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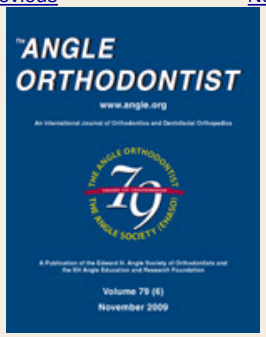

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Original Article

Optimal Loading Conditions for Controlled Movement of Anterior Teeth in Sliding Mechanics

A 3D Finite Element Study

Jun-ya Tominaga[a], Motohiro Tanaka[b], Yoshiyuki Koga[c], Carmen Gonzales[a], Masaru Kobayashi[d], and Noriaki Yoshida[e]

Abstract

Objective: To determine optimal loading conditions such as height of retraction force on the power arm and its position on the archwire in sliding mechanics.

Materials and Methods: A 3D finite element method (FEM) was used to simulate en masse anterior teeth retraction in sliding mechanics. The degree of labiolingual tipping of the maxillary central incisor was calculated when the retraction force was applied to different heights of a power arm set mesial or distal to the canine.

Results: When the power arm was placed mesial to the canine, at the level of 0 mm (bracket slot level), uncontrolled lingual crown tipping of the incisor was observed and the anterior segment of the archwire was deformed downward. At a power arm height of 5.5 mm, bodily movement was produced and the archwire was less deformed. When the power arm height exceeded 5.5 mm, the anterior segment of the archwire was raised upward and lingual root tipping occurred. When the power arm was placed distal to the canine, lingual crown tipping was observed up to a level of 11.2 mm.

Conclusions: Placement of the power arm of an archwire between the lateral incisor and canine enables orthodontists to maintain better control of the anterior teeth in sliding mechanics. Both the biomechanical principles associated with the tooth's center of resistance and the deformation of the archwire should be taken into consideration for predicting and planning orthodontic tooth movement.

Keywords: Sliding mechanics, Power arm, Anterior teeth retraction, Finite element method, Deformation of archwire

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