My complete conversion - London lingual orthodontics provider

Dr Asif Chatoo describes his navigation of digital technology

By Dr Asif Chatoo, London

My professional journey has no end or destination. If I ever felt satisfied by one system and I applied it in the same way without acquiring new knowledge or discovering more advanced technologies and materials, I would consider myself ready for retirement, which I am certainly not.

My voyage through digital technology, however, has just reached a natural conclusion. I realised recently that I had progressed through all aspects of digital technology as it relates to orthodontic treatment and I had completed a circle (Fig. 1).

My journey started with photography some years ago, but the process accelerated, and in recent years, everything has gone digital, including radiography, record-taking, treatment planning, and the manufacture of brackets and wires.

Over the course of my digital conversion, I have tried several different systems, all of which have delivered important benefits. The system I have used most as I completed the digital circle over the last two years is suresmile (OraMetrix). It is a treatment management system I have used most as I completed the digital circle over the last two years is suresmile (OraMetrix). It is a treatment management system and among its benefits is that it is immediate. Adult patients are particularly grateful not to have impressions taken, and the orthodontic nurses are delighted to avoid this most trying aspect of record-taking. It was invariably messy. Being impression-free has brought more value to the team than going paperless.

It goes without saying that a key benefit of digital technology is the integration of the orthodontic processes and records. For instance, a scan of the patient’s teeth can be superimposed on to a photograph, which I can in turn integrate with a grid. I can relate the tooth positions to facial planes and check that the dental midline is centrally located. I can show the patient his or her teeth and bite and I can provide him or her with a visual simulation of the difference that treatment will make. The patient can then ask questions. My vision for the finished result may not be the patient’s vision and being able to manipulate the outcome on screen means one can be absolutely sure the patient understands the treatment planning. The patient can influence the treatment if he or she wishes, and if he or she changes his or her mind towards the end, the technology allows for last-minute revision.

In order to convey how this approach differs from other treatments on offer, I compare it to the difference between an off-the-peg suit and going to a tailor in Savile Row. Many of the patients I treat at my practice are referred by leading dentists.

Their expectations are high. Sometimes orthodontic treatment is just one part of an interdisciplinary treatment that in its entirety will cost in excess of £20,000. Patients expect perfection—in so far as it is possible in an ageing dentition—and they expect a high level of service. Suresmile allows me to deliver both. Rightly for a West End practice, many of the benefits of suresmile relate to communication and the care of patients with high expectations, but there are also personal benefits for the clinician.

In my case, there is one that surpasses all others. Bending archwires at the end of treatment is almost always inevitable and it is an aspect I dread. Why am I so hung up on this? The reason is that, if one bends a wire on one tooth, one will affect all the other teeth. This will increase the chairside time. The solution is the robotic wire bending that is central to suresmile.

I aim to deliver several things to my patients: an aesthetic result, a functional occlusion and an occlusion that is comfortable at rest. More than anything, I want them to be wowed by their experience.

I believe suresmile delivers that wow factor. I have gone 360 degrees and am now fully digital, but this is only the first navigation of new and evolving technology. My orthodontic journey continues and I suspect a few more digital revolutions await.
A Practical Treatment Objective: Alveolar Bone Modeling with a Fixed, Continuous-Arch Appliance

By Thomas W. Barron & Frank Bogdan, USA

Bone is a dynamic tissue that is continuously adapting its structure via the processes of remodeling and modeling. Remodeling is the coupled sequence of resorption and formation involved in physiologic turnover. It is necessary to achieve or maintain internal architecture in response to mechanical needs, repair microdamages in the bone matrix, and to maintain plasma calcium homeostasis. Remodeling can only be observed histologically or by chemical assay of biomarkers. Modeling is a change in the size and shape of a bone that can be observed and measured radiographically. It is the net gross anatomic result of bone resorption and formation on a given bone surface in response to growth and development or mechanical load. These processes are well accepted phenomena in the field of physiology.

