Postdoctoral position

Study of the influence of a static MAGnetic field on the BONE remodeling. (MAGBONE)

Laboratory	Laboratoire de Mécanique et ses Interfaces ENSTA-Paris
Supervisor	J. Boisson (jean.boisson@ensta-paris.fr) https://perso.ensta-paris.fr/~boisson/index.html
Collaborators	N. Kadlub (Hôpital Necker, APHP), A. Coudert (BIOSCAR)
Funding	Agence d'Innovation de la Défense (CIEDS)
Duration	24 months from october 2024.
Salary	≈~3200€ brut /months
Experiences	Mecanichal testings, cell biology, scaffolds

Project description

Since 2016, our team has been developing a new surgical device: the magnetically activated mandibular distractor [1, 2, 3]. This implantable device uses the interaction between two permanent magnets. Because of the configuration of the surgery, the internal magnet, integrated into the implant, remains close to a fracture line throughout the procedure (4 to 5 months). The magnetic field produced could therefore have a direct influence on the bone remodelling process.

The aim of the project is to quantify the influence of a static magnetic field on bone cells (osteoclasts and osteoblasts) and on the bone produced (organotypic cultures). Initially, we will carry out cell cultures in static magnetic fields with different configurations. In particular, the influence of magnetic field intensity, orientation and gradient will be explored. The magnetic structures integrated into the cultures will be produced using 3D printing for optimum control of the configuration. Using these systems, we will then characterise the effect of the magnetic field on the differentiation and function of osteoblasts and osteoclasts. We will then explore the effect of the magnetic field on bone growth in an organotypic model using calvaria and femurs from newborn mice.

The microstructure will be imaged and the mechanical properties will be characterised using various tensile, flexural, indentation and compression tests. In parallel, we will investigate the possibility of adding magnetic particles to the cellular medium. This highly exploratory aspect will be developed in a second phase in order to optimise the coupling between the magnetic field and the bone cells.

The person recruited will initially be responsible for producing the magnetic systems used in the cultures, followed by the design and operation of the mechanical tests on the biological tissues. In a second phase, he or she may also be involved in the design of prototypes of medical devices incorporating permanent magnets, or in the feasibility of integrating magnetic particles into the biological environment.

Candidate profile

The profile sought is that of a materials or structures mechanic with a very good knowledge of biological materials, or a biologist with an interest in the mechanics of materials. As experimental aspects are important to the project, the candidate will need to demonstrate a good interest in setting up such tests. The candidate will be part of the LMI's life mechanics team and will have to work in collaboration with the biologists and surgeons involved in the project. An excellent ability to work in a multidisciplinary team is important.

Location

The host site is the Mechanics and its Interfaces Laboratory (LMI) of ENSTA-Paris, located in Palaiseau on the Ecole Polytechnique campus. This site will host the design of the magnetic systems and the mechanical tests. Cell cultures will be carried out in the BIOSCAR U1132 research unit at the Lariboisière hospital (Paris 10ème).

Application
Interested candidates should contact J. Boisson (jean.boisson@ensta-paris.fr) and send a CV and covering letter.

References

[1] Boisson et al, Feasibility of magnetic activation of a maxillofacial distraction osteogenesis, design of a new device, J Craniomaxillofac Surg, 2016
[2] Strozyk et al, Distracteur à plaques et ensemble d'un tel distracteur à plaques et d'un outil d'activation, PCT/EP2016/080481 2015
[3] Kadlub et al, Mandibular magnetic distractor: preclinical validation, Br J Oral Maxillofac Surg, 2022