

## AAO Foundation Award Final Report

Principal Investigator	Jeffrey C. Nickel
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Secondary Investigators	Larry D. Crouch, Thomas Petro, Richard A. Reinhardt
Award Type	Biomedical Research Award
Project Title	Concentrations and Distribution of interleukin (IL)-1, IL-6, Tissue Necrosis Factor, and Transforming Growth Factor Cytokines During Orthodontic Tooth Movement
Project Year	1998 (Project timeline: July 1, 1998 - June 30, 1999)
Institution	University of Nebraska Medical Center, College of Dentistry
Summary/Abstract (250 word maximum)	<p>In <b>Part 1</b> of this project, the first specific aim was undertaken to demonstrate the relationship between stress and velocity of tooth movement. Seven subjects participated in the 84-day study. In each subject, a continuous retraction force averaging 18 g was applied to 1 of the maxillary canines, whereas a continuous retraction force averaging 60 g was applied to the other. The magnitude was adjusted for each canine to produce equivalent compressive stresses between subjects. Estimated average compressive stress on the distal aspect of the canine teeth was 4 kPa or 13 kPa. The moment-to-force ratios were between 9 and 13 mm. Tooth movement in 3 linear and 3 rotational dimensions was measured with a 3-axis measuring microscope and a series of dental casts made at 1- to 14-day intervals. The results showed a statistical difference in the velocity of distal movement of the canines produced by the 2 stresses (<math>P = .02</math>). The lag phase was eliminated and average velocities were 0.87 and 1.27 mm/month for 18 and 60 g of average retraction force. Interindividual velocities varied as much as 3 to 1 for equivalent stress conditions. It was concluded that effective tooth movement can be produced with lower forces and that because loading conditions were controlled, cell biology must account for the variability in tooth velocities measured in these subjects. In <b>Part 2</b> of the project, the velocity of tooth movement was correlated with concentrations of IL-1b and IL-1RA in the gingival crevicular fluid (GCF). GCF cytokine concentrations from experimental and control teeth were expressed relative to total protein in the GCF and compared using an Activity Index (AI). The results showed that the velocity of tooth movement in an individual was related to their AI. The correlation between AI and tooth movement was stronger from the distal (<math>R = 0.78</math>) than from the mesial (<math>R = 0.65</math>) of retracted teeth. The results demonstrate that individual differences in cytokine production correlate with interindividual differences in the velocity of canine retraction.</p>
Were the original, specific aims of the proposal realized?	Yes

<p>Were the results published? If not, are there plans to publish? If not, why not?</p>	<p>Results were published in:  Iwasaki LR, Haack JE, Nickel JC, Reinhardt RA, Petro T: Human interleukin-1 beta and interleukin-1 receptor antagonist secretion and velocity of tooth movement. <i>Arch Oral Biol</i> 46:185-189, 2001.  Iwasaki LR, Haack JE, Nickel JC, Morton J: Human tooth movement in response to low stress magnitudes, <i>Amer J Orthod Dentofac Orthoped</i> 117:175-83, 2000.</p>
<p>Have the results of this proposal been presented? If so, when and where? If not, are there plans to do so? If not, why not?</p>	<p>Results have been presented:</p> <p>Dec. 11, 2003      “Mechanical and biological factors pertinent to orthodontic tooth movement,” University of California at San Francisco School of Dentistry, San Francisco, California.</p> <p>Sept. 8, 2003      “Biological and mechanical factors pertinent to orthodontic tooth movement,” Pre-congreso Internacional de Ortodoncia, Sociedad Colombiana de Ortodoncia, Bogota, Colombia.</p> <p>Aug. 18, 2003      “Tooth movement in response to known orthodontic stress is related to the ratio of cytokines in gingival crevicular fluid,” 4<sup>th</sup> International Conference on the Biological Mechanisms of Tooth Movement and Craniofacial Adaptation, New York University, New York, New York.</p> <p>June 2003            "Human tooth movement velocity is related to stress magnitude and GCF cytokines," Annual General Session of the IADR, Gothenburg, Sweden.</p> <p>Apr. 21, 2003      “Controlled orthodontic tooth movement and cytokine secretion in gingival crevicular fluid,” Department of Orthodontics, School of Dental Medicine, University at Buffalo, Buffalo, New York.</p> <p>Oct. 24, 2002      “Controlled orthodontic tooth movement and cytokine secretion in gingival crevicular fluid,” School of Dentistry, University of Minnesota, Minneapolis, Minnesota.</p> <p>Oct. 3, 2002        “Controlled orthodontic tooth movement and cytokine secretion in gingival crevicular fluid,” Department of Dentistry, Faculty of Medicine and Dentistry, University of Alberta, Edmonton,</p>

	<p>Canada.</p> <p>Sep. 11, 2002 “Controlled orthodontic tooth movement and cytokine secretion in gingival crevicular fluid,” Faculty of Dentistry, University of Toronto, Toronto, Canada.</p> <p>Apr. 17, 2002 “Controlled orthodontic tooth movement and cytokine secretion in gingival crevicular fluid,” Section de Medecin Dentaire, Division of Physiopathologie Buccale et Parodontie, University of Geneva, Geneva, Switzerland.</p>
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