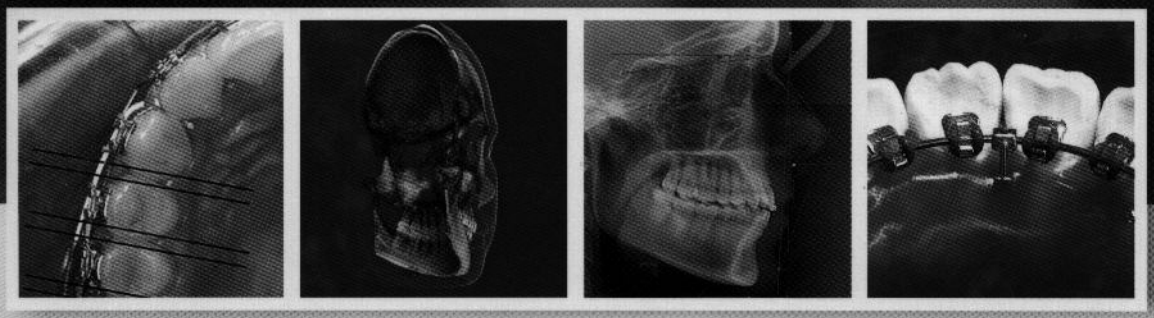
Clinical Orthodontics

Current Concepts, Goals and Mechanics



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Epilogue

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Back to the future

CHAPTER CONTENTS

Since ancient times, predicting the future has held enormous fascination for human beings, often at the expense of the present moment and regrettably to the ignorance of the valuable past. Even though prognosticators of professional progress typically have had no more accuracy than ordinary astrological horoscopes, they sometimes offer tantalizing mind games that excite orthodontists about the near and far future. However, any forecast should keep in mind that life is too complex and baffling for most people to understand even as it happens, much less to predict accurately. With this caveat, I humbly and cautiously address some issues that I see in the future of orthodontics.

THE UNCHANGEABLE

However, before we consider the benefits that are likely to accrue from changes in the future, it might temper our expectations to consider some of the features of our profession that probably will not change. For example, the genetic gift of sensitivity to stimuli, which has helped humans evolve, survive and prosper, will probably not change without some serious, sophisticated and yet unforeseen tinkering with the human genome. This stimuli sensitivity determines how much compliance patients will apply to their therapies.[1–3] For all of the improvements seen in orthodontics over the past 50 years, e.g. bonded appliances, titanium wires, preadjusted appliances, noncompliant therapies, temporary anchorage devices (TADs) etc. orthodontists have not experienced concomitant improvements in modifying patients' behaviours, nor should they expect to experience much relief from this burdensome task in the future.[4]

The inability to obtain reasonable patient compliance will remain the principal deterrent to predictable and successful orthodontic therapy that doctors and patients have with removable invisible appliances, e.g. Invisalign,[5] Essix,[6] Simpli5[7,8] etc. For this reason, I think effective future management of orthodontic patients will reside with some type of fixed appliance. Nevertheless, rather than despairing about this unchangeable feature of human nature, future mechanotherapies and treatment planning strategies may well develop the capacity to mitigate orthodontic forces to the point that they no longer annoy patients and subsequently encourage greater compliance and consistently improved orthodontic treatments, regardless of the appliance that doctors and patients choose.

SUSTAINING AND DISRUPTIVE TECHNOLOGIES

Clayton Christensen[9] has differentiated technological changes as those that sustain existing products or procedures and those that have a disruptive effect. Sustaining technologies foster improvements and have the purpose of achieving better performance of established articles and methods. Consequently, most advances and improvements have a sustaining character about them and deal with quantitative features.

Disruptive technologies, on the other hand, have qualitative attributes that distinguish them and offer entirely new approaches that soon overpower and displace established products and processes. Radio technology provides a good

example of these phenomena. Sustaining technologies concentrated on developing better vacuum tubes, more efficiently and for less cost. Whereas the transistor obsoleted the most sophisticated vacuum tube technology and totally changed the entire radio industry.

Over the past 100 years orthodontists have seen only a few truly disruptive innovations. The first, of course, was the edgewise bracket introduced by Angle.[10] This bracket gave clinicians the first instrument for controlling teeth in three-dimensions, and nothing has yet superseded it. All of the other innovations in edgewise bracket development such as the twin bracket design, wing additions, self-ligation types, preadjusted systems, lingual brackets etc. have merely provided sustaining technologies that, while adding sophistication, have not fundamentally changed the way orthodontists deliver therapy. Neither has the transition from gold wires to stainless steel to nitinol or even plastic filaments offered anything but sustaining procedures.

More recently, Invislign[5] introduced a disruptive technology that eliminates the use of brackets altogether. Although it fails to have the principal disruptive characteristic of providing a cheaper product, it has other features common to disruptive products, i.e. simpler, smaller and more convenient. Whether mainstream therapists can tweak this technology enough to produce consistently good results that are acceptable to doctors and patients remains to be seen. Nevertheless, without any doubt, this poses a disruptive technology that patients want and for which they will spend more,[11] and orthodontics will have to accommodate to it one way or another.

