**A novel device in orthodontics**

**Dr Chung H Kau** presents a series of case studies on the use of a new device to speed tooth movement during orthodontic treatment

**Introduction**
This series of case studies illustrates the use of a new device to enhance tooth movement during orthodontic treatment. The novel device used in these studies was the AcceleDent Type I (Figure 1a), a larger study version of the smaller commercially available device (Figure 1b). The device uses the application of cyclic forces to move teeth in bone faster through accelerated bone remodeling. The product has a removable mouthpiece, similar to a sports mouthguard, which applies forces directly to the dentition. The mouthpiece is put into the subject’s mouth and is attached to a component just outside the mouth that provides the small mechanical force to the teeth. This piece houses the mechanical, electrical, and energy components that activate the mechanical forces. The patient places and activates the device once daily for twenty minutes.

The applied force (0.2 Newtons or 20 grams) is intended to be barely noticeable and should not be uncomfortable (some researchers have theorised that the pulsing may actually decrease pain associated with standard orthodontic adjustments). Importantly, AcceleDent is designed to work with all existing orthodontic appliances including fixed appliances and clear aligners, and is therefore intended as a complement to, rather than a replacement of, existing orthodontics.

**The study**
Seventeen patients were enrolled and results are reported on 14 patients who completed device use. Three patients used the device for only minimal periods and are not included in the results (patient moved, patient’s device malfunctioned and was not replaced, patient did not reliably use the device). Patients used the device during the alignment (11) or space closure phase (3). A Sirona Galileos Cone Beam (CBCT imaging device) was used at the start and end of treatment to assess root resorption. This system emits a radiation dose between 29 to 54μSv (as reported by the manufacturer). The field of view is a spherical volume of 15cm, the voxel size is between 0.15 to 0.30mm, and the grayscale is 12 bit. Image manipulation was carried out using the manufacturer’s software, Galaxis, to increase the accuracy of the assessment, all three-planes (sagittal, axial and coronal views) were utilised.

Overall, patients tolerated the device well and most said device-use was easy. CBCT images provided an excellent way to view root resorption; no statistically significant changes were noted for root lengths. Additionally, no clinically significant changes were noted. Overall tooth movement rates were found to be 0.526mm per week. This rate is favorable when compared to published rates of movement. In order to more fully explore this device, case study reports on three example patients are provided.

**Case report 1**
The first case relates to TOB, a 16-year old Hispanic female, who consented and was enrolled in the study. She had no outstanding medical history or ongoing medical issues. She presented with a Class I malocclusion with bi-maxillary skeletal proclination. Extraction of the first bicuspid was carried out to aid in the facial profile. She had approximately 7mm of extraction site distance in each of her four quadrants. Her device use started on 25th June 2008 and completed on September 24th, 2008. Her settings were constant throughout the study at 0.2 Newtons (20g of force), 30Hz., and 10 minutes of on-time per use. She used the device twice a day (mornings and evenings) and her compliance rate was approximately 65%. She typically used the device while watching TV or movies, or while reading.

When assessing tooth movement, her maxillary bodily tooth movement occurred at a rate of about 1.5mm per month, her mandibular rate was just under 1mm per month (Figure 2). Her case was somewhat complicated by a tendency to cross-bite, and therefore after most of her maxillary space had closed she stopped device use in order to simplify her treatment regime.

**Case report 2**
The second case is FLR, a 56-year old African American female enrolled in the study on 18th June 2008. She weighed 150 pounds and had previous periodontal disease, which had been stabilised. She had an 11.15mm extraction site distance in her mandibular right quadrant and a 7.84mm extraction site distance in her mandibular left quadrant. This was an extremely difficult case as the extraction site had to be closed without affecting the inter-arch relationship.

Her device use started on 30th June 2008 and completed on 9th March 2009. After approximately two months of use the device settings were increased from 0.2 Newtons (20 grams), 30Hz, and 10 minutes of on-time per use to 0.31N (30g), 20Hz, and 10 minutes of on-time per use. At various points in time the patient reported feeling the device vibrations stronger on one side than the other, this changed throughout treatment. The patient required several devices throughout treatment – in two instances the device ceased to function; the device was replaced in each instance within a few days with a functional device.

In the initial stages, she reported the device...
as ‘bulky’, ‘tedious’ and unreliable; however, after six-months of use the patient adamantly requested to continue device-use when given the option to discontinue. The patient continued using the device throughout her orthodontic treatment and her compliance was 95%.

When assessing tooth movement, the patient’s overall rate for both spaces was just under 1mm per month (0.9mm). As expected since it was a larger space, her right quadrant moved slightly faster than her left quadrant (1.0mm vs 0.8mm per month) see Figure 3.

**Case report 3**
The third case was one in which initial alignment was carried out. BEC, a 12-year old Caucasian, male enrolled in the study on 28th July 2008. He presented with a Class I malocclusion on a skeletal I base. He had about 6.5mm of mandibular alignment displacement based on the Little’s Index.

His device use started on 30th July 2008 and completed on 18th February 2009. His settings were constant throughout the study at 0.2 Newtons (20g of force), 30Hz, and 10 minutes of on-time per use. He used the device twice a day (mornings and evenings) and his compliance rate was approximately 75%. Based on the Little's Index he had 4.48mm of alignment displacement on 10th September 2008, 0.93mm of alignment displacement on 24th September 2008, and had no alignment displacement by 8th October 2008 (Figure 4). Overall, this was a movement rate of 2.74mm per month. The patient continued to be in alignment thereafter throughout treatment. He did need a new mouthpiece during the study.

**Discussion**
This series of case reports represents the first in human case reports conducted on the use of a novel cyclical device in orthodontics. Previous animal studies have shown that cyclical forces at 2 Newtons and frequencies of 0.2 and 1 Hz for 20 minutes daily, provided accelerated tooth movement in addition to the typical static forces provided 24-hours per day (braces)(Mao 2002, Mao and Nah 2004). In this study, the AcceleDent device was used as an adjunct to routine treatment. The types of forces were cyclical in nature hence providing an almost pulsating nature. Consistent with the animal models, the device was used for only 20 minutes a day. The closest force characteristic that this device produced would be seen as an intermittent force and these types of forces have been shown to allow cementum to heal and prevents further resorption (Faltin et al 2001, Acar et al 1999, Konoo et al 2001). The initial device shows promising rates of tooth movement. An independent study on root resorption also indicates little or no adverse change to root morphology.

**Conclusion**
The AcceleDent device is a useful adjunct to orthodontic treatment. If used in the appropriate case setting, accelerated tooth movement can occur.

**References**

Figure 2: Maxillary and mandibular arches before and after treatment. The teeth extracted are indicated by a cross X

Figure 3: Mandibular arches before and after space closure

Figure 4: Mandibular arches showing the pictures before orthodontic treatment and after alignment