

Volume 79, Issue 4  
(July 2009)

[◀ Previous Article](#)[Volume 79, Issue 4 \(July 2009\)](#)[Next Article ▶](#)[◀ Previous](#)[Next ▶](#)

 [Add to Favorites](#)  [Share Article](#)  [Export Citations](#)  [Track Citations](#)  [Permissions](#)

[Full-text](#)[PDF](#)

Carmen Gonzales, Hitoshi Hotokezaka, Yoshinori Arai, Tadashi Ninomiya, Junya Tominaga, Insan Jang, Yuka Hotokezaka, Motohiro Tanaka, Noriaki Yoshida (2009) An In Vivo 3D Micro-CT Evaluation of Tooth Movement After the Application of Different Force Magnitudes in Rat Molar. The Angle Orthodontist: Vol. 79, No. 4, pp. 703-714.

Original Articles

## An In Vivo 3D Micro-CT Evaluation of Tooth Movement After the Application of Different Force Magnitudes in Rat Molar

Carmen Gonzales<sup>a</sup>, Hitoshi Hotokezaka<sup>b</sup>, Yoshinori Arai<sup>c</sup>, Tadashi Ninomiya<sup>d</sup>, Junya Tominaga<sup>a</sup>, Insan Jang<sup>a</sup>, Yuka Hotokezaka<sup>e</sup>, Motohiro Tanaka<sup>f</sup>, and Noriaki Yoshida<sup>g</sup>

### Abstract

**Objective:** To investigate the precise longitudinal change in the periodontal ligament (PDL) space width and three-dimensional tooth movement with continuous-force magnitudes in living rats.

**Materials and Methods:** Using nickel-titanium closed-coil springs for 28 days, 10-, 25-, 50-, and 100-g mesial force was applied to the maxillary left first molars. Micro-CT was taken in the same rat at 0, 1, 2, 3, 10, 14, and 28 days. The width of the PDL was measured in the pressure and tension sides from 0 to 3 days. Angular and linear measurements were used to evaluate molar position at day 0, 10, 14, and 28. The finite element model (FEM) was constructed to evaluate the initial stress distribution, molar displacement, and center of rotation of the molar.

**Results:** The initial evaluation of PDL width showed no statistical differences among different force magnitudes. Tooth movement was registered 1 hour after force application and gradually increased with time. From day 10, greater tooth movement was observed when 10 g of force was applied. The FEM showed that the center of rotation in the molar is located in the center of five roots at the apical third of the molar roots.

**Conclusion:** The rat's molar movement mainly consists of mesial tipping, extrusion of distal roots, intrusion of mesial root, palatal inclination, and mesial rotation. Although the initial tooth movement after the application of different force magnitudes until day 3 was not remarkably different, 10 g of force produced more tooth movement compared with heavier forces at day 28.

**Keywords:** [Tooth movement](#), [In vivo micro-CT](#), [FEM](#), [Rat molar](#), [Time lapse](#), [Superimposition](#)

Accepted: September 2008;

<sup>a</sup> PhD student, Division of Orthodontics and Dentofacial Orthopedics, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan

<sup>b</sup> Senior Assistant Professor, Division of Orthodontics and Dentofacial Orthopedics, Nagasaki University, Nagasaki, Japan

<sup>c</sup> Professor, Institute for Oral Science & High-Tech Center, Matsumoto Dental University, Shiojiri, Nagano, Japan

<sup>d</sup> Assistant Professor, Institute for Oral Science & High-Tech Center, Matsumoto Dental University, Shiojiri, Nagano, Japan

<sup>e</sup> Senior Assistant Professor, Division of Radiology and Cancer Biology, Nagasaki University, Nagasaki, Japan

THE ANGLE  
ORTHODONTIST

www.angle.org

An International Journal of Orthodontics and Dentofacial Orthopedics

70  
YEARS OF LEADERSHIP  
THE ANGLE SOCIETY (IASO)

A Publication of the Edward H. Angle Society of Orthodontists and  
the EH Angle Education and Research Foundation

Volume 79 (4)

November 2009

[Current Issue](#)  
[Available Issues](#)

An Open Access Site  
Courtesy of the  
EH Angle Education and  
Research Foundation

Please **contribute** to the  
Angle Foundation to help keep  
this website free and open access

### Journal Information

ISSN: 0003-3219

Frequency: Bimonthly

### Register for a Profile

Not Yet [Registered?](#)

Benefits of Registration Include:

- A Unique User Profile that will allow you to manage your current subscriptions (including online access)
- The ability to create favorites lists down to the article level
- The ability to customize email alerts to receive specific notifications about the topics you care most about and special offers

[Register Now!](#)

<sup>f</sup> Assistant Professor, Division of Orthodontics and Dentofacial Orthopedics, Nagasaki University, Nagasaki, Japan

<sup>g</sup> Professor, Division of Orthodontics and Dentofacial Orthopedics, Nagasaki University, Nagasaki, Japan

Corresponding author: Dr Hitoshi Hotokezaka, Division of Orthodontics and Dentofacial Orthopedics, Nagasaki University, Sakamoto 1-7-1, Nagasaki 852-8588, Japan. ([hotoke@nagasaki-u.ac.jp](mailto:hotoke@nagasaki-u.ac.jp))

**Related Articles**


**Articles Citing this Article**

[Google Scholar](#)

**Search for Other Articles By Author**

- ⊖ Carmen Gonzales
- ⊖ Hitoshi Hotokezaka
- ⊖ Yoshinori Arai
- ⊖ Tadashi Ninomiya
- ⊖ Junya Tominaga
- ⊖ Insan Jang
- ⊖ Yuka Hotokezaka
- ⊖ Motohiro Tanaka
- ⊖ Noriaki Yoshida

**Search in:**

 Angle Online