In the orthodontic literature, it is widely held that the alveolar bones of the maxilla and mandible are immutable—that once formed, their size and shape cannot be changed significantly with tooth-borne, continuous-arch orthodontic appliances. Attempts to do so have been associated with root and cortical plate resorption, loss of periodontal attachment and unstable tipping of teeth. Under this paradigm, orthodontic treatment must maintain the existing size and shape of the alveolar bone. In many cases, this can only be accomplished with surgery, tooth extraction, or separation of the midpalatal suture.

In recent years, there has been a growing body of clinical evidence bolstered by studies that challenge the immutability of the alveolar bone and the mandate to treat to the existing dentofacial arch form. The purpose of this article is to present a review of the literature challenging alveolar bone immutability along with clinical cases treated with passive self-ligating orthodontic brackets and low-force orthodontic appliances to demonstrate alveolar bone remodeling.

Challenging Alveolar Bone Immutability

The alveolar process is defined as that part of the maxilla and mandible that forms and supports the socket of the teeth (Fig. 1). It includes the thin lamella of bone that surrounds the root of the tooth and gives attachment to the principal fibers of the periodontal ligament. It also includes the supporting inner and outer cortical plates of compact bone along with the spongy bone between the cortical plates. Though anatomically, no distinct boundary exists between the body of the maxilla or the mandible and their respective alveolar processes, the bone surrounding the teeth from root apex to the crest of the socket is considered to be the alveolar bone. By means of the teeth, alveolar bone can be loaded with biomechanical force. The cellular response of the PDL to orthodontic force has been well characterized on both the pressure and tension sides of the bone. The alveolar bone is translated through the tongue of bone confined by the buccal and lingual cortical plates. Until recently, remodeling—or changing the size and shape of the developed alveolus by disrupting the equilibrium of forces acting on the pressure of the buccal mucosal surface and allowing the light continuous force of the tongue to dominate—according to Fränkel, when the forces of the cheeks are eliminated, the teeth tip laterally in the direction of least resistance. The alveolar walls in the radicular area are likewise deformed in a buccal direction. Furthermore, the acrylic shields extend into the vestibule exert a constant outward pull on the connective tissue fibers and muscle attachments that are transversed to the alveolar bone by the fibers of the peristeme. Apposition of buccal bone aids in the lateral movement of the dentosurface. The ability of periodontal tension to induce apposition of bone on the lateral alveolus has been demonstrated in the animal studies of Altman and Harvold in addition, a study by Bresden, et al., utilizing metallic implants placed in the maxillae of patients treated with the Fränkel appliance demonstrated that widening of the maxilla was due to deposition of new bone along the lateral border of the alveolus rather than increased growth at the midpalatal suture.

This phenomenon of alveolar modeling, specifically lateral translation of the alveolus, achieved by disrupting the equilibrium of the inner and outer oral mucosal and periodontal tension is consistent with the Functional Matrix Theory of Moss. While granting the innate growth potential of cartilage and bone, his theory holds that growth of the face occurs as a response to functional needs and neuromuscular influences and is mediated by the soft tissue in which the jaws are embedded.

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placement of the cortical bone." This pathologic process is well established and has been extensively documented in case reports and textbooks. The intrasitial pressure of various odontogenic cysts has been measured and found to exert an ultra-low force load on the alveolar bone. This phenomenon clearly demonstrates that the developed alveolus can be modeled via pathologic induction with light, continuous force. Another commonly observed example of bone modeling is the bulge of the cortical plate associated with a patally impacted canine. The impacted tooth is typically associated with an enlarged follicle. When the canine is exposed and brought into the center of the alveolus a normal palatal contour returns.

Kokich and Kokich25 demonstrated localized modeling of the alveolus in response to tooth displacement. Light, continuous orthodontic force was employed to distalize a tooth into the atrophic alveolar ridge associated with a congenitally absent second premolar. The distalized tooth moved with its supporting bone, changing the size and shape of the atrophic alveolus (Fig. 3).