Orthodontic bonding provides another example of disruptive orthodontic technology that displayed all of the characteristics of disruptive products. First, bonding offered a simple and cheaper product that promised lower margins, not greater profits for manufacturers. Second, bonding in the beginning gave worse product performance than brackets welded to bands. Third, bonding created features that orthodontists valued, i.e. cheaper, simpler, smaller and more convenient ways of attaching brackets to teeth. Within a few years of bonding's introduction, hardly anyone used bands on anterior teeth, and the most profitable product of orthodontic manufacturers went away. Sustaining technologies have improved the delivery of bonding with the implementation of indirect bonding, which after three decades shows much greater growth and acceptance.[11]

THREE-DIMENSIONAL IMAGING

But what can orthodontists expect in the future? Three-dimensional (3D) imaging will continue to have a larger place in the armamentarium of orthodontists. With one image, clinicians will have access to information they could only obtain in the past with multiple imaging procedures, e.g. periapicals, bitewings, occlusal, panoramic, cephalometric, tomograms, CAT scans etc. While such imaging has obvious clinical advantages, it will result in a never-before-seen consumer sovereignty. The patients will own their records, which will have a universality that will allow them to transfer easily anywhere they wish – electronically. More than ever, patients will drive the outcomes of dental care because of the transparency of the procedures. This will obviously make the delivery of orthodontic therapy more exacting, precise and difficult. Welden Bell,[12] my mentor in orofacial pain management, remarked that unless doctors satisfy the patient's chief complaint, they should consider the therapy a failure. With more patient input and authority, that decades-old admonition will gain new importance.

Up till now, computers have performed primarily clerical tasks in orthodontic offices, and only recently have they assumed tasks of clinical importance, e.g. diagnosis, treatment planning, visualized treatment objectives, indirect bonding, model formation, occlusograms, computer aided design and manufacturing (CAD CAM) bracket design, robot-manufactured wire forms etc. At the moment, these tasks remain too costly for most clinicians, but as new sustaining technologies emerge, the cost of these valuable adjuncts will surely diminish and come within the reach of all orthodontists.

Sustaining technology has driven the development of dental impressions and model formation, and accuracy, ease of use, cost and flexibility have continued to improve as dentists progressed from dental compound and impression plaster to hydrocolloid, to alginate, then to polyethers and now to vinyl polysiloxane materials. Some companies have already developed 3D virtual modelling that allows the fabrication of ceramic crowns without the benefit of constructing traditional models of stone. Technology now exists for combining 3D scanning and model construction via stereolithography; but in the case of Invisalign, clinicians must still make real-time vinyl polysiloxane impressions, which the company subsequently scans with computerized tomographic radiographs to develop their virtual and stereolithic models.

A truly disruptive technology and departure from impressions and model formation will occur when information gathered from the patient's 3D cranial image combines with computer technology to produce stereolithic models sans impressions. That technology now exists through SureSmile,[13] but the scarcity of 3D imaging in orthodontic offices makes it impractical to apply. However, I have little doubt that this technology will find extensive use in the near future.

By training and patient expectation, dentists are therapists, not diagnosticians; and that is why mechanotherapies hold so much interest for them. But that will change dramatically in the future because of the disruptive diagnostic and treatment planning technology that will develop. Right now, dentists generally and orthodontists specifically use an iterative model based on personal experiences and their memories of those experiences to help them plan treatment. I continue to doubt that computers will develop human-like artificial intelligence with creative skills, but they do have infinite storage capacity and unrivalled recall capacities that will make them ideal for storing and retrieving collective experiences and weighing treatment options before starting orthodontic therapy.

MASS-PRODUCED CUSTOMIZED ORTHODONTIC APPLIANCES

One development that seems inevitable because it is just now gaining traction is the use of mass-produced, customized orthodontic appliances. Innovations such as SureSmile,[13,14] Insignia,[15,16] iBraces and Invisalign[5] have made such a concept possible as they customize treatment on an individual basis, which, incidentally, the original straight-wire appliance[17] intended to do but couldn't. Nano particle technology will probably enhance this trend by enabling CAD CAM use within the clinical setting. Heretofore, orthodontists have presided over cottage industries that modelled themselves using a guild mentality. Even as aggressive clinicians discovered ways of effectively and efficiently treating more patients, they began to use an industrial model akin to the manufacturing assembly line. Being therapists first and diagnosticians secondly has driven the profession by therapeutic features, e.g. myriad edgewise brackets, bonding, nitinol wires, preadjusted appliances etc. This has changed the packaging of orthodontics and caused several clinical adjustments, but has not substantially changed the functionality of our therapeutic delivery model.

TECHNOLOGY, PROCESSES AND BEHAVIOUR

Effective orthodontic management systems require the coalescence of three elements: technology, work processes and behavioural changes. The dismissal of any one or two of these features leaves a fragmented and essentially inefficient model for patient care. Orthodontists have ignored this management principle and achieved success in the past by working with what Chris Anderson, Editor of Wired Magazine, calls a *short-tail model,*[18] which restricted care to a small population that valued their services and could afford a high fee from a limited number of people trained to deliver orthodontic care. Recent evidence indicates that a long-tail model will serve the profession and the public better by providing a larger population with a low-cost, high-quality product.

