

New applications of Diffusion Tensor Imaging techniques in the morphological evaluation of healthy and injured muscles

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Purpose of this study was to evaluate a new approach with a DTI technique for the study of architecture of healthy and injured striated muscle tissue in cases of strain injury.

DTI technique allows to highlight the magnitude and direction of the diffusion of water molecules in tissues and it becomes an indicator of the functional organization, allowing the identification of connections between the different structures showing any pathological changes.

Currently this technique is routinely used in the study of CNS but recently it has also been proposed in the morphological evaluation of skeletal muscle. The application of this technique allows us to detect the presence of anomalies such as the alteration and displacement of the muscle bundles [1,2] and could play a crucial role not only in diagnosis but also in managing the rehabilitation of muscle injuries.

The entire study was performed using a 3T Achieva Philips scanner; a SENSE 8 channels head coil, acquiring DTI sequence and T1 weighted 3D TFE. DTI was performed in 10 men with a strain injuries (grade I or II) in the lower limb muscles previously diagnosed by ultrasound examination. For each patient, we analyzed both healthy and injured limbs. The examination performed in the acute phase (within ten days from the injury) showed the presence of an area of oedema or haemorrhage of variable size. The perilesional area, if compared to healthy tissue, showed a marked alteration of the alignment of fibers. The examination carried out at a distance of 15-20 days showed a progressive reduction in the extent of haemorrhage that highlighted the structural alterations of the injured area, and noted a reduction in muscle fiber size of the affected muscle. The DTI provides detailed information on anatomical alterations in muscles strain and therefore may play a crucial role in diagnostic classification of the lesions. The evaluation of the scar may also be used to evaluate the healing has occurred not only from the clinical but also from anatomical perspective.

References

- [1] Lansdown DA. et al. Quantitative diffusion tensor MRI-based fiber tracking of human skeletal muscle. *J Appl Physiol* 103: 673-681.
- [2] Wang L. et al. 2012. Multi-Scale Modeling and Simulation of the Cardiac Fiber Architecture for DMRI. *IEEE Trans Biomed Eng.* 59: 16-19.

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