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

Broad Section D

Title of Project : "Materials Science of Anisotropy" for induction of bone tissue anisotropy

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Research Project Number : 18H05254 Researcher Number : 30243182
Keyword : biofunctional materials, bone anisotropy

【Purpose and Background of the Research】

Biological apatite crystallizes in an anisotropic hexagonal crystal system, which governs the mechanical function of bone tissue. The apatite orientation varies depending on the bone anatomical portion, which corresponds to the *in vivo* stress distribution (Figure 1).

In this project, we raise a fundamental and core question, "what makes anisotropy in bone tissue?" and try to answer it by an interdisciplinary approach merging "Materials Science" and "Bone Biology". We apply two identical strategies; (1) elucidation of mechanisms for spontaneous organization of bone anisotropy (direct approach) and (2) development of anisotropic bone implant using additive manufacturing (indirect approach).

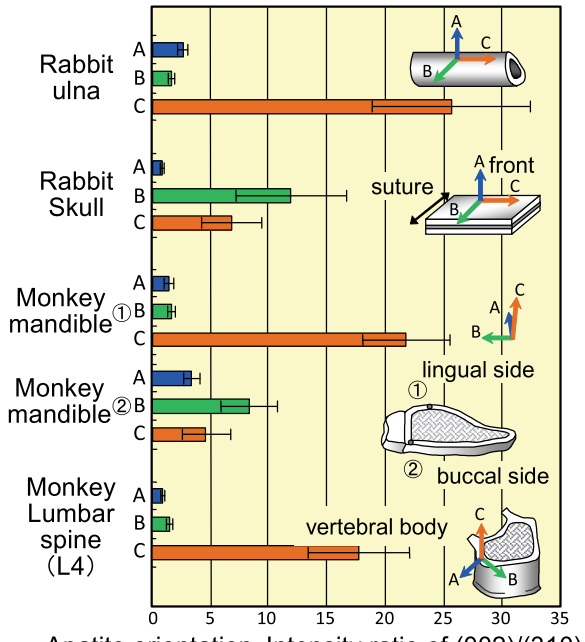

Figure 1 Apatite orientation depending on the bone anatomical portion

【Research Methods】

(1) Spontaneous generation process of anisotropy in biological system

Unveiling the biological mechanisms underlying the endogenous regulation of bone anisotropy mediated by cellular signaling.

(2) Construction of novel biomaterials which realize the anisotropic bone regeneration

Elucidation and control of regulatory mechanisms of anisotropic atomic arrangements in metal additive manufacturing for novel implants with biocompatible mechanical performances.

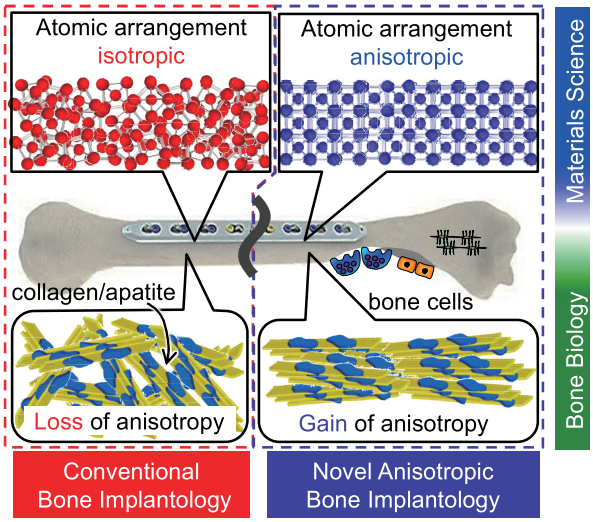

Figure 2 Development of a novel anisotropic bone implantology by merging "Materials Science" and "Bone Biology"

【Expected Research Achievements and Scientific Significance】

An interdisciplinary approach for unexplored mechanisms underlying the expression of "anisotropy" in bone tissue will pioneer a new scientific field, "Materials Science of Anisotropy".

【Publications Relevant to the Project】

・T. Ishimoto, K. Hagihara, T. Nakano *et al.*, *Scripta Materialia*, 132 (2017) pp. 34—38.
・T. Ishimoto, T. Nakano *et al.*, *Bone*, 103 (2017) pp. 216—223.

【Term of Project】 FY2018-2022

【Budget Allocation】 148,800 Thousand Yen

【Homepage Address and Other Contact Information】

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