# Tracking the Injury

*Follow-up of muscle injury using diffusion tensor MRI: a case study*

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**Introduction:**
Hamstring injuries are among the most frequent muscle injuries and are responsible for a large number of missed competition games and training in professional football clubs. Diagnosis is based on clinical assessment, preferably supported by high-resolution T2-weighted MRI. However, T2-weighted MRI primarily reports on muscle edema and hemorrhage and often fails to accurately reflect the underlying muscle fiber injury, which hampers it utility in a patient-tailored rehabilitation program. Diffusion-tensor MRI (DT-MRI) has shown to be sensitive for exercise-induced changes in athlete's muscle that were not visible on T2-weighted MRI[1]. In addition, by mathematical modeling of the diffusion-weighted signal, we can obtain information on exercise- or injury-induced changes in the intrinsic muscle fiber diffusion (DT-MRI) as well as blood perfusion (with the so-called IVIM model). For this study, we developed and implemented a protocol for DT-MRI and IVIM assessment of skeletal muscle injury and we applied the protocol in a case study of muscle injury and recovery.

**Methods**
We performed a follow-up study of the injured adductor longus muscle of an otherwise healthy subject. DT-MRI as well as T2-weighted scans were performed at 5, 12, 19, 26 and 33 days after onset of muscle injury. DTI parameters were calculated for the adductor longus muscle and T2 images were reviewed qualitatively.

**Results and discussion:**
The patient presented with sudden onset of pain in the right groin after kicking the ball during soccer practice. Function was limited by pain but no limited ROM was reported with an initial VAS score of 6. The strain was graded as a grade I/II, Mueller-Wohlfahrt 3a muscle strain in the right adductor longus muscle on the initial T2-weighted scans. Return to play was at 12 days after onset. T2-weighted imaging showed a hyperintense lesion, which slowly became less prominent but remained well visible over the 33 days. In contrast, DT-MRI normalized at the second time point, which coincided with the patient's return to play. Furthermore IVIM analysis of muscle perfusion showed that, whereas muscle diffusion had normalized after 12 days, the perfusion remained elevated. Increased muscle perfusion might partly explain the remaining hyperintensity on T2-weighted MRI as well. Although further analyses need to be done, these initial results show that DT-MRI with advanced modeling of the diffusion signal provides increased insights in muscle recovery after sports-related injury.

**References**
[1] M.froeling et al. Radiology 2015