UNIVERSITY OF BRESCIA

PhD Program
in
TECHNOLOGY FOR HEALTH

TECHNOLOGY INTEGRATION FOR FUNCTIONAL HIERARCHICAL IMAGING OF MUSCULOSKELETAL SOFT TISSUES

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XXXVII Cycle

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Background

This research aims to combine technologies in order to deepen the imaging of hierarchical structures of tissues in relation to their mechanical behaviour, that here is function. Indeed, the musculo-skeletal system is the main target, in which organs and tissues exert prevalently a mechanical function, such as load support, force production, joint lubrication, shock absorption, motion restrain etc. Searching for innovative multi-scale and multi-parametric experimental protocols can give more insights for advanced diagnosis and therapy, such as for tissue engineering, necessarily starting from a pre-clinical, laboratory, context, but with continuous attention to the clinic.

Objectives

The research deals with bio-imaging of musculoskeletal soft tissues, aiming to combine two aspects: structure/composition-function relationship - i.e. “functional imaging” -, and multi-scale investigation – i.e. “hierarchical imaging”. Specific objectives are: 1) to design and implement an experimental protocol of tissue functional imaging at the nanometre scale; 2) to design and implement an experimental protocol of tissue functional imaging at the micrometre scale; 3) to design and implement an experimental protocol that combines the previous ones towards a tissue hierarchical functional imaging.

Methodologies

The research implies the application of - but may not be limited to - Atomic Force Microscopy (AFM) and micro-computed tomography (micro-CT). The same for the investigated tissues: focus will be on fibro/cartilaginous soft tissues (e.g. ligaments, tendons, menisci, articular cartilage), but the proposed approach could eventually interest other kinds of tissues.

	YEAR 1				YEAR 2				YEAR 3			
	M 1-3	M 4-6	M 7-9	M 10-12	M 13-15	M 16-18	M 19-21	M 22-24	M 25-27	M 28-30	M 31-33	M 34-36
COLLECTION OF SAMPLES												
approval of ethical commitee												
harvesting												
1. SUB-MICRON FUNCTIONAL IMAGING ON TISSUE												
acquisition of the theoretical and practical fundamentals												
structural imaging												
functional imaging												
2. MICRON FUNCTIONAL IMAGING ON TISSUE												
structural imaging												
functional imaging												
3. MULTI-SCALE FUNCTIONAL IMAGING ON TISSUE												
structural imaging												
functional imaging												
DISSEMINATION												

Expected Results and Impact

Expected result is the design of an experiment that connects the nano- (e.g. by AFM) and micro-functional imaging (e.g. by micro-CT with loading apparatus) on a same tissue, thus to realize a hierarchical functional imaging capable to advance the still partial understanding of the structure-function relationship that links all structure levels. This can be an important tool for advanced medical diagnosis and treatment.