

Biotechnology in Orthodontics

Chung H Kau*

Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, 1919 7th Avenue South, Room 305, Birmingham, AL 35294, USA

The clinical practice of orthodontics has changed since I started residency years ago. The basic premise of moving teeth through alveolar bone using bio-mechanical methods within a safe, cellular environment has not changed much. In most clinical scenarios, the most common treatment approaches to correct the malocclusion by providing mechanical forces in a controlled manner. These techniques have been in place for approximately 100 years and involve a system of metal archwires and brackets, typically referred to as orthodontics. The basic system may be augmented with elastics, metal bands, head gear, retainers, and other ancillary devices as dictated by the specific and individualized treatment. These forces are static in that they are only adjusted at specific visits but then stay constant and do not change between visits.

There are two important areas that affect the biology of tooth movement.

One of these areas involves the environment in which the teeth are accommodated. When a force is applied to a tooth, a complex interaction between osteoblasts, osteoclasts and bone matrix occurs. The exact true mechanism is still being defined. Some biologist would claim that tooth movement maybe considered an inflammatory process. Cytokines, such as interleukin-1 (IL-1), interleukin-6 (IL-6), and receptor activator of nuclear factor κ B ligand (RANKL), are inflammatory or pro-inflammatory mediators play an important role in re-modelling the periodontal ligament (PDL) tissue. These processes allow the teeth to move through bone.

The other important area to consider is the exact mechanism in which teeth move. There are 4 main theories of tooth movement;

1. Hydrodynamic theory

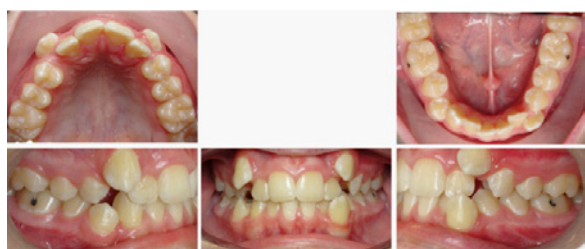


Figure 1: Severely crowded Class I malocclusion on Skeletal I base. This case required 4 first premolar extractions.



Figure 2: 5 months into the treatment protocol using a standard straight wire technique.



Figure 3: "Settling" the case into occlusion.

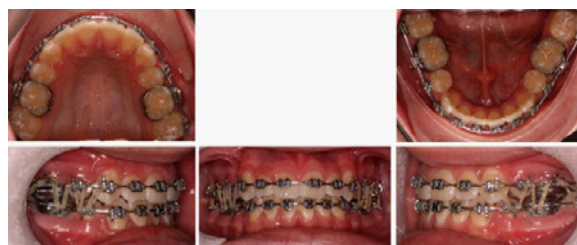


Figure 4: Applying the finishing touches to the occlusion.

2. Piezoelectric theory
3. Pressure tension theory
4. Biomechanical theory

It is interesting to note that not one theory is universally accepted though there is evidence that one is more compelling than the other.

I have seen in the last year or so, an introduction of various techniques that accelerate tooth movement. How is biotechnology changing the way in which orthodontists practice?

I have been involved in a study that uses photo-biomodulation to up-regulate biology and hence decrease the treatment time in orthodontics. Photobiomodulation, is an emerging medical and dental technique in which exposure to light or light emitting diodes stimulate cellular function leading to beneficial clinical effects. In some instances this technique is known as low level light therapy or LLLT. The primary claim of this technology is to increase electron transportation system by targeting the cytochrome oxidase pathway. The light spectrums may vary but it falls in the infra-red range. The ultimate by-product

*Corresponding author: Chung H Kau, Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, 1919 7th Avenue South, Room 305, Birmingham, AL 35294, USA, E-mail: ckau@uab.edu

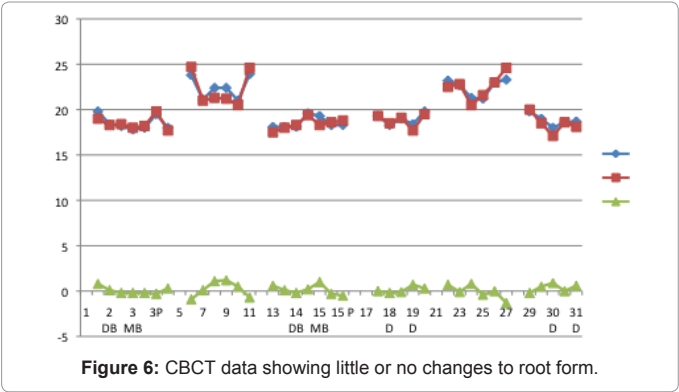
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in this process is an increase in ATP available in the local areas of cell function.

In the case example provided, a young male patient with a Class I malocclusion on skeletal I base presents for orthodontic treatment. He has severe crowding in the upper and lower dental arches (Figure 1). 4 first premolars were extracted followed by a course of orthodontic treatment. During the treatment, photo-biomodulation was applied to alter the cell processes involved in tooth movement (Figures 2-4). The resulting treatment time to completion of treatment was 13.1 months (Figure 5). Cone Beam Computerized Tomography representation of



the root morphology indicated little to no changes to root during the treatment process (Figure 6).

The use of biotechnology in orthodontics is gaining popularity and if proven to be effective can be a mainstay application within the profession. These applications coupled with efficient biomechanics can significantly alter the practice of orthodontics.

In my opinion, it will be a game changer!