ELEONORE BOLLE

POSTDOCTORAL FELLOW | PROGRAM 3
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

Appointment duration: January 2020 to January 2024

PhD PhD (QUT), MSc (Joint Degree Technische Universität Braunschweig and Université de Technologie de Compiègne), BSc (Joint Degree Technische Universität Braunschweig and Université de Technologie de Compiègne MEng (TBD)

Research Interests: Tissue Engineering, Biomaterials, In Vitro Models

RESEARCH SUMMARY

Tears of the rotator cuff tendons often require the tendon to be surgically re-attached to the bone. Surgical outcomes, however, remain unsatisfactory, with re-tear rates as high as 94% reported.
The overarching aim of this research is to develop tissue engineered scaffolds which replicate the mechanical and anatomical features of native, healthy tendon tissue and can be used to re-attach the tendon to the bone to improve healing outcomes.

PROJECT LIST

Establishing an Anatomical and Biomechanical Model of the Human Shoulder for In Silico Scaffold Optimisation

- Aim: To establish a computational model of the shoulder to simulate stresses and strains in the shoulder
- Background: Patches that are currently utilised in the clinics to augment rotator cuff repairs are not mechanically matched to the shoulder resulting in high re-tear rates of patch augmented surgeries.
- Impact: This research will result in a first in field anatomical and biomechanical computational model. This model will provide valuable information on stresses and strains in the shoulder whilst performing certain movements and will be used as a guide to develop the next-generation tendon patches that can match these loads.

Establishing the Role of Growth Factors Expressed in Healing Tendons in Inducing Stem Cell Tenogenesis – an In Vitro Full Factorial Study

- Aim: To study the ability of four growth factors, all shown to be differentially expressed in healing tendons, compared to healthy tendons, for their ability to promote tenogenesis.
- Background: Stem cell therapies have received a great deal of attention, further advancement of stem cell therapies requires identification of growth factors that guide cell differentiation towards tenogenic lineage. Several studies have investigated the roles of certain growth factors on tenogenic differentiation, however, none of these studies have investigated growth factors that are intrinsically expressed in the healing tendon in a systematic approach or have reported a validated differentiation protocol.
- Impact: This study will provide the field of tendon research with a robust and validated differentiation protocol for the differentiation of stem cells into tenocytes, validated against human rotator cuff cells. Further, this study will provide insight into the role of intrinsically expressed growth factors in modulating stem cell tenogenesis, a pre-requisite to develop tissue engineered scaffold to improve healing outcomes of torn rotator cuff tendons.

Developing a Fine-Fibred Tissue Engineered Scaffold for Rotator Cuff Repair

- Aim: This research aims to develop next generation patches that replicate mechanical and anatomical features of native, healthy tendon tissue and deliver tenogenic growth factors.
- Background: Cells within the tendon, responsible for tissue repair and homeostasis, respond to biological and mechanical cues and loading. Current clinically available patches used for surgical repairs are neither mechanically, nor anatomically, matched to the native, healthy tendon tissue and do not provide any biological cues. This research will characterise the native tissue using histological and material characterisation techniques to inform the design of the scaffolds. These scaffols will then be optimised using the computational model established in Project 1. Finally, growth factors that have been shown to promote tenogenesis in Project 2 will be incorporated into the scaffolds.
- Impact: This research will result in a tissue engineered scaffold that is akin to human tendon and mechanically matched to the loads in the human shoulder.

GRANTS

- 2022 ARC-ITTC Seed grant: Biomechanical characteristics of the human supraspinatus tendon under physiological loading

SELECTED PUBLICATIONS

- Australian Orthopaedic Association QLD branch and Queensland Orthopaedic Research Foundation (QORF) research meeting, Brisbane, September 2022, An Engineering Approach to Improve Healing Outcomes with Rotator Cuff Tears
- o Australasian Society for Biomaterials and Tissue Engineering Annual Conference, Christchurch, NZ, April 2023, A Computational Approach Towards Developing Novel Patches for Rotator Cuff Tendon Repair

SUPERVISION

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