

Orthodontic Faculty Research Activities

(University of Washington, Seattle, WA)

By Dr. Anne-Marie Bollen, DDS, MS, PhD

The activities of the faculty at different orthodontic programs are often not well known by the orthodontic community. In this issue of "Faculty Files," we are therefore featuring the research efforts at one outstanding university, the University of Washington, Seattle, as an example of a program where research is an important and integral part of the departmental activities. Not many programs have a research program as extensive and varied as the University of Washington's.

Ongoing research projects in the department of Orthodontics at the University of Washington encompass laboratory research, animal experiments, clinical studies and systematic reviews. Some of the research projects currently undertaken by full-time faculty in the department are outlined below.

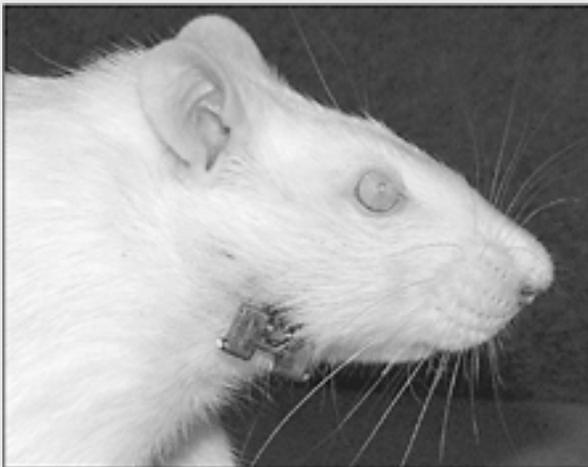


FIGURE 1 RAT WITH DISTRACTOR IN PLACE

Greg King, DMD, DMSc (Professor and Chair) is conducting a randomized clinical trial to assess the cost effectiveness of a program of interceptive and preventive orthodontics in the mixed dentition for Medicaid patients compared to full treatment in the permanent dentition. This study also compares privately financed patients with those on Medicaid. The long-term goal is to influence Medicaid policies to put more emphasis on interception of malocclusions in the mixed dentition, rather than on the more expensive full treatments in the permanent denti-

tion. We hope that such a focus could provide more access to orthodontic services for Medicaid patients and more orthodontists would be willing to provide these services.

Dr. King has also been involved in studies to assess the feasibility of using tele-dentistry to provide interceptive services to patients who might otherwise not have access to an orthodontist. In these studies, quality orthodontic services are being provided by the general dentists who are already treating these patients supervised in real time by an orthodontist at a remote location via tele-dentistry. Dr. King is also establishing a network of private practice orthodontists to conduct clinically relevant studies in their practices. Two protocols will be initiated in the next few months: one will assess the uses and success of TADs as they are being used in our area; the second will be a study to assess the effectiveness of retention of vertical corrections.

Using implanted strain transducers, Dr. King is also conducting studies to measure strains in the PDL caused by mastication and orthodontic appliances. Dr. King is also working on the bone changes that occur during and after distraction osteogenesis in a rat model.

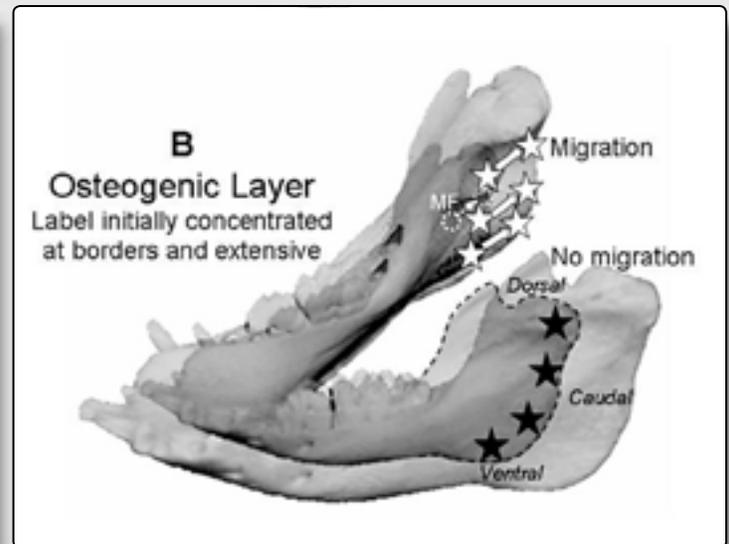
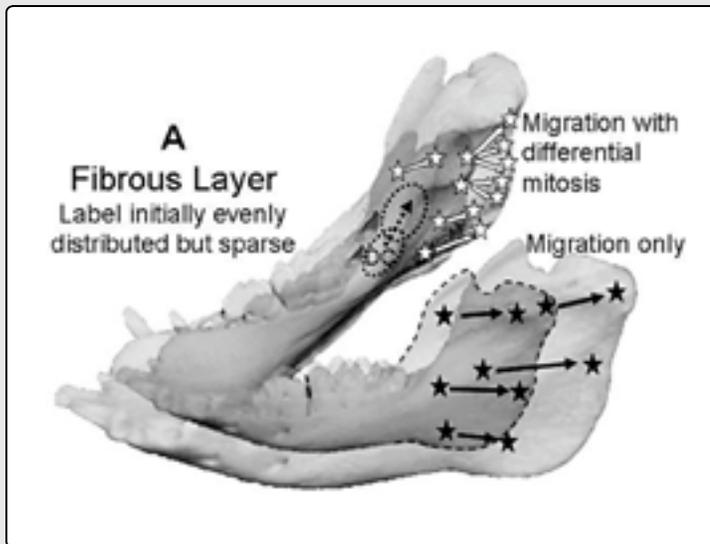
Sue Herring, PhD's (Professor) research projects relate to bone growth, periosteal migration and muscle function. Increased knowledge about these biological phenomena are important to the field of orthodontics since moving teeth and influencing craniofacial growth is based on the remarkable mechanical responsiveness of bones.

