

【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering)



Title of Project : Induction of anisotropic bone tissues based on combination of materials science and bone biology

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Research Area : Materials Science and Engineering

Keyword : biomaterials, bone regeneration, bone biology, biological apatite orientation

【Purpose and Background of the Research】

It is extremely difficult to quickly recover the anisotropic bone microstructure in the defected bone even by the most advanced tissue engineering technique (Fig. 1). Considering bone anisotropy and the mechanism at varied aspects by which bone anisotropy forms is necessary to develop a novel bone graft which induces anisotropic bone microstructure with oriented collagen/apatite.

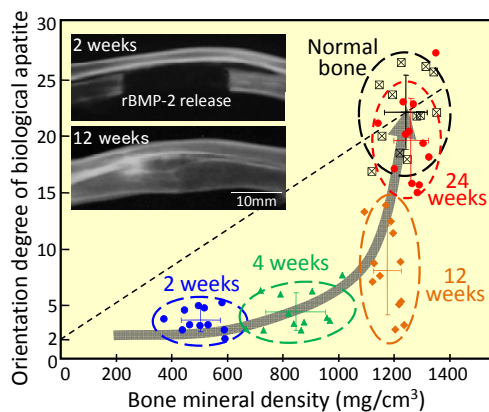


Figure 1 Variation of bone mineral density and orientation degree of biological apatite during bone regeneration process

In this project, we set two research topics from biological and materials scientific aspects; (A) in biological scientific aspect, the essential mechanism for formation of bone tissue anisotropy will be ascertained based on various scale-levels: gene, molecule, bone cell and bone tissue levels, (B) in materials scientific aspect, the novel biomaterials for regeneration of bone function will be artificially developed via biomimetic process and mechanisms.

【Research Methods】

Two dominant projects mentioned above will be performed for clarifying the formation mechanism of bone anisotropic microstructure composed of collagen and biological apatite and the subsequent development of novel biomaterials.

(A) Elucidating the mechanism through which the unique anisotropic bone structure forms (Fig. 2)

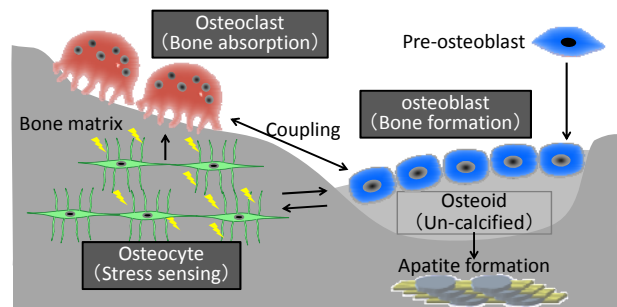


Figure 2 Clarification of cascade on the various levels through which the anisotropic bone tissue forms

- (1) Genetic and molecular levels: focusing on specific signal, gene and cytoskeletal proteins
 - (2) Cellular level: focusing on osteocyte morphology and arrangement, and osteoblast migration
 - (3) Tissue level: focusing on *in vivo* stress distribution, material and structural parameters and the related mechanical properties
- (B) Development of novel bone graft materials based on the biomimetic process and mechanism

【Expected Research Achievements and Scientific Significance】

A combination of materials science and bone biological science will be accomplished to understand the formation mechanism of anisotropic bone tissue, and will finally open up the novel research field, “Materials Bone Biology”.

【Publications Relevant to the Project】

- T. Nakano et al., *Bone*, 51 (2012) pp.741–747.
- T. Ishimoto, T. Nakano et al., *J. Bone Miner. Res.*, 28 (2013) pp.1170–1179.

【Term of Project】 FY2013-2017

【Budget Allocation】 165, 900 Thousand Yen

【Homepage Address and Other Contact Information】

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