AAO Foundation Award Final Report

Principal Investigator	Robert J. Nikolai, Ph.D. Professor of Biomechanics in Orthodontics
Co-Investigator	Y. Y. Alexander Chung, D.M.D., M.S. Former Orthodontic Resident; Now in Private Practice
Secondary Investigators	None
Award Type	Research
Project Title	Post-buckling Responses of Arch wire Segments *In Vitro*: A Preliminary Study
Project Year	1996-97
Institution	Center for Advanced Dental Education Saint Louis University St. Louis, Missouri
Summary/Abstract (250 word maximum)	In part motivated by a report in the literature of an abbreviated clinical trial, seemingly the first of its kind, to gain arch length by distally driving terminal molars with locally buckled wire segments, a controlled on-the-bench study was designed to investigate the post-buckling responses of a sample of flexible arch wires. Activation-deactivation cycle plots were obtained from eight rectangular wires (two sizes by four materials or composition0. The design included two characteristic (passive wire) lengths and activating deformations of three and six mm. A total of 256 tests (eight per cell) were conducted at oral temperature. The plot of the cycle was in four distinct segments: pre-buckling; post-buckling activation; post-buckling deactivation; and unbuckling. Dependent variables quantified from the plots were the driving force size as deactivation commenced, the extent of deactivation before unbuckling occurred, an average rate of deactivation (in grams/mm), and the force magnitude as unbuckling began. Although the deformation of the wire in fact was bending, activation by longitudinal pushing generated cycles substantially different in shape and size from their familiar counterparts obtained from localized transverse displacements.

	Magnitudes of spring-back were substantial despite large activations, and only two of the eight wires exhibited full deactivations less than 80% of their activating displacements. Judging from the force magnitudes obtained at the start of deactivation, several of the wires seem clinically unsuitable except, possibly, when adjacent first and second molars are to be modestly distally displaced as a unit. In summary, the results of the study were encouraging, and further testing – including additional wires and activating displacements – followed by broad clinical trials – is recommended.
Were the original, specific aims of the proposal realized?	The objective of the project was to undertake an apparently first controlled examination of the potential of a buckled arch wire-segment as a substantially activated orthodontic appliance component. Sought from eight wires were sufficient elastic ranges and maximum force magnitudes during deactivation that were not biomechanically excessive. Without question, four of the eight wires appeared to be viable candidates for clinical, buckling-activation application.
Were the results published? If not, are there plans to publish? If not, why not?	An original article entitled 'Controlled Localized Buckling Responses of orthodontic Arch Wires," co-authored by Dr. Chung and the PI, appeared in 1999 in Volume 116 (pp 308-316) of the American Journal of Orthodontics and Dentofacial orthopedics.
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?	A presentation entitled 'Full-Cycle Buckling-Post-buckling Responses of Orthodontic Arch Wires" was delivered by the PI at the annual meeting of the American Association for Dental Research in March 1998 in Minneapolis, MN. A presentation entitled "Responses of Orthodontic Arch Wire Segments Activated by Controlled Buckling" was delivered by the PI during an oral research session at the annual meeting of the American Association of Orthodontists in May 1998 in Dallas, TX