Setting First division Belgian (discovery cohort) and UK (replication cohort) soccer.

Patients (or Participants) Players had to be adult out-field players, who did not sustain a HSI in the 6 months before the scan. In total, 96 participants finished the study.

Interventions (or Assessment of Risk Factors) The muscle fibre typology was non-invasively estimated using proton magnetic resonance spectroscopy. During the 1–3 years follow-up period, all sustained injuries were provided by the medical team.

Main Outcome Measurements A cox regression model was used to identify if muscle fibre typology is a risk factor to sustain a HSI. Receiver operating characteristic (ROC) curves were analysed.

Results Belgian players with a fast typology display a 6.7-fold higher risk than slow typology players in experiencing a new HSI (14 HSI; p=0.024). This was independently confirmed in the UK cohort (5.0-fold risk; 13 HSI; p=0.023). ROC curve analysis revealed an AUC of 0.63 in the total cohort and 0.76 in the discovery cohort, indicating poor to fair sensitivity and specificity.

Conclusions The muscle fibre typology is discovered as a novel and important risk factor to sustain a HSI in professional soccer. This opens a new perspective on the mechanism of HSI, possibly related to more pronounced muscle fatigue in fast typology players. Future personalised prevention strategies could take these interindividual muscle composition differences into account.

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034   HIGHER NECK STRENGTH MAY LOWER HEAD ACCELERATION DURING PURPOSEFUL HEADING IN FOOTBALL: A SYSTEMATIC REVIEW

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Background The long-term effect of repeated head impacts during purposeful heading in football is largely unknown. However, evidence suggests that head acceleration during purposeful heading may be reduced by players having strong neck musculature.

Objective To investigate the relationship between neck strength and head acceleration during purposeful heading in football.

Design This systematic review included a comprehensive search of five electronic databases: EMBASE, MEDLINE, CINAHL, SportsDiscus and Web of Science.

Setting All competitive levels of football regardless of setting (high school, football club or academy) were included.

Patients (or Participants) All football players regardless of age, sex, health status or playing level were included.

Interventions (or Assessment of Risk Factors) Only original research reporting on the relationship between neck strength and head acceleration during purposeful heading in football were included. For experimental research designs, studies were included if neck strengthening was the intervention of interest.

Main Outcome Measurements Neck strength measurement using hand-held dynamometry and head acceleration captured during purposeful heading using accelerometry or video analysis.

Results From an initial search of 1174 potentially eligible papers, five cross-sectional studies met the eligibility criteria for inclusion in this review. A total of 190 participants (67% Female) with a mean age of 19 years (range 15–24 years) were recruited across the five studies. Playing level ranged from high school football to division I and II collegiate level. Evidence from four level IV studies supported a statistically significant relationship between higher neck strength and lower head acceleration during purposeful heading in football (p=<0.05; r<-0.5). The fifth study showed a weak association (r=-0.10).

Conclusions Data available from cross-sectional research supports that higher neck strength may lower head acceleration during purposeful heading in football. Further evidence is required to determine the most effective method to strengthen the neck musculature in football players and the impact this may have on the long-term health of players.

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035   CAN WE PREDICT RECOVERY AND RE-INJURY FOLLOWING CALF MUSCLE STRAIN INJURY?

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Background Calf muscle strain injuries (CMSI) are prevalent in sport, but investigations into the variable recovery periods and re-injury are lacking.

Objective To determine whether clinical and MRI findings are predictive of recovery and re-injury following CMSI.

Design Retrospective audit of injury data (2014–2017).

Setting Data from the Soft Tissue injury Registry of the Australian Football League (STRAFL).

Patients (or Participants) 149 Australian Football League players.

Interventions (or Assessment of Risk Factors) Blinded radiologists assessed MRI characteristics including: the anatomical location of injury, waviness, and severity of aponeurotic disruption (AD): none (0%), mild (<50%), severe (50%-99%), complete (100%). Clinical factors included: age, mechanism, and injury history.

Main Outcome Measurements The recovery period consisted of four milestones: pain free walking, running at >90% of maximum speed, return to full training, return to play (RTP). Risk factors for re-injury were evaluated for early re-injury (<2 months), and overall (<2 seasons). Multi-variable regression was used to evaluate clinical and MRI predictors of recovery and re-injury.

Results 149 CMSI (114 index, 35 re-injuries) were included: 126 soleus, 17 gastrocnimius, and 6 other. The anatomical location of injury did not impact recovery (all, p>0.05). CMSI with severe AD took on average 11.9 days longer to RTP than injuries with no AD (p=0.003), and the presence of AD (p=0.03) and a running-related mechanism of injury (p=0.01) were the strongest predictors of a longer RTP for soleus injuries. Older age (p=0.001) and a history of a previous ankle injury (p=0.03) were risk factors for early re-injury, while older age (p=0.01) and a history of previous CMSI (p=0.002) were risk factors for re-injury overall.

