

Biomechanics (Biodesign)

1. Staffs and Students

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2. Purpose of Education

Biomechanics

The class is for the understanding of fundamental concepts of mechanics, and introduction to the advanced studies including the biomechanics of living bodies, tissues, and cells. Some applications to the basics of medical devices with mechanical functions are also discussed.

3. Research Subjects

1. Remodeling of structural and supporting tissues under mechanical stimuli

Biomechanical studies on structural/supporting tissues such as bones, ligaments and tendons are carried out. In particular, to elucidate the adaptation mechanism of these tissues, the effects of controlled mechanical stimuli applied to living cells and tissues are investigated.

2. Development of Bone Regeneration Device with Bioabsorbable Organic/Inorganic Composite Materials

Devices for bone regeneration with the use of bioabsorbable Organic/Inorganic Composite materials are developing. In vitro and animal experiments are carrying out for pre-clinical experiments. Furthermore, bone regeneration mechanism when implanting Organic/Inorganic composite materials is examined by in vitro and in vivo tests.

3. Development of Regeneration Devices for Soft Tissues with the use of bioabsorbable materials

Regeneration technology for structural/supporting tissues such as ligaments, tendons, dura mater, peripheral nerves and small blood vessels are investigated utilizing bioabsorbable polymers. Our strategy is based on the regeneration by the self-healing mechanism achieved through the optimum milieu provided by biomaterials. We already have promising results in the animal experiments for the cases of dura mater and peripheral nerves.

4. Development of Soft and Flexible Resin Base Dentures for Elderly Persons

We are developing innovative soft and flexible resin base dentures those are able to moderate the stimulation to mucous membranes and give the patients to get the moderate masticatory force for elderly persons. As the soft and flexible materials for the denture base, we have developed copolymer of 2-ethylhexyl methacrylate and methyl methacrylate that shows relatively hard properties or very soft properties depending on the amount of the contents. By utilizing these new materials, we are now designing new soft and flexible resin base dentures with gradient functions.

4. Publications

Original Articles

1. Kadono H, Furuzono T, Masuda M, Okada M, Ueki M, Takamizawa K, Tanaka R, Miyatake K, Koyama Y, Takakuda K. In vivo evaluation of hydroxyapatite nanocoating on polyester artificial vascular grafts and possibility as soft-tissue compatible material. *ASAIO J.* 2010;56(1):61-66.
2. Kawai T, Yamada T, Yasukawa A, Koyama Y, Muneta T, Takakuda K. Anterior Cruciate Ligament Reconstruction Using Chitin-coated Fabrics in a Rabbit Model. *Artif Organs.* 2010;34(1):55-64.
3. Nakayama H, Takakuda K, Matsumoto HN, Miyata A, Baba O, Tabata MJ, Ushiki T, Oda T, McKee MD, Takano Y. Effects of altered bone remodeling and retention of cement lines on bone quality in osteopetrotic aged c-Src-deficient mice. *Calcif Tissue Int.* 2010;86(2):172-183.

4. Arita T, Asoda S, Koshitomae H, Katakura H, Takakuda K. Collagen fiber anchoring platforms for percutaneous devices. *ASAIO J.* 2010;56(3):235-240.
5. Yoshida T, Kikuchi M, Koyama Y, Takakuda K. Osteogenic activity of MG63 cells on bone-like hydroxyapatite/collagen nanocomposite sponges. *Journal of materials science. Materials in medicine.* 2010;21(4):1263-1272.
6. Ueda K, Mukai T, Ichinose S, Koyama Y, Takakuda K. Bioabsorbable device for small-caliber vessel anastomosis. *Microsurgery.* 2010 Sep;30(6):494-501.
7. Wang W, Itoh S, Yamamoto N, Okawa A, Nagai A, Yamashita K. Enhancement of nerve regeneration along the chitosan nanofiber mesh tube on which electrically polarized beta-tricalcium phosphate particles are immobilized. *Acta Biomater.* 2010 Oct;6(10):4027-33.
8. Wang W, Itoh S, Aizawa T, Okawa A, Sakai K, Ohkuma T, Demura M. Development of an injectable chitosan/marine collagen composite gel. *Biomed Mater.* 2010 Dec;5(6):065009.

Presentations

1. Takakuda K. Structural Tissue Regeneration with Biomaterials. The 4th International Conference on the Science and Technology for Advanced Ceramics STAC-4 (Yokohama, Japan), 2010 June.
2. Kikuchi M, Yoshida T, Koyama Y, Sotome S, Itoh S, Takakuda K, Shinomiya K, Edamura K, Tanaka S, Irie A. Bone-Mimicking Material: Hydroxyapatite/Collagen Nanocomposite. International Conference on Nanomaterials ICN-2010 (Kottayam, India), 2010 Apr.
3. Wei Wang, Soichiro Itoh, Akiko Nagai, Kimihoro Yamashita. Bone Implant of Electrically Polarized Ceramics. 3rd International Congress on Ceramics (Osaka, Japan). 2010 Nov.