Dr. Herring's extended studies on muscles provide us with much information since powerful chewing muscles exert quite a lot of loading on the craniofacial tissues, but we know very little about skull mechanics during function.

A recent study in Dr. Herring's laboratory involved the use of mini-pigs to measure skeletal deformation and muscle contraction and to associate these data with growth. Among the topics tackled over the years are whether weaning changes bone strain, how muscles migrate along bones during growth, whether muscles put pressure on adjacent bones, whether sutures tensed by function grow faster than compressed sutures, and whether the nasal septum is a compressive strut.

FIGURE 2 (A AND B) SUPERIMPOSITION OF YOUNGER AND OLDER MANDIBLE COMPARING THE DISTRIBUTION OF CELL LABELING IN THE PERIOSTIUM FOR EACH OF THE TWO HYPOTHESES ON PERIOSTIAL GROWTH.

SUE HERRING'S STUDY SHOWED LABELING IN ACCORDANCE WITH THE HYPOTHESIS THAT INCLUDES BOTH CELL MIGRATION AND DIFFERENTIAL MITOSIS. FROM: ANAT REC 290:1366-1376; 2007.



Anne-Marie Bollen, DDS, MS, PhD (Professor) recently finished a systematic review on the interactions between periodontal health and malocclusions and orthodontic treatment. Subjects with malocclusions tend to have worse periodontal health than subjects without malocclusions. However, the correlation between malocclusion and periodontal disease does not prove a causal effect. The systematic review on the relation between orthodontic treatment and periodontal conditions found that subjects who had orthodontic treatment have slightly worse periodontal health than subjects without prior treatment.

Anne-Marie also recently finished a study on the effects of dietary calcium levels on periodontal bone density and alveolar bone loss in a rat model. As expected, higher levels of dietary calcium resulted in greater alveolar (and facial as well as dental) bone density. Animals on the high calcium diet also exhibited less age-related and less induced (through interdental ligature insertion) periodontal bone loss. Since higher levels of bone density have been related to slower orthodontic tooth movement and less post-treatment relapse, these results suggest that subjects on higher calcium diets may experience slower orthodontic tooth movement and less post-treatment relapse.

Greg Huang, DMD, MSD, MPH (Associate Professor) recently completed a five-year NIH project on third molar removal and TMD, and found that there appears to be a relationship between third molar removal and subsequent TMD. He will continue this line of research using the practice-based network (PRECEDENT) that has been established in the Northwest. Likewise, together with Dr. King he is planning several orthodontic practice-based network studies — one on temporary anchorage devices, and one on retention. Dr. Huang is also interested in investigating the relationship between orthodontics and oral bisphosphonates, and has submitted a grant to NIDCR. He is a co-investigator on Dr. King's grant assessing disparities in access to orthodontic care, as well as comparing early versus comprehensive orthodontic treatment in a Medicaid population. Dr. Huang is also involved in performing a systematic review on the stability of open-bite treatment. Finally, he is planning a study investigating different therapies to address decalcification after orthodontic treatment.

