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The Cruzan Center for Dental Research

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Research is an integral part of the University of Nebraska Medical Center (UNMC) College of Dentistry's mission and strategic plan. The College of Dentistry (COD) has experienced substantial growth in its research enterprise since the opening of the Cruzan Center for Dental Research (CCDR) as evidenced by a 16-fold growth in extramural funding from 1998 to 2006. Through major investments from the COD, UNMC, and the generosity of UNMC College of Dentistry alumni and their spouses Dr. and Mrs. Winston V. Cruzan and Dr. and Mrs. Gene Dixon, funds were allocated for the building of the Cruzan Center for Dental Research. The CCDR is a state-of-the-art facility that serves as the central unit for research and has 2 components: the clinical research component and the basic science component. The primary funding source for the clinical component is industry, while the basic science component is primarily funded by NIH, but also receives some funding from other government and industrial sources.

The CCDR Clinical Component

Due to the structure of the Cruzan Center, the COD faculty have the opportunity to collaborate on a variety of clinical research projects that include investigators from multiple disciplines, such as medicine and pharmacy. Additionally, investigators from the COD collaborate with other dental schools and medical and dental healthcare providers in the local community.

In 1998, Caren M. Barnes was named Coordinator of Clinical Research for the Cruzan Center of Dental Research and was the first dental hygienist to lead a clinical research facility in a US dental school. I am a member of the Association of Clinical Research Professionals and have extensive experience in the design and participation in clinical research and has strong relationships with dental industry that have resulted in sustained funding for over 30 years. My approach to the Cruzan Center was to provide comprehensive infrastructure support to faculty participating in clinical research in order to maximize their efficiency and time while meeting the timelines of industry, government, and the dental community. Services the CCDR provides for investigator-initiated studies include: literature searches, preparation of grant applications and applications for regulatory agencies (IRB, Pharmacy and Therapeutics Committee, FDA, etc), as well as protocol design, statistical design and analysis, budget preparation, identification of funding sources, and database development for clinical outcomes trials. Many of these same services are provided to industry for industry-initiated projects. Strong community networks have enabled the Center to recruit a culturally diverse population of subjects.

The faculty that have participated in clinical research have a broad area of expertise in clinical research in the following areas:

- Randomized clinical trials, multi-center trials
- Dental Instruments/Equipment
- Etiology of Oral Diseases

- Oral Hygiene Devices
- Oral Pharmaceuticals
- Dental Materials and Biomaterials

Notably, since 1998, a large portion of clinical and applied research funding has come from the participation of dental hygienists in clinical research at the Center. The following is a representative example of research conducted at the CCDR that dental hygienists participated in as a principal investigator or participating personnel:

- A Comparison of the Efficacy of a Rowenta Powered Toothbrush (MH700) and the Oral B Braun Powered Toothbrush in Affecting Plaque Accumulation and Gingival Bleeding
- A Clinical Evaluation of the Efficacy of a Plastic Prophylaxis Polishing Cup Compared to a Conventional Natural Latex Prophylaxis Polishing Cup
- The Effects of Aluminum Trihydroxide Airpolishing Powder on Dental Restorative Materials and Enamel
- A Comparison of a Waterpik Double-Motor Powered Toothbrush and a Manual toothbrush in Affecting Interproximal Bleeding Reduction and Plaque Accumulation
- An Examination of the Effect of the sonicare Powered Toothbrush on Salivary Flow on Patients With Xerostomia Secondary to Head and Neck Radiation Therapy
- A Comparison Of Irrigation To Floss As An Adjunct To Toothbrushing: Effect On Bleeding, Gingivitis and Supragingival Plaque
- The Effects of NUCare Root Conditioner on Gingival Healing
- The Application of Computer Aided Cytology for Detection of Precancerous and Cancerous Lesions of the Oral Mucosa: A Multicenter
- A Randomized, Investigator-Masked, Multicenter Study to Compare the Safety and Efficacy of Nystatin Oral Suspension and Nystatin Frozen Oral Suspension in the Treatment of Patients with Oral Candidiasis
- A Phase III, Multicenter, Randomized, Double-Blind, Placebo-Controlled Study to Assess the Efficacy and Safety of Cevemeline in the Treatment of Zerostomia Secondary to Radiation Therapy for Cancer in the Head and Neck Region
- A Qualitative Evaluation of the Abrasiveness of Selected Prophylaxis Pastes When Used on Enamel, A Hybrid Composite and Porcelain Using a Non Contact Profilometer and Glossmeter
- A Qualitative Evaluation of the Abrasiveness of Selected Prophylaxis Pastes When Used on Enamel, A Hybrid Composite and Porcelain
- A Laboratory Assessment of the Efficacy of the Summit+ Compact Toothbrush Compared to the Oral-B 35 Indicator

