Substantial Strain in Extramuscular Connections Show Exposure to Force: A Major Role in Epimuscular Myofascial Force Transmission

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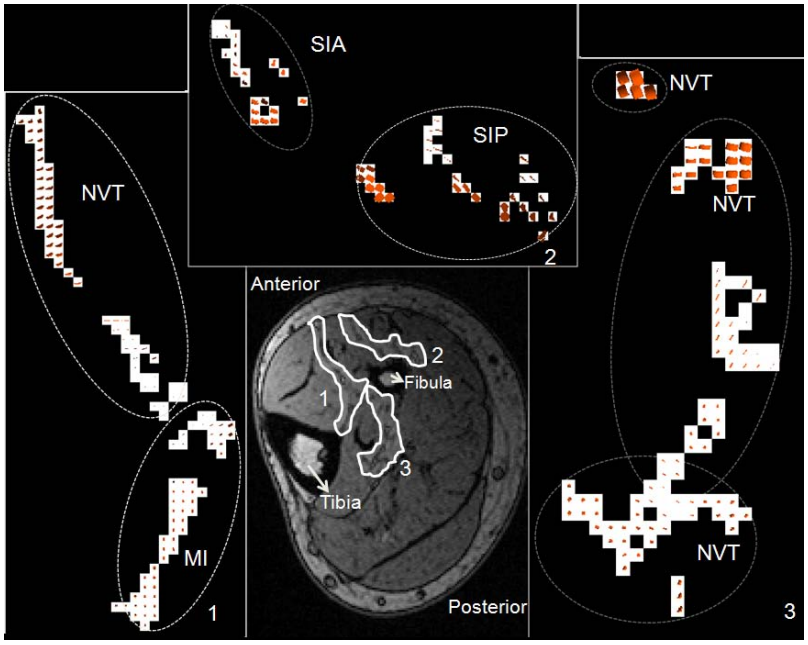
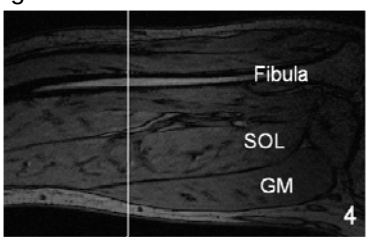
INTRODUCTION: Extramuscular connections (i.e., collagen reinforced neurovascular tracts and compartmental boundaries) have been shown experimentally to transmit substantial amounts of muscle force: *extramuscular myofascial force transmission* [1]. Using MRI, our goal was to study the in vivo deformation of extramuscular connections within the lower leg of a human subject.
METHODS: The ankle angle of a male (30 years old, height=175 cm and weight=70 kg) was fixed (at 90°). The effects of passively changing the knee angle on local deformation of extramuscular connections were assessed. Intensity based nonrigid B-spline semilocal registration [2] was used to obtain displacement fields for a knee angle=160° (reference state) and a knee angle=130° (deformed state). Principle values of Green-Lagrange strains were calculated for each voxel (size=0.8x0.8x0.8 mm).
RESULTS: With changing knee angle, extramuscular connections show substantial strain (Figure): maximal local lengthening and shortening equals 75% and 50% in proximal and distal direction respectively. Note that our MRI data also show substantial strain not only in m. gastrocnemius, but also in other muscles within the entire lower leg, not crossing the knee. We conclude that, extramuscular connections to which such inter-antagonistic mechanical interactions are ascribable are exposed to considerable changes of force and hence are important elements of myofascial force transmission pathways in human, in vivo.



Panels 1-3: Strains in extramuscular connections as superquadric glyphs (in orange) in selected regions on an axial slice (inset). MI: interosseal membrane, SIA & SIP: anterior & posterior intermuscular septum, respectively, NVT: neurovascular tract. **Panel 4:** Location of the axial slice studied on the leg with (vertical line). SOL: m. soleus, GM: m. gastrocnemius



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