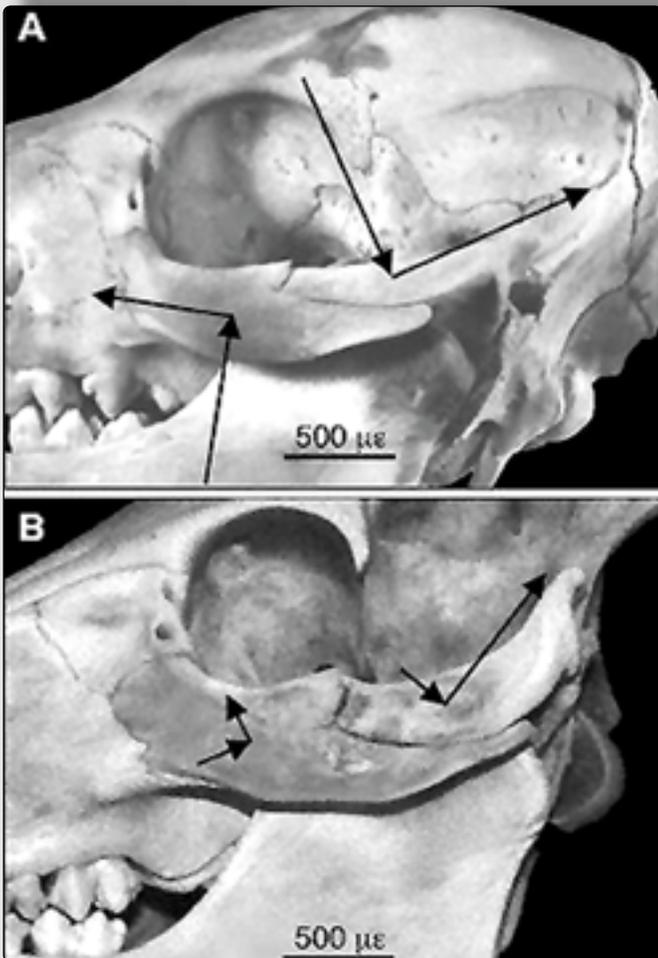


FIGURE 3 PATTERNS OF STRAIN DURING MASTICATION IN YOUNG (A) AND OLDER (B) PIG. NOTE THE CHANGE IN SIZE AND DIRECTION OF THE ARROWS DEPICTING STRAIN ON THE ZYGOMATIC ARCH. FROM: J EXP BIOL 208:4509-4521; 2005.

Geoff Greenlee, DDS, MSD (Clinical Assistant Professor) is engaged in several research projects. His primary research is with the Northwest/Alaska Center to Reduce Oral Health Disparity, studying the effect of early orthodontic intervention on Medicaid-insured children. This large prospective randomized clinical trial will yield interesting data upon its completion in 2009. A regular co-investigator with other department members, Dr. Greenlee is also doing a systematic review with Dr. Greg Huang on orthodontic treatment and anterior open bites as part of his Master of Public Health degree in Epidemiology.

Zi-Jun Liu, DDS, MS, PhD (Associate Professor) has been studying tongue volume, function and biomechanics using a well-established pig model to understand how tongue volume influences mastication, respiration and mechanical loads, and to reveal the effects of tongue volume reduction on upper airway morphology, craniofacial growth, remodeling and occlusal development.

He is also conducting a clinical study on anterior open bites in East-African children. This study uses imaging (Cone-beam CT and 3D ultrasound) and physiological tools (EMG, bite force, tongue and lip pressures, and articulation evaluation) to understand characteristics of morphology and function in this clinical condition. Dr. Liu is also working with Dr. King on the in-vivo pig study measuring functional strains of the PDL, and to understand how diet and orthodontic tooth movement affect these structures and stains, and the underlying mechanism of mechano-transduction.

Kathy Rafferty, PhD's (Assistant Professor) current research interests are postnatal growth of the craniofacial skeleton, loading of the craniofacial complex, and the interaction between the two. Presently Dr. Rafferty's focus is on the condyle following forward positioning of the mandible. As part of a pilot study, she is investigating condylar differences in gene expression associated with changes in loading and growth using RT-PCR and immune histochemistry techniques in growing minipigs with and without functional protrusion.

As illustrated above, the ongoing research projects by the full-time faculty at the University of Washington, Department of Orthodontics cover a varied and large number of topics. In addition, each of the residents is working on a thesis project. Some of these projects are extensions or integral parts of the research by the full-time faculty. Other projects by the residents involve part-time and affiliate faculty, as well as faculty from other departments in the school of dentistry. This results in a continuing active exchange of ideas and discussions which makes being part of this department always interesting and intellectually stimulating.