

Australian Society
of Orthodontists



University of Sydney



New approaches, new technology in modern Orthodontics

PART 2

*Creating **Brighter** Futures*

New approaches, new technology in modern Orthodontics

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This newsletter continues the summary of Professor William Proffit's keynote address at the World Federation of Orthodontists' Congress held in Sydney in February 2010.

This second part looks at the recent and emerging technologies which will shape the way orthodontics is practised in the future.

3D technology

3D imaging is currently attracting vast interest in orthodontics, particularly **3D radiographs** and photographs. 3D photographs can be used to make very detailed and accurate soft tissue measurements of the face, probably more useful in a research environment than in routine clinical practice.

Digital video clips can be attached to a patient's electronic file along with still photographs. Video clips could be an important and clinically useful diagnostic tool, demonstrating speech and smile dynamics from repose to full smile and back to the rest position. Esthetics associated with speech and smiling are more readily reviewed from video clips than still photographs and should be taken from frontal, three quarter and profile views.

MRI (magnetic resonance imaging) technology is a valuable research tool for growth and treatment response studies as there is no radiation to the patient and it is minimally invasive. MRI also has limited application in clinical orthodontics for diagnosis of patients who have temporomandibular dysfunction. Some authors contend that articular disc displacement at an early age is a factor in the development of a skeletal Class II malocclusion (Flores – Mir 2006) and although it may contribute to mandibular deficiency, Prof Proffit does not believe that it

is a primary etiological factor. It is therefore unnecessary to take an MRI in routine clinical practice, but could be considered in children who have an internal joint derangement.

Currently **Cone Beam CT** (CBCT) is the 3D technology that is attracting the greatest interest in orthodontics as it provides a three dimensional visualisation of the jaws and teeth. It is a useful tool in diagnosis, treatment planning and evaluation of treatment outcomes. Diagnostically, CBCT is now increasingly used to localise impacted canines and evaluate possible damage to the roots of adjacent teeth. CBCT can also provide simultaneous views of teeth, bone and facial soft tissue outline for diagnosis and evaluation of facial asymmetry.

CBCT scans can be used to generate stereo lithographic models (3D-printing) suitable in distraction osteogenesis cases for surgical planning, manufacture of custom distracters and orientation of the distracters. (Fig 1.)



Figure 1

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Professional Education Network

Colgate Professional Oral Care launched The Professional Educator Network in 1996 in response to ongoing requests to carry out educational sessions in Dental Hygiene, Dental Therapy, Oral Health Therapy and Dentistry programmes Australia-wide. A series of modules were developed by experienced Dental Professionals covering key oral health topics – including Toothpastes, Mechanical Plaque Removal, Fluorides, Mouthrinses, Tooth Whitening, Dentine Hypersensitivity, Erosion, the Oral Health/ Systemic Health relationship and 'Bright Smiles Bright Futures'.

The sessions are designed to be very interactive and exploring the latest research and technologies. Practical sessions enable students to become familiar with the usage, taste and feel of products and comfortable in recommending appropriate products to their patients.

These modules conducted by the Colgate Professional Education team are scheduled throughout the courses at appropriate year levels in order to meet the following objectives:

- To support Dental Hygiene, Dental Therapy, Oral Health Therapy and Dentistry programmes by offering quality educational input into their curricula.
- To assist students in learning about oral hygiene product technology and oral health topics allowing them to make appropriate product recommendations and provide good oral health messages at patient and community levels.
- To increase the awareness of good oral hygiene practices and access to appropriate oral health products in the community.

The Colgate Oral Care Professional Educators are: Christina Pedreschi (WA), Jasmine Bell (SA), Cathryn Carboon (VIC), Jenny Morgan (NSW), Felicity Dougherty, Lizzy Hall and Zanna Franks (Qld).

For more information about the Professional Education Network please contact Dr Sarah Raphael.
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CBCT scans are ideal for computer aided surgical planning in complex surgical cases where bone movements are required in all 3 dimensions (Gateno et al).

Different treatment plans and surgical movements can be simulated to determine appropriate movements to achieve the optimum treatment result. CBCT scans can also be used for the planning and manufacture of bone graft templates, custom made bone replacement implants and even CAD-CAM generated surgical splints following re-orientation of the virtual surgical models.

Prof Proffit believes that the most important application for CBCT is in the evaluation of treatment outcomes as it allows researchers to superimpose and evaluate treatment changes in three dimensions.

Rather than conventional two dimensional cephalometric superimposition using traditional landmarks and outlines, images from CBCT scans can be superimposed on three dimensional landmarks and then displayed using either semi-transparent overlay or surface distance changes and colour mapping. (Fig 2)

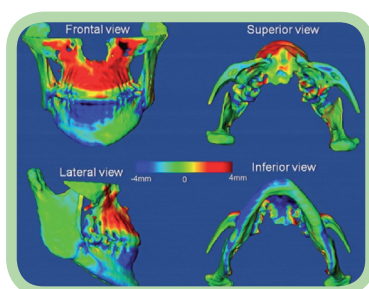


Figure 2

Genetic analysis

Although genetic analysis applied to orthodontic diagnosis and treatment is still in its infancy, researchers have already been able to identify a genetic link to some orthodontic problems. For example primary failure of eruption linked to Parathyroid hormone receptor 1. (Decker E, 2008)

Proffit anticipates that genetic analysis will soon be applied to predict the likely growth pattern of prognathic Class III patients. This research is already in progress at the University of North Carolina with investigation into family ascertainment and phenotype characterization. The next step will be linkage mapping, candidate gene identification and mutational analysis. He also maintains that blood testing will be simplified and replaced by saliva testing as more than 1100 proteins and 3000 species of m-RNA have so far been identified in human saliva.

