Bony adaptation after expansion with light-to-moderate continuous forces

Collin D. Kraus, Phillip M. Campbell, Robert Spears, Reginald W. Taylor, Peter H. Buschang

DOI: https://doi.org/10.1016/j.ajodo.2014.01.017

Abstract:

Introduction

The purpose of this study was to evaluate the biologic response of dentoalveolar bone to archwire expansion with light-to-moderate continuous forces.

Methods

With a split-mouth experimental design, the maxillary right second premolars of 7 adult male dogs were expanded for 9 weeks using passive self-ligating brackets (Damon Q; Ormco, Orange, Calif) and 2 sequential archwires (0.016 × 0.022-in copper-nickel-titanium alloy, followed by 0.019 × 0.025-in copper-nickel-titanium alloy). Intraoral and radiographic measurements were made to evaluate tooth movements and tipping associated with expansion; archwire forces were measured using a force gauge. Microcomputed tomography was used to compare buccal bone height, total tooth height, total root height, and buccal bone thickness. Bone formation was evaluated histologically using tetracycline and calcein fluorescent labels and hematoxylin and eosin stains.

Results

Buccal expansion was produced by forces between 73 and 178 g. Compared with the control side, which showed no tooth movement, the experimental second premolars were expanded by 3.5 ± 0.9 mm and tipped by 15.8°. Buccal bone thickness was significantly thinner (about 0.2 mm) in the coronal aspects and significantly thicker (about 0.9 mm) in the apical aspects over the mesial roots. The tipping and expansion significantly (P <0.05) reduced buccal bone height (ie, caused dehiscences) at the mesial (about 2.9 mm) and distal (about 1.2 mm) roots. Bony apposition occurred on the trailing edges of tooth movement and on the leading edges of the second premolar apices. The axial microcomputed tomography slices indicated, and the bone histomorphometry and histology demonstrated, newly laid-down bone on the periosteal side of the buccal cortical surfaces. Ordered osteoblast aggregation was also evident on the periosteal surfaces of buccal bone, just cervical to the apparent center of rotation of the tooth. Tooth and root heights showed no significant differences between the experimental and control second premolars.

Conclusions

Buccal expansion with light-to-moderate continuous forces produced 3.5 mm of tooth movement, uncontrolled tipping, and bone dehiscence, but no root resorption. Bone formation on the periosteal surfaces of cortical bone indicates that apposition is possible on the leading edge of tooth movements

This abstract refers to the AJO-DO