Post-doctoral position:

Bone behavior around a self-tapping dental implant during its insertion, analysed through synchrotron radiation-based fast computed tomography

The **LEAD** (Laboratoire d'Excellence en Application Dentaire), created in 2014, is a collaborative project between **Anthogyr** and **MatéIS** laboratory (UMR CNRS 5510). Anthogyr (Straumann group, Sallanches, France) is a major actor in the conception, production, and commercialization of **dental implants** around the world. MatéIS is a material science laboratory at INSA de Lyon, University of Lyon (Lyon, France) recognized for its important activity on biomaterials for dental and orthopedic applications. The objectives of the LEAD are to improve dental implants materials and processes and to develop less invasive and/or personalized dental implants.

Anthogyr has recently launched the Axiom X3® implant, with a different geometry designed to reduce peri-implant bone stress due to the implant insertion and hence maintain a maximum of the bone stock. While this implant has demonstrated an efficient osteointegration with time, the reasons for such good clinical outcomes are not clearly understood. Analyses are currently undergoing to highlight the mechanisms underlying this outcome. Under the Ovovi project (Outil pour la Visualisation de l'Os au cours du Vissage d'un Implant dentaire), an *in situ* experimental set up has been set up to characterize the influence of an implant insertion on bone structure. Bone samples from porcine iliac crests have been scanned through **micro-computed tomography** (µCT) at MatéIS (voxel size = 12 µm) before and after the insertion of the implant. Such experiments allowed to evaluate the peri-implant bone deformation as well as the formation of debris close to the implant surface that are both known to be involved in the further implant osteointegration. These first analyzes have highlighted differences between the new Axiom X3® and regular implants, in terms of bone densification around the implant, supporting the LEAD to perform further investigations.

In that context, new characterizations of the implant insertion have been performed using synchrotron radiation µCT (Sr-µCT) on beamline ID19 at the ESRF (European Synchrotron Radiation Facility, Grenoble, France). Using the same *in situ* experimental device, fast Sr-µCT (voxel size = 11 µm, rotative speed = 3 rpm) was used to follow the implant insertion within bone samples. In parallel, implanted bone samples were scanned at low rotative speed but with higher resolution (voxel size = 3 µm, rotative speed = 0.3 rpm,

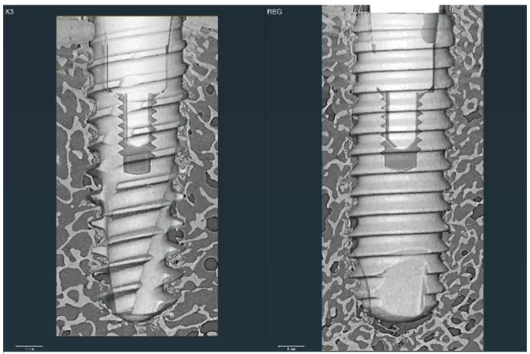

Figure : Implanted bone after implantation at higher resolution (voxel size = 3 µm). Left: Axiom X3®; right: regular implant figure) in order to precisely analyze the debris formed during insertion. In total, 6 Axiom X3® and regular implants were scanned.

The candidate mission will be to analyze this data set of Sr-µCT scans in order to better understand the influence of the implant geometry on bone biomechanical behavior during insertion. Bone morphological characterizations will be held to follow the formation of debris and the bone volume fraction around the implant. Digital Volume Correlation will also be applied to follow peri-implant bone strain development during the insertion.

Requested skills:

The post-doctorate candidate must have a strong experience in the manipulation and processing of volumetric data. Skills in computer languages such as Python or Matlab will be needed for the further treatment of the data. Some knowledge in biomechanics are preferable as a digital volume correlation algorithm will be use to investigate bone strain/stress behavior during implant insertion.

Host Laboratory:

The candidate will be located in the MatéIS laboratory hosted on the INSA Lyon campus in Lyon agglomeration in France.

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