Guest Editorial

The Clear Plastic Appliance

A Biomechanical Point of View

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In the last decade the clear plastic appliance (CPA) treatment received remarkable attention from the orthodontic profession and general practitioners. Different companies emerged and all are using vigorous advertisement to promote their products mainly directly to the patients.[1,2]

Following the first 'treatment experiences' with the CPA, and several published case reports, practitioners realized that bodily movements and extrusions are not accomplished as expected.[3] Therefore, two modifications were implemented in order to improve crown and especially root control; bonded metal or clear attachments and composite attachments.[4]

A force and a moment are needed to move teeth bodily.[5] In the edgewise system, the moment is developed in the bracket itself by full engagement of the wire in the bracket. This engagement in the bracket is a must, since moments are produced by the couple (two equal and opposite forces) resulting from contact of the wire with the opposite walls of the bracket's slot.

In order to move a central incisor bodily palatally when a 100g of direct force is applied 10 mm away from its center of resistance, a moment of 1000 g-mm is needed. 1600g is needed to develop this moment in the bracket (Figure 1). This number is dramatically increased by hundreds of grams when the distance from the bracket to center of resistance becomes larger as with periodontitis.

Can any CPA, without or with different attachment, produce and deliver such heavy forces in its occlusal and especially in its gingival parts? From careful analyses of the appliance it is apparent that the answer is negative. Even using an attachment cannot change this basic structure and the behavior of the CPA, and cannot change physical laws. Moreover, it is very unlikely that the CPA can deliver hundreds or thousands of grams to the teeth without being distorted. Only the occlusal part of the CPA can deliver relatively heavier forces to the teeth. Those forces can mainly tip the teeth or intrude them.

When the CPA first appeared in the market as a comprehensive treatment option, many orthodontists thought that this clear and esthetic device might be the ideal system since it envelops the whole crown. The index and thumb were used to demonstrate its effect, but this finger demonstration is deceptive. When the fingers grasp a body, most of the forces exert at the edges of the fingers, not at their base. If we look at the CPA, we understand that most of its force is exerted at the very occlusal part and is rapidly reduced going gingivally.

When we place the CPA on the teeth we expect the desired tooth movement to occur. If this does not happen, the CPA surrenders to the stiffer teeth and becomes distorted. Its gingival edges move away from the teeth and no force can be exerted in the gingival area while the force is concentrated only in the occlusal part. This distortion prevents any possible couple to be developed and no bodily movement of the tooth is possible. This occlusal force encourages intrusion. Therefore, it is not uncommon to see teeth that were undesirably intruded using the CPA and it is described as the water melon seed effect. Unfortunately, when

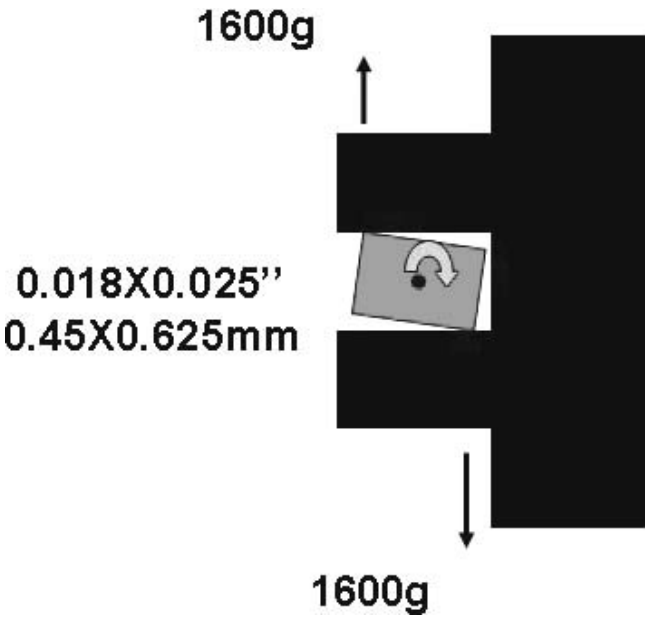

Figure 1. The way the forces in each side of the brackets are calculated when the moment developed by the force is 1000 g-mm, 100g of force are placed on a tooth where the center of resistance is 10mm away from the vector on the bracket and has to be counteracted in order to develop bodily movement. The counteracting moment is derived from the couple at the bracket (0.625 mm × 1000 g).

this unwanted intrusion occurs, extrusion of the tooth using only the CPA is impossible.

Smart, sophisticated improvisation using bonded attachment auxiliaries and elastics are needed.[7] The attachments are very useful in making the CPA retentive. They increase the contact surface area between the teeth and the CPA by adding bulges, irregularities and undercuts.

Since tipping and intrusion are the movements that can be accomplished by the CPA we suggest using it in cases where only tipping and/or intrusion are needed. When bodily movement and torque are needed, using the CPA might give a compromise solution. Even demonstrating that the CPA can move canines bodily using panoramic radiographs is questionable.[8] Several papers have shown that even extremely tipped canines may appear straight and parallel to their neighboring teeth in panoramic radiographs.[9]

We suggest that those patients treated by CPA have to be informed that auxiliary elements may be bonded to their teeth while being treated, and/or a fixed appliance system may be used in the finishing stage for better results, which means obeying the biologic, physiological esthetical long term retention rules.

The profession needs both empirical clinical evidence based studies[10–14] and fundamental methodological physical biomechanical laboratory studies that will illuminate and explain the real effects and different possible movements using the CPA.

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