Technology-driven industries without a labour cartel have a history of lowering costs for customers; e.g. computers, cameras, television, telephones etc. Orthodontics achieved this price depreciation while practically unconscious of it. For example, in 1952, the average wage earner had to work 432 hours to pay for orthodontic care. In 1997, the number of hours worked to pay for orthodontic care that had considerably more comfort and certainty had dropped to 297 hours. In 2009, the number of hours has dropped to 250. One can only imagine what a coherent orthodontic management system combined with technology could do to lower patient orthodontic investments dramatically and thereby greatly increase the number of people willing to use our services.

For orthodontists to grow and prosper, they must plan on treating more patients, but they cannot do it with traditional methods of management. This will present an imperative for orthodontic professionals to adopt a management style that can optimize available technology, newly designed work processes and behavioural changes needed by doctors, staff and patients to offer therapies that minimize the variables that waste time, decrease efficiency and result in poorer treatment outcomes. A recent study[14] displays the ability of 3D computer-aided treatment design to significantly improve orthodontic therapy in less time and fewer appointments.

Current university graduate systems will provide one of the main obstacles to preparing orthodontists for this new urgency because they still have traditional 2–3 year programs that have minimum interface with the commercial companies that have developed these technologies. This will need to change, but whether orthodontists receive their training in an academic environment or pursue it outside of schools, they should expect a rather steep learning curve. Orthodontists should not expect to add these new skills with any less time, discipline or effort than those traditionally taught in graduate school. At any rate, orthodontists will no longer have the luxury of remaining computer illiterate.

For readers who surmise from this brief look into the future of orthodontics that technology and machines will not only dominate but also direct orthodontic therapy and thereby make orthodontists unnecessary, I offer this rejoinder. Eric Hoffer[19] once said, 'Machines may make people superfluous, but they cannot make them harmless. No matter how many and how ingenious the machines, there will always be people around to mess things up'. He further admonishes us in this same publication, 'For the creative individual, no matter how richly endowed, cannot achieve much without hard work. A learning, creative society is automatically a disciplined society'.

I doubt that technology will obsolete orthodontists for the simple reasons that accurate diagnosis and reasonable treatment planning along with successful patient management will remain the cornerstones of orthodontics, and knowledgeable professionals will need to extend their considerable skill and expertise into the therapeutic equation. The new technologies will augment that need, not diminish it, and orthodontists need to prepare for some intensive and extensive training. In the future, more than ever, orthodontics will require a full-time commitment.

REFERENCES

1. McNamara JA Jr, Trotman CA. Creating the compliant patient. Ann Arbor: Center for Human Growth and Development. University of Michigan; 1997; 33:198.
2. White LW. Behavior modification of orthodontic patients. J Clin Orthod 1974; 9:501–505.
3. White LW. A new paradigm of motivation. PCSO Bulletin 1988:44–45.
4. Chess S, Thomas A. Know your child. New York: Basis Books; 1987.
5. Tuncay OC. The Invisalign system. New Malden: Quintessence; 2006.

6. Sheridan JJ, Ledoux W, McMinn R. Essix appliances: minor tooth movement with divots and windows. J Clin Orthod 1994; 28:659–664.
7. Dischinger W. Red, white and blue aligners. Clin Impressions 2008; 15:36–38.
8. Fuller J. A simple aligner system for minor anterior correction. Clin Impressions 2008; 16:21–22.
9. Christensen CM. The innovator's dilemma. Boston: Harvard Business School Press; 1997.
10. Angle EH. The latest and best in orthodontic mechanism. Dental Cosmos 1929; 71:164–174, 260–270, 409–421.
11. Noble J, Hechter FJ, Karaiskos NE, et al. Future practice plans of orthodotic residents in the United States. Am J Orthod Dentofacial Orthodped 2009; 135:357–360.
12. Bell WE. Orofacial pains. Chicago: Year Book; 1989.
13. Sachdeva R. SureSmile technology in a patient-centered orthodontic practice. J Clin Orthod 2001; 35:245–253.
14. Mah J. Efficacy of the SureSmile Process. W.J. Orthod 2009 [submitted for publication].
15. Andreiko C. JCO interviews Craig Andreiko, DDS, MS, on the Elan and Orthos Systems. J Clin Orthod 1994; 28:459–472.
16. Andreiko C, Smith R. Increasing clinical performance and 3D interactive treatment planning and patient-specific appliances. In: Corp O, ed. Ormco web page. Orange: Ormco Corp; 2008.
17. Andrews LF. Straight wire, the concept and appliance. San Diego: L.A. Wells Company; 1989.
18. Anderson C. The Long Tail. New York: Hyperion Publishers; 2006:168.
19. Hoffer E. Before the Sabbath. New York: Harper and Collins Publisher; 1979.