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Sprinting: a key piece of the hamstring injury risk management puzzle

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Improvements in hamstring injury risk management strategies are necessary, especially in sports requiring “sprinting” (i.e., maximal acceleration and/or velocity). Sprinting represents about two-thirds of hamstring injury mechanisms.^[1] Several sprinting-related parameters are associated with hamstring injury.^[2–5] Thus, this editorial aims to 1) emphasize the importance of sprinting and 2) provide general principles for practical implementation of sprinting interventions as a component of hamstring injury risk management in primary and secondary prevention.

Why should we consider sprinting as a piece of the hamstring injury risk management puzzle?

First, as an injury mechanism,^[1] sprinting represents one parameter on which we can act to reduce hamstring injury risk. Sprinting kinematics such as greater anterior pelvic tilt and thoracic side bending during swing phase^[4] and kinetics such as lower horizontal force production capacity during sprint acceleration^[5] are associated with higher hamstring injury risk.

Second, optimal exposure to maximal or near-maximal running velocity is suggested as a protective factor.^[3] Since an acute and rapid increase in sprinting volume is associated with markedly increased hamstring injury risk,^[2] a lack of regular preparatory sprint training may induce a higher risk of sprint-related injuries.^[6] Simply put, the hamstring muscles need to be prepared to safely provide the “function” it is to perform, and sub-

optimal adaptation to biomechanical strain presents a higher risk for damage. At high velocity (>7m/s or >26km/h), a 30% increase in running velocity leads to a ~100% increase in hamstring muscle requirements.^[7] We suggest that athletes mostly or only exposed to high but not maximal running velocity (i.e. ≤90% of maximal velocity) often have not exposed their hamstring muscles to the sprinting-specific mechanical requirements needed for adequate preparation and prevention.^[7]

How to implement sprinting within a hamstring injury risk management approach?

Sprinting should be considered a key component of a comprehensive, multifactorial (i.e., physical and psychological), individualised hamstring injury risk management approach contextualized to each sport. Within this global approach, the complex and unique sprinting movement biomechanics (e.g., leg interaction, elastic energy transfer, reflexes, kinematics, kinetics, lumbo-pelvic control) should be the focus of the preparation and prevention in sports requiring high running velocities.

We suggest that sprinting implementation should follow a loop including 1) evaluation, 2) intervention/preparation based on the evaluation, and repeat of step 1 by re-evaluation and progression (figure 1).

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Sprinting implementation for hamstring injury risk management

Evaluation / Re-Evaluation

- Sprinting ‘structures’: lower extremity range of motion, mobility, strength, and stability
- Sprinting kinematics: thigh angular movement, pelvic tilt, trunk incline^[3,6]
- Sprinting kinetics: horizontal force production capacity during sprinting using field tools (e.g., radar, laser, photocells, Global Positioning Systems or high-speed videos if available)^[4,5]
- Sprinting exposure: consider Global Positioning System to quantify the weekly distance of high-velocity running (i.e., <90% individual maximal velocity) and monitoring/regulating week after week^[1,2]



Intervention

- Individualized
- Prepare the structure to sprinting:
 - ↳ constraints (sprinting technique, pelvic kinematic)
 - ↗ function (sprinting exposure, hamstring strengthening)
- Progressivity
- Variation: normal, heavy sled or downhill running
- Regularity: no break >7-10 days
- Periodization: 48h recovery between sprinting sessions

Figure 1: Proposed guidelines for implementation of sprinting interventions for hamstring injury risk management in primary and secondary prevention.

Evaluation/Re-evaluation

Evaluation of the sprinting ‘structures’, kinetics,^[5] kinematics,^[4,8] and/or exposure,^[2,3] can be done according to the time and level of athlete. For example, Lahti et al.^[9] has proposed an on-field evaluation procedure with two assessments over the football season of four musculoskeletal categories: posterior chain strength, range of motion, lumbopelvic control, and sprint mechanics. Such evaluations allow individualising the sprinting intervention/preparation by tailoring to the athlete’s specific individual capabilities and deficiencies.^[6,9]

Intervention/Preparation

Finding the appropriate balance for each individual athlete and avoiding under- and over-exposure to sprinting is critical.^[3] We suggest first targeting the sprinting pattern before considering sprinting ‘load’ by preparing the system to sustain the sprinting constraints: “form first, load second”. Then, a progressive increase in the volume, intensity and exposure to sprinting is suggested, tending towards regular, micro-dosed sprinting (>90% of maximal velocity) at least once a week without ignoring the sprinting pattern.^[6] Regularity in sprinting practice is critical, ensuring a season-long exposure with no substantial interruption of more than 7 or 10 days and periodization of training including at least 48 hours of

recovery between sprinting sessions.^[6] Variation in force and velocity of sprinting can be promoted by using heavy sled or downhill running. Examples of programmes have been proposed to improve sprinting kinematics^[8] or sprinting kinetics,^[9] or to introduce sprinting as a preventive strategy in male football players.^[10]

Finally, we think that such a sprint-oriented hamstring risk management strategy can potentially reduce injuries while also improving sprint performance. This win-win performance-prevention strategy could have a higher impact on athletes and coaches’ buy-in, leading to easier implementation and higher adherence.

Sprint regularly to reduce hamstring injuries: use it or lose it!

Sprinting is an irreplaceable measure for hamstring injury risk management and should be integrated through a multifactorial approach (box 1). Such an approach using sprinting can be viewed by athletes and coaches as a gradual mitigation process given the regular, progressively increased exposure to the risk factor - sprinting - to build up ‘immunity’ for sprint-related hamstring injