MRT - QUANTITATIVE ULTRASOUND FOR THE EVALUATION OF ACHILLES TENDON DEFORMATION

Stijn Bogaerts[1], Catarina De Brito Carvalho[2], Lennart Scheys[3], Kaat Desloovere[4], Koen Peers[1]
[1]Dept. of Development & Regeneration, KU Leuven / Dept. of Physical Medicine & Rehabilitation, University Hospitals , Leuven, Belgium, [2]ESAT/PSI & UZ Leuven, MIRC, KU and University Hospitals , Leuven, Belgium, [3]Dept. of Development & Regeneration, Institute for Orthopedic Research and Training (IORT), KU / Div. of Orthopedics, University Hospitals , Leuven, Belgium, [4]Dept. of Rehabilitation Sciences; Clinical Motion Analysis Laboratory, KU Leuven and University Hospitals, Leuven, Belgium

The Achilles tendon is the thickest tendon of the human body and structured in a hierarchical manner. Despite this design, Achilles tendinopathy remains a highly prevalent condition with mechanical loading being of crucial importance in management. However, rehabilitation exercises are often prescribed in a "one size fits all" principle. To improve this, tools are required to evaluate the tendon and tailor exercises to the patient's tendon characteristics. The static evaluation of structural characteristics of tendons has become common clinical practice, but it is known that there is only a weak correlation between structural findings and therapeutic outcome. Unfortunately, the dynamic-functional evaluation of mechanical properties is less straightforward.

The breakthrough for in-vivo evaluation of mechanical properties came with technical improvements in ultrasound. Ultrasound was then used to track two reference points during an isometric contraction on a dynamometer leading to an estimation of global tendon mechanical properties.

While this improved insight for the global in-vivo mechanical behaviour of the whole tendon, recent advancements in ex-vivo research have provided valuable insight in local – intratendinous – mechanical behaviour, suggesting that the different hierarchical levels of tendons behave in distinct functional ways. However, quantification of these local tendon mechanics in-vivo has proven to be technically challenging.

Fortunately, recent advancements in the field of real-time ultrasound scanning now provide the possibility to perform in-vivo, non-invasive measurements by automated speckle-tracking algorithms. My PhD project investigated the possibility of using high spatial resolution ultrasound to allow for evaluation at lower hierarchical levels of the tendon.

Firstly, in a systematic review [1] we synthesized an overview of the methods already used in the literature. Secondly, we validated the high-frequency ultrasound based speckle tracking technique [2]. Results confirmed that the Achilles tendon displaces non-uniformly, with a higher displacement found in the deep layer of the tendon. Adding to this, results showed a non-uniform regional strain behaviour in the Achilles tendon during passive elongation, with the highest strain observed in the superficial layer.

Follow-up studies in this PhD project have then evaluated the interaction between the presence of tendon pathology and local tendon mechanics [3], and the influence of biomechanical changes (i.e. change in knee angle during ankle plantar flexion contraction) or ageing on the mechanical behaviour at local – intratendinous - level. Data have been acquired and results are currently being analysed.