Baseline MRI findings were not associated with re-injury (all, p>0.05).

Conclusions Presence of aponeurotic disruption and a running-related mechanism of injury resulted in longer return to play times for soleus injuries. Only clinical data, not MRI characteristics, were associated with risk of re-injury.

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036 CRITERIA-BASED RETURN TO SPORT DECISION-MAKING FOLLOWING LATERAL ANKLE SPRAIN INJURY: A RELEVANT PART OF THE PREVENTION – PERFORMANCE PARADOX FOR SECONDARY AND TERTIARY INJURY PREVENTION?

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Background Lateral ankle sprain (LAS) injury is one of the most frequently incurred musculoskeletal injuries and shows high recurrence rates in individuals participating in sports. This increased re-injury risk is hypothesised to be mainly caused by the persistence of sensorimotor impairments and premature return to sport (RTS) clearance. Therefore, it is indicated to develop and implement evidence-based criteria to guide RTS decisions for LAS patients in order to minimize re-injury risk and maximise performance.

Objective To identify prospective studies that used a criteria-based RTS decision-making process for LAS patients.

Design Systematic review.

Setting Secondary and tertiary injury prevention.

Patients LAS patients.

Main Outcome Measurements Studies were included if they prospectively applied a criteria-based RTS decision-making process for LAS patients.

Results No relevant studies could be identified. However, we retrieved 47 relevant questionnaires, as well as 45 clinical and functional assessments commonly used in studies during the search process.

Conclusions There are currently no published evidence-based criteria to inform RTS decisions for LAS patients. It seems that RTS decisions following LAS injury are still generally time-based. We propose seven variable categories that could be used to develop a criteria-based RTS decision paradigm. These categories were generated in accordance with our results (i.e. questionnaires and tests) and the latest scientific insights. In summary, RTS decisions should acknowledge both preventive and performance criteria. Finding the right balance between these two divergent purposes within the rehabilitation process, is essential in order to minimize the athlete's re-injury risk and maximise performance. It is thus of paramount importance that all relevant stakeholders (e.g. athlete, medical staff, coaching, staff) take part in the RTS decision-making process. Future research should aim to reach consensus on these variables and apply them to actual RTS decisions within prospective study designs to evaluate re-injury risk and successful return to performance.

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037 HEAVY SHOULDER STRENGTHENING EXERCISES IN PATIENTS WITH HYPERMOBILITY AND LONG-LASTING SHOULDER SYMPTOMS: A FEASIBILITY STUDY

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Background Patients with hypermobility spectrum disorder (HSD) are in great risk of experiencing shoulder symptoms, but evidence for exercise as treatment is sparse.

Objective To evaluate the feasibility of heavy shoulder strengthening exercise in patients with HSD and long-lasting shoulder symptoms.

Design Feasibility study.

Setting Primary care.

Patients (or Participants) Twelve patients (39.3±13.9 years) with HSD and shoulder instability and/or pain >3 months.

Interventions (or Assessment of Risk Factors) 16-week progressive heavy shoulder strengthening programme 3 times/week using exercises targeting scapular and rotator cuff muscles.

Main Outcome Measurements Pre-defined progression criteria included recruitment rate (acceptable: 6 patients/month), test duration (acceptable: <120 min), patient retention (acceptable: >80% complete intervention), training adherence (acceptable: >75% adhere to >36 training sessions), adverse events (acceptable: minor events with no patients discontinuing the study), besides patient and physiotherapist feedback. Treatment outcomes were assessed using patient-reported health parameters, such as the Western Ontario Shoulder Instability Index (WOSI (0–2100, better to worse)), outcomes on pain, fatigue and kinesiophobia, besides isometric shoulder strength and clinical tests (shoulder instability, hypermobility and proprioception).

Results Recruitment rate was 5.6/month, assessment duration (mean±SD) 105±9 min, retention 100%, adherence 83%, and four patients experienced short-lasting soreness/pain. Patient feedback was positive, and physiotherapists found the intervention relevant and applicable to the patient-group. WOSI total score improved by 51% (mean±SD, points: baseline 1037 ±215; follow-up 509±365; mean change (95% CI), 528 (318; 738)), and patients reported reduced pain, fatigue and kinesiophobia. Shoulder strength measurements improved by 28–31% (mean change (95% CI), Nm/kg: scaption 0.51 (0.23; 0.78); internal rotation 1.32 (0.70; 1.95); and external