Fontenelle reported alveolar bone modeling with a passive/active dissociation appliance in non-growing patients.26 The appliance (Fig. 4) consisted of a passive, rigid cast lingual arch and active, low modulus wires activated between the cast lingual arches. Dissociation of the passive and active components facilitates the application of low, constant force load with near constant moment-to-force ratios, resulting in bone modeling induced by dental displacement. Clinical cases were shown demonstrating lateral modeling of the alveolus as observed by Frankel and localized alveolar modeling with tooth displacement as observed by Kokich and Kokich.

Williams and Murphy described alveolar bone modeling with evidence of apposition of bone on the maxillary buccal alveolus in permanent dentition patients (Fig. 5a). This was induced by a light, continuous load applied bilaterally to the maxillary alveolus with the Max 2000® alveolar development appliance (Fig. 5a). Their appliance consists of two nickel-titanium springs embedded in and connecting separate acrylic panels in a framework retained by bands on the first bicuspids and first molars. The transpalatal springs delivered 150 grams of force each in a lateral direction. Biopsies were performed on two patients upon completion of lateral alveolar development. The specimens were harvested via full-thickness flaps from the labial alveolar crest between the maxillary right first bicuspids and canines (Fig. 5b). An internal control specimen was taken from interspace between the ipsilateral mandibular first bicuspids and canine (Fig. 5c). Standard hematoxylin and eosin stained sections were examined with and without polarized light and a maxillary specimen was subjected to fractional analysis.

The maxillary treatment sections demonstrated the absence of the lamellar pattern characteristic of mature bone and polarized light demonstrated a woven bone pattern characteristic of immature or new bone (Fig. 6). In addition, fractional analysis of the polarized light specimen demonstrated fractal patterns suggestive of woven bone modeling.

**Alveolar Bone Modeling with a Fixed, Continuous-Arch Appliance**

In recent years, fixed, passive self-ligating (PSL) appliances have been developed along with low-friction/low-force, continuous arch protocols for orthodontic treatment. Dr. Hishi and Radias has reported evidence24 with his OSM apparatus support- ing the ability of passive self-ligating brackets to deliver lower magnitude forces compared with elastomeric ligated appliances applied to the same maxillary incisors in an in vitro model (Fig. 7). Evidence has also been re- ported supporting the ability of passive self-ligating brackets to achieve a reduction in the frictional resistance to sliding at the bracket/wire inter- face.24-26 The resultant load applied to the teeth and transmitted to the alveolar bone necessarily decreases as the frictional resistance to sliding and the force required to overcome it decreases. Clinical evidence has been reported demonstrating significant widening of the dental arches following treatment with the low friction/low-force Damon System.26-28 An increase in the transverse dimension of the alveolar bone has also been reported in response to the low, biomechanical load delivered by this treatment regimen.29-31

The following case reports provide examples of the alveolar bone model- ing the authors have observed over a combined 28 years of experience utilizing the Damon passive self-ligating fixed appliance and treat- ment protocols advocated by Dr. Dwight Damon.

**Discussion**

The case reports presented dem- onstrate examples of the change

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**CASE STUDY 1**

**CHILD ALVEOLAR MODELING: Pre-treatment**

**Diagnosis**

A 9-year-old male patient presented in the mixed dentition with premature loss of his maxillary left primary canine with space loss and a blocked-out and unerupted lateral incisor. He exhibited normal circular muscle tonus and lip competence. The lateral cephal showed upright maxillary and mandibular incisors.

**Treatment Summary**

Phase I of the mixed dentition treatment was initiated with Damon passive self-ligating appliances, including brackets placed on all the non-mobile primary teeth. Copper-Ni-Ti wires (0.014") and light Ni-Ti coil springs were activated one-half of a-bracket length between the mandibular permanent central incisors and primary canines, and between the maxillary left permanent lateral incisor and primary first molar. Low-torque brackets were selected for the upper and lower incisors to help minimize proclination from the force of the spring. Damon wire sequence protocols were observed.