Temporary anchorage devices

Miniplates attached to the zygomatic buttress have been well received by both patients and orthodontists. Proffit feels that miniscrews are currently receiving more attention than justified in comparison to miniplates. He believes that miniscrew anchorage should only be used when no other anchorage is available, to assist eruption of individual teeth into the arch and to upright molars.

More complex applications such as intrusion of maxillary posterior teeth to close anterior open bites, retraction and/or intrusion of protruding maxillary incisors and distal movement of molars or the entire maxillary arch should be reserved for miniplates.

Miniplates have the advantage of adjusting the point of force application to the desired position simply by extending an arm from the intra-oral tube.

(Fig 3)



Figure 3

Another exciting application is maxillary protraction in skeletal Class III treatment using miniplates to provide anchorage for Class III elastic traction (Heymann G, De Clerck 2010).

Miniplates offer the potential for skeletal maxillary protraction along with posterior condylar and fossa remodelling without the adverse dental compensations of traditional tooth borne Class III treatment. (Fig 4)



Figure 4

Bracket system technology

Modern self-ligating brackets have recently been extensively and aggressively marketed as having a much lower co-efficient of friction than traditional ligated brackets. Proffit considers that friction is only one component of resistance to sliding when a tooth is clinically moved along an orthodontic archwire. Resistance to sliding is defined as the sum of the forces that appose sliding. During clinical orthodontic tooth movement binding occurs as the tooth tips on the archwire, due to the resistance of the tooth root to movement. This elastic binding starts to occur after only 7° of tooth tipping and accounts for 90% of the resistance to sliding.

Another major factor in resistance to sliding is inelastic binding caused by notching of the archwire as the tooth tips (Kusy and Articulo, 1999). (Fig 5)

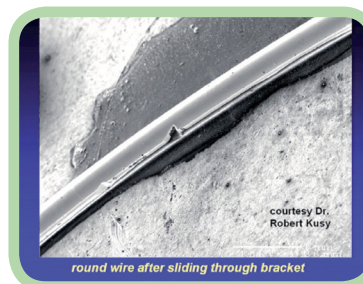


Figure 5

Brighter Futures is published by the Australian Society of Orthodontists (NSW Branch) Inc. in conjunction with the Orthodontic Discipline at the University of Sydney.

The newsletter is intended to help keep the dental profession updated about contemporary orthodontics, and also to help foster co-operation within the dental team.

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Therefore Proffit believes that friction is a minimal component of resistance to tooth movement during orthodontic sliding mechanics, a fact that he considers is conveniently forgotten by the marketers of self ligating brackets who choose to 'cherry pick' information from research articles. It is therefore important to carefully check the facts when assessing the promotion of any product.

Based on some research findings indicating no advantage to self-ligating brackets over conventional ligation when comparing rate of tooth movement, total treatment time, appointment intervals, number of appointments, gingival condition, breakages and number of unscheduled appointments (Fig 6),

Proffit refutes the marketing strategy of self-ligating brackets that reduction of friction will result in faster orthodontic treatment and reduced clinical time.

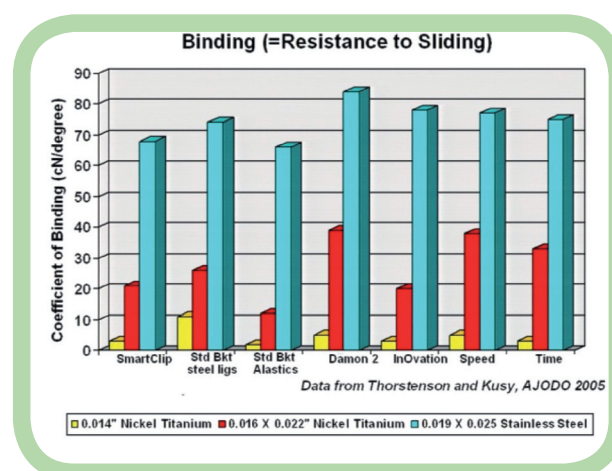


Figure 6

CAD-CAM applications to fixed appliances

CAD-CAM technology has been adapted to manufacture custom prescription brackets with customised bases that simplify archwire selection and adjustment. This technology also allows customisation of archwire design and bracket-archwire combinations. Although considered state of the art in appliance design, these techniques do not at present incorporate a facility to relate the dentition to the facial hard and soft tissues. A software interface does not yet exist to incorporate valuable soft and hard tissue measurements derived from digital diagnostic techniques and from clinical assessment.

Conclusion

Several technologies have emerged that have significant beneficial applications in orthodontic diagnosis and treatment. Further development of these technologies is eagerly anticipated. However for these technologies to advance the art and science of orthodontics they must be comprehensively integrated to provide more successful and consistent treatment results.

References available on request

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