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COMPUTATIONAL MECHANOBIOLOGY OF MUSCULOSKELETAL TISSUES

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MINISYMPOSIUM

Advances in tissue engineering and in biomedical imaging in the past decade have hugely increased the need for data-driven computational models of musculoskeletal tissues such as bone, teeth, cartilage, tendons, ligaments, as well as engineered, biofabricated tissues. Computational modelling paired with imaging data can provide new insights into quantities of interest not easily measureable in the lab, such as transport properties, mechanics, and dynamic information. Musculoskeletal tissues are regulated by mechanistic and mechanobiological processes that depend on morphology and hierarchical structure, as well as material properties. Shape adaptation, remodelling, damage repair, mineralization, and signal propagation, are critical dynamic biological processes that enable these musculoskeletal tissues to resist failure during our lifetime, despite being under-engineered compared to static engineering structures sustaining repeated loadings. The growth, adaptation, and repair of these tissues depend crucially on mechanosensation and mechanotransduction - the ability to sense mechanical states and to generate biological responses. Several computational models, experiments, and tissue engineering scaffolds were developed in recent years to shed light on these mechano-regulated processes.

The objective of this minisymposium is to bring together the expertise of established and emerging researchers investigating the complex mechanobiological interplays at stake in musculoskeletal tissues, including mineralised tissues (bone, teeth) and soft tissues (cartilage, tendon and ligament), particularly in the context of clinical and biomedical applications such as orthopaedic prostheses, prosthetic dentistry, implantology, bioscaffold design, and tendon repair. The minisymposium aims to share and transcend the different computational approaches (e.g., phenomenological models, cell-based models, multiscale approaches), the results that can be obtained with them, and the biological insights that they can provide, both in terms of data analysis and interpretation, and in terms of predicting time evolutions in health and disease. A specific focus will be on the integration of novel experimental data in computer models, collected e.g. using high-resolution micro-computed tomography, electron microscopy, polarisation-dependent second harmonic generation, DualBeam (FIB/SEM) systems, bone chamber models, bioreactors, and scaffolds.