**Result**

Pre- and posttreatment images demonstrated the treatment result after 16 months of treatment. The size-corrected view of the mandibular arch illustrates the significant change in the size and shape of the mandibular alveolar bone induced by this approach. Similar changes were seen in the maxillary as well. The patient’s parents were pleased with the result of Phase I treatment and opted not to pursue Phase II finishing treatment.

**CHILD ALVEOLAR MODELING: After Eruption of Permanent Teeth. Phase II Treatment was Not Pursued in this Case**

**CHILD ALVEOLAR MODELING: Pre-/Posttreatment Comparison Demonstrates Alveolar Bone Modeling**
in the size and shape of the maxil-
larly and mandibular alveolar bone
observed in adolescent, adult and
children treated with a passive self-
ligating, continuous arch appliance
and Damon low friction/low-force
treatment protocols. Specifically,
the increase in the transverse di-
mension of the alveolus appears to
be the result of lateral translation of
the buccal and lingual cortical plates
induced by the biomechanical load
applied to the teeth and transmitted
to the alveolar bone. These cases pro-
vide additional clinical evidence for
the ability of the alveolar bone to un-
dergo biomechanical loadinduced
modeling.

As Frankel had done previously with
his Function Regulator appliance,
Damon has proposed a mechanism of
action for the dentoskeletal re-
sponse to his treatment regimen.
Based on clinical observations and
analysis of photographs, plaster
study model measurements and
medical CT surveys of treated cases,
he suggests that the light, continu-
ous force delivered by his treatment
approach disrupts the equilibrium
of the tooth positions maintained by
the inner and outer oral musculature
acting on the alveolar bone and
attachment. When the anterior component of
the force acting along the continuous
archwire is kept low, it is mitigated
by the resting pressure of the lip in
patients with adequate circumoral
muscle tonus. The posterior compo-
nent of force is likewise resisted by
multi-rooted molars along with the
ascending rami in the mandible and
the tuberosity in the maxilla. A
resultant lateral component of force
is expressed and transmitted from
the teeth to the alveolar bone, induc-
ing bone modeling or posterior arch
adaptation as he describes it.

The OSIM findings of Badawi sup-
port Damon’s proposed mechanism
of action, specifically the assertion
of a lower anterior vector of force
delivered with a passive self-ligating
appliance compared with an intra-
mucosal ligated appliance applied to
the same simulated malocclusion.
In addition, there is a cellular mecha-
nism of action that supports alveolar
bone modeling induced by tooth dis-
placement. Figure 8 from Graber de-
scribes bone modeling occurring in
the periodontal ligament and on the
periosteal surfaces resulting from
net apposition of bone in the direc-
tion of the line of applied force and
net resorption of bone away from
the direction of force. Furthermore,
this ability to move bone with a light,
continuous load applied to the teeth
has been corroborated in the sagittal
dimension by Melvin’s Functional
Motion Theory: is correct and the change in
the alveolar form induced by this low-
friction, low-force treatment ap-
proach provides an opportunity to
recapture the full genetic potential
of the patient’s alveolus.

Furthermore, alveolar bone mode-
ling is a practical treatment objective

CASE STUDY 2
PERIADOLESCENT ALVEOLAR
MODELING:

Pretreatment

Diagnosis
An 11.5-year-old female patient pre-
sented with a Class I jaw relationship and
severe tooth size/arch length discrepancies with 9 mm of crowd-
ing in the maxillary arch and 15 mm
crowding in the mandibular arch.
Her mandibular incisors were up-
right at 89° to the mandibular plane
and the tuberosity in the maxilla. A
resultant lateral component of force
was expressed and transmitted from
the teeth to the alveolar bone, induc-
ing bone modeling or posterior arch
adaptation as he describes it.