The CCDR Basic Science Component

The basic science component of CCDR is comprised of faculty that have 3 major units of focus: bioregulation, biomaterials, and cellular signaling in cancer. The faculty from the CCDR basic science component receive the majority of their funding from NIH and additional funds from foundations and industry. The COD has been ranked in the top 30 US dental schools in NIH funding for 6 consecutive years, which is remarkable as the COD has one of the smallest faculty sizes.

Many of the NIH-funded research studies conducted by the bioregulation unit have investigated various aspects of periodontal disease. Recently completed was an NIH-funded study by Jeffrey Payne, DDS, M Dent Sc, and Richard Reinhardt, DDS, PhD, that investigated the effects of low-dose doxycycline on osteopenic bone loss in post-menopausal women. Other NIH- funded studies have included translational research investigating the effects of periodontal therapy in private practice on glycosylated hemoglobin levels of diabetic patients, lymphocyte subpopulations in periodontal tissues, supportive periodontal therapy during estrogen deficiency, and novel pharmaceutical methods to augment bone growth in the oral cavity.

Biomaterials research is one of the fastest growing areas at the College of Dentistry. At present, research efforts fall into 1 of 4 general categories: biomechanics, mechanical and physical testing of biomaterials, biological response evaluation, and outcomes assessment (clinical trials). The research focus in biomechanics includes TMJ function, tooth wear, and cavity preparation design.

The TMJ research focuses on the long-term health of the synovial joints, mechanical stress, and its resulting deformation of lining tissues that are important factors in the generation of fluid transport and nutrition for the articular tissues. This research utilizes techniques such as computer generated numerical modeling of muscle and joint forces and in vivo testing (human) of computer modeling predictions to explore the mechanisms controlling stresses in the TMJ. Research on tooth wear is investigating the significant losses of tooth structure that can occur with occlusal and incisal wear and the etiology and mechanisms that govern wear. The extent of tooth wear is currently evaluated by means of qualitative or ordinal scales that are insensitive to small changes in loss of tooth structure that cannot ascertain the rate of wear. These problems are being addressed by the development of a quantitative measuring method that uses a computer-aided-design (CAD) software program to record and model the incisal and occlusal wear facets of the human dentition. When fully developed, this system will allow the location, size, and distribution of wear facets to be recorded, as well as determining the rate of wear. The effect of dental treatment and disorders like bruxism and bulimia on the loss of tooth structure are some of the areas that could apply this technique. Cavity preparation design is being investigated relative to the life span of dental restorations. Current life-span predictions are based on clinical evaluation that in general does not account for the amount of tooth structure removed during the operative process. Present research efforts are aimed toward determining the volumetric changes that occur when tooth structure is removed during various tooth preparation procedures. Future research will focus on determining the fatigue resistance of prepared teeth with various cavity preparation sizes. This will ultimately permit the development of a failure prediction model for teeth that are candidates for given cavity/crown preparation procedures. Restoration life-span information could allow the dentist and patient to make more accurate treatment planning decisions.

The Nebraska Center for Cellular Signaling (NCCS) was formed in the fall of 2003 creating a Center of Biomedical Research Excellent (CoBRE) under the IdeA program, which is funded by the NIH and the National Center for Research Resources. A number of areas within the field of cell biology are rapidly converging on a common theme: cellular signal transduction. This is particularly true for the fields of cell adhesion, cell motility, and cancer biology. The main focus of this Center is to bring together individuals studying signal transduction to form an organized, cohesive group. The project leaders of this Center share interests in cell motility, cell adhesion, growth regulation, apoptosis, metastasis, and invasion. A thread that ties this group together is their desire to understand signaling pathways that impact cellular behavior as well as the underlying theme of signaling through adhesion receptors and receptor tyrosine kinases.

This is a very exciting time in dental research and there is so much to explore and so many questions to be answered. Whether in a state-of-the-art laboratory or clinical facility, the University of Nebraska Medical Center College of Dentistry is fortunate to have faculty expertise, dedication, and outstanding facilities so that we may contribute to the ever burgeoning scientific body of knowledge of dental hygiene and dentistry.