainly driven by Invisalign and university-based orthodontic programs. Thanks in part to its incorporation into academia, during the past few years, a "*RE-evolution*" of aligner-based orthodontic systems has occurred, propelling the concept toward the realm of evidence-based disciplines, improving clinical efficacy, and reducing the biomechanical gap that separates it from bracket-based techniques. Despite brackets' incontrovertible mechanical virtues, based on consumer trends, one could argue that winds of change seem to foresee the demise of the bracket. Is it the day-to-day discomfort associated with the use and maintenance of fixed appliance? Is it the quest for more cost-effective solution of final consumer's (a.k.a. patients) problems? Or is it the pressure exerted by our ever-changing social conventions, increasingly preoccupied by esthetics and physical appearance? It is probably a combination of factors that compose the driving force of innovative improvement of aligner orthodontics, at the cost of bracket use, leading us to suspect that in the triad that integrates the agents of change in orthodontics (orthodontist-patient-industry), the orthodontist may well be the least influential. Could the orthodontic community's hesitance to adopt new technologies, including plastic aligner-based systems, be interpreted as renunciation to participate, in favor of opportunist without the adequate academic formation? Is it not at least *questionable* that most of aligner orthodontics performed worldwide is carried out by general practitioners? Attention must be drawn to viral stories as similar to that of Amos Dudley (orthodonticshttp://amosdudley.com/weblog/Ortho), a 23-year-old digital design student at NJIT and "do-it-yourself" enthusiast who decided to fabricate his own $60 dollar set of aligners to self-correct his minor malocclusion.

If the orthodontic community does not appropriate computer-aided design-computer-aided manufacturing-based aligner mechanotherapy, which includes improving through research in mechanics and biology of plastic aligner tooth movement as well as plastic science, we risk surrendering these promising therapeutic alternatives to irresponsible over-simplification and the commoditization of our profession. If orthodontists fail to grasp the opportunity to adopt new therapeutic possibilities delivered by innovation, others will readily occupy their place, leading the progress of our specialty. We can be active agents of change, adopting new treatment modalities, and offering our experience and expertise, derived from clinical application of new tools, participating in subsequent development. We can participate in the RE-evolutions of our fascinating times (does accelerated tooth movement, stem cell therapy, genetic intervention, 4D PRINTED smart materials ring a tone?), or we can play the *ostrich*, preferring to ignore (derived from "ignorance") our surroundings, bestowing on others the power to determine our future.

If in fact the time has come for aligner-based orthodontics, we must decide the role we wish to play.

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As a member of the INSAO Research group, his initiatives are focused on the use of 3D imaging and finite elements analysis in the study of biomechanic bases of different orthodontic tooth moving systems, with special emphasis on plastic aligners. He currently participates in collaborations with other research groups locally and abroad investigating clinical and biomechanical effects of micro-osteoperforation, accelerated tooth movement and application of piezoelectric effect and electromechanical impedance in orthodontics.

He is a reviewer for The Angle Orthodontist, Journal of the World Federation of Orthodontists and member of the editorial board of the International Journal of Orthodontic Rehabilitation.

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