Treatment Summary
Damon protocols were employed with
initial .025” Copper Ni-Ti wires and
Ni-Ti open-coil springs activated
one half of a bracket width to begin
to create space for the unbracketed,
blocked-out teeth. Eyelid attach-
ments were placed on the lingually
blocked-out teeth and lightly ligated
to the coil springs with enough force
to minimally deflect the archwire.
Since the alignment at the 10-week
appointment was deemed insuf-
ficient to engage a larger wire and
comfortably close the bracket door,
the initial wires were inspected for
deforation and replaced. The
springs were then reactivated, the
blocked-out teeth ligated and the pa-
tient reappointed for 8 weeks.

Although in significantly crowded
cases the transitional wire is typically
a .012” Copper Ni-Ti wire engaged in
preparation for an .014” x .025” Copper Ni-Ti wire,
at the fifth week bracket alignment
was again deemed insufficient for
rectangular wire engagement so a
.016” Copper Ni-Ti wire was placed,
the springs were reactivated, and
the blocked-out teeth ligated. As
subsequent appointments as space
was created, initially blocked-out
teeth were bracketed and engaged
with .014” Copper Ni-Ti wires. At 3.5
months, the decision was made to
continue with the nonextraction
preparation. This severely crowd-
ed case did not progress beyond
the .010” Copper Ni-Ti wires until 12
months into treatment.

Results
The final result was obtained after
23 months of treatment. Retention
included bonded lingual wire retain-
ers and clear, vacuum-formed Essex-
type removable retainers to be worn
while sleeping. Sizecorrected lower
occlusal photographs taken at initial
bonding and debonding illustrate the
change in the size and shape of the
mandibular alveolus induced by
passive self-ligating treatment. By
this three-year posttreatment follow
up appointment, teeth # 8 and # 9
had been crowned and the bonded
maxillary lingual wire had been re-
moved. The patient reported intra-
oral removable retainer wear and
the alveolar modeling obtained had
remained remarkably stable.

Conclusions
This article presents case reports
demonstrating a change in the size
and shape of the alveolar bone in
child, adolescent and adult patients
received by a continuous arch, self-
ligating appliance. These cases, along
with a growing body of evidence,
challenge the immutability of the
alveolar bone and the axiom of treat-
ing to the existing arch form. It is the
authors’ considered opinion that
Melvin Moss’s Functional Motion
Theory is correct and the change in
alveolar form induced by this low-
friction, low-force treatment ap-
proach provides an opportunity to
recapture the full genetic potential
of the patient’s alveolus.

Furthermore, alveolar bone mode-
ling is a practical treatment objective

PERIADOLESCENT ALVEOLAR MODELING:
Pre-/Posttreatment Comparison Demonstrates Alveolar Modeling

PRETREATMENT

POSTTREATMENT

3 YEARS POSTTREATMENT

Results

E5

ORTHODONTIC

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E4

ORTHO TRIBUNE
Virtual reality and orthodontics: A new patient experience

By Dr Yasmine Harichane, Canada

Imagine the following scenario: your patient arrives, both relaxed and calm, at your practice. Although the patient is visiting the practice for the first time, he is comfortable with it and knows its interior well. Without further introduction, the patient takes a seat in the dental chair, and the orthodontic procedure is performed quickly and comfortably with patient compliance. There are no complications or tension, and the treatment is easily achieved. Imagine such a soothing and comfortable environment in which to treat patients. Now imagine this very same scenario through the eyes of the patient. One can see that it could actually be a comfortable experience.

