

AAO Foundation Award Final Report

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Secondary Investigators	
Award Type	Biomedical Research Award
Project Title	Relationship of mineral distribution with mechanical properties of oral bone
Project Year	07/01/2013-06/30/2014
Institution	Ohio State University
Summary/Abstract (250 word maximum)	<p>The objective of this project was to examine the role of degree of bone mineralization (DBM) parameters in controlling dynamic masticatory loading demand and its applicability to the diagnosis of the mechanical stability of oral bone regions with complications. Human cadaveric mandibular cortical and trabecular bones were subject to nanoindentation, dynamic mechanical analysis, and static and fracture testing following non-invasive micro-CT and clinical cone beam CT (CBCT) scanning. The elastic modulus had significant positive correlations with plastic hardness and viscosity while negative correlations with viscoelastic normalized creep and tangent delta for both cortical and trabecular bone tissues of human cadaveric mandibles ($r=0.343\sim0.852$, $p<0.001$). CBCT based mean DBM had positive correlations with strength and toughness ($r=0.429\sim0.482$, $p<0.05$) at the macro-level of cortical bone. Micro-CT and CBCT based mean DBM had significant positive correlations with modulus, strength, and toughness ($r=0.556\sim0.900$, $p<0.04$) while no significant correlation with tangent delta ($p>0.288$) at the macro-level of trabecular bone. For clinical studies, oral bone sites with periodontal disease had no significantly different values for all clinical CBCT based DBM parameters from control sites ($p>0.05$). The mean DBM was significantly higher for the failed dental implant group than for the contralateral successful group ($p<0.026$) while variability of DBM were significantly lower ($p<0.041$). Left TMJ condyle had a significantly higher mean gray value (1384.503 vs. 1330.092, $p<0.001$) than the right condyle. These outcomes will provide baseline information to help develop an innovative strategy for early diagnosis to reduce the potential risk of progressive deterioration of the mechanical stability of oral bone with complications under dynamic masticatory loading.</p>
Were the original, specific aims of the proposal realized?	Yes, the original specific aims were realized as described in the Summary.

<p>Were the results published? If not, are there plans to publish? If not, why not?</p>	<ol style="list-style-type: none"> 1. Kim, D-G, Kwon, Hyun-Jung, Jeong, Yonghoon, Erin Kosel, Lee, Damian, Han, Jung-Suk, Kim, Hye Lee, Kim, Dae-Joon, "Elastic, plastic, and viscoelastic properties of bone tissue at the implant interface with different treatments and healing periods." 2014 (in preparation). 2. Kim, Do-Gyoon, Jeong, Yonghoon, Erin Kosel, Agnew, Amanda, McComb, David, Bodnyk, Kyle, Hart, Richard T., Kim, Min Kyung, Han, Sang Yeun, William M. Johnston "Region and Sex Dependent Variations of Human Mandibular Subchondral Bone Tissue Properties." 2014 (in preparation). 3. Kim, D-G, Kwon, Hyun-Jung, Jeong, Yonghoon, Elias, Kathy L, Erin Kosel, Kim, Hye Lee, Park, Cheol-Woo, Kim, Dae-Joon, Han, Jung-Suk, "Viscoelastic, and Plastic Mechanical Properties of Bone Tissue at the Implant Interface." <i>Trans. of Orthopaedic Res. Society, Vol. 39, p.1547, 2014.</i> 4. Jeong, Yonghoon, Kim, Min Kyung, Han, Sang Yeun, Agnew, Amanda, Kim, Do-Gyoon, "Regional Variation of Mechanical Properties in Human Mandibular Subchondral Bone Tissue." <i>Trans. of Orthopaedic Res. Society, Vol. 39, p.1502, 2014.</i> 5. Vivian Ariail, Yuan-Ding Li, Hua-Hong Chien, Do-Gyoon Kim, "Changes of Alveolar Bone Mineral Distribution in Periodontitis Patients." <i>AADR meeting, #643 (Mar 2014).</i> 6. Arman Haghghi, Hyun-Jung Kwon, Jungha Cho, Trenton Johnson, Huan-Yu Chen, Samantha Crance, Do-Gyoon Kim, "Role of Cartilage in Determining Mechanical Behavior of Temporomandibular Joint." <i>AADR meeting, #404 (Mar 2014).</i> 7. Andrew Hansen, Andrew Hong, Do-Gyoon Kim, "Asymmetry of Human Condyle Bone Mineral Density Distribution." <i>AADR meeting, #1185. (Mar 2014).</i> 8. Andrew Hong, Andrew Hansen, Do-Gyoon Kim, "Gender Difference of Changes in Bone Mineral Density with Age." <i>AADR meeting, #526. (Mar 2014).</i>
<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>	<ol style="list-style-type: none"> 1. Kim, D-G., "Quality of bone regeneration at the bone-implant interface.", Invited Speaker, 2nd Asia-Pacific Bone & Mineral Research Meeting, Seoul, Korea, May 30, 2014 2. Kim, D-G., "Nanoindentation for Bone Tissue Engineering.", Invited Speaker, Seoul National University Interdisciplinary Bioengineering Symposium, Seoul National University, Seoul, Korea, November, 2013 3. Kim, D-G., "Nanoindentation for Bone Tissue Engineering.", Invited Speaker, Seoul National University Interdisciplinary Bioengineering Symposium, Seoul National University, Seoul, Korea, November, 2013

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<p>To what extent have you used, or how do you intend to use, AAOF funding to further your career?</p>	<p>This AAOF biomedical research award is very helpful to produce the preliminary results that are needed to advance current scientific knowledge to the next level and develop large scale projects. These research activities inspire me to continue cultivating my research career.</p>