This is not some hypothetical futuristic utopia, this is actually happening now, and the aforementioned points are some of the many benefits of virtual reality (VR). VR is a process that entails immersing the viewer in a 360° environment. By turning his head left, right, up or down, the patient can visualize a real or an artificial environment. The spectator could be immersed in the Caribbean Sea surrounded by corals or in a Canadian forest (Fig. 1). The operation is simple: the participant wears a lightweight and comfortable headset in which a smartphone is inserted (Fig. 2). Owing to the gyroscopic sensors, the smartphone will project a matching image corresponding to the movement. If the patient raises his head left, right, up or down, the patient will see the sky or the ceiling, and if he lowers his head he will see his feet. This technique is made possible by a 360° shot using a dedicated camera (Fig. 3) and simple editing software (Fig. 4). The result is simply astonishing as we find ourselves projected into a place that may vary from actual tourist sites to virtual scenarios as in video games. The applications in orthodontics are numerous and at present we are exploiting only a tiny part of its potential functions. The possibilities might be endless. Hence, it might become possible for the patient to visit the dental office from his home, where he can visualize the front desk, admire the treatment rooms or view the cleanliness of the sterilisation room (Fig. 5). The aim is to offer a virtual visit of the practice to allow the patient to choose a quality clinic, as well as familiarize himself with the space before his first appointment. Once physically seated in the chair, the patient can wear the VR headset during the treatment and visualize a restful environment of his choosing. From here on, it is solely a matter of preference as the patient might enjoy the beach, a VR video of Honolulu, or maybe even climbing a mountain. Any VR video is acceptable, as long as it achieves its purpose: calming the patient during a treatment session. Thus, everything becomes less tense, and the patient is relaxed. This might also be convenient for the dentist, as he can then execute whatever treatment is necessary as quickly and efficiently as possible.

Figure 8. Orthodontic bone modeling, or site-specific formation and resorption, occurs along the periodontal ligament and periodontal surfaces.

Convincing the patient to undertake an orthodontic treatment is one thing, convincing him to follow the relevant recommendations is another. Obtaining patient compliance is not easy, especially in the case of younger patients. Furthermore, dentists have an unfortunate notorious association with pain and suffering, which might induce anxiety in a patient. Again, VR can be applied here to divert the attention of the most dynamic patients. Another aspect worthy of mention regarding the benefits is the intellectual retention of instructions on hygiene procedures, for example, which might be dependent on support. It is plausible to assume that verbal instructions on hygiene may be forgotten once the patient has left the clinic. Most orthodontic practices provide only leaflets, but few patients retain these or follow their recommendations. A VR video featuring the practitioner or team members might have a much greater impact on follow-up care at home. The message could be pre-recorded and viewed on demand by the patient. The aims of this format is that it can provide different intellectual integration between information, which is connected to a stream of visual and auditory stimuli. The clinician might wish to promote the patient retaining the provided information in an easier way to achieve greater clinical success. For example, youngsters might remember their favourite movie line by heart, as opposed to information provided by their dentist. This is because it demands less of youngsters to remember words that are connected with pictures.

For the health practitioner, VR may yield an unexpected, but welcome, advantage in terms of professional education (Fig. 6). Many of us have not been able to attend a conference on the other side of the world for logistical reasons. In the near future, it will be possible to attend an orthodontic congress and listen to international speakers while sitting comfortably at home. Similarly, the demonstration of a new therapeutic technique will be easier with a VR video rather than plugging into a detailed explanation in an article without any illustration. The trainer can record his or her procedures with a 360° camera to allow the student to learn through immersion the technical movements and ergonomics of the technique being taught.

It would be an understatement to claim that VR provides an alternative to conventional styles of learning. Although it is far from perfect, it allows for a wider spread of knowledge and a totally immersive pedagogy. VR is changing the way we work, learn, and treat our patients. We have seen over time an evolution of orthodontic care by improving patient comfort. We are not just dealing with a set of teeth fixed into a bone mass append- ed to a skull, but with a person whose positive experience will inevitably lead to clinical success. Similarly, orthodontic education has evolved over time, since the transmission of knowledge is no longer done with a Kodak Carousel slide projector, but with sophisticated presentation software, incorporating photographs and clinical videos. VR is paving the way to a higher degree of evolution regarding how to understand our environment, whether it is an environment of care or work. As with tourism or cinema, VR offers many opportunities in the field of health.

Orthodontics is entering into a 360° revolution focused on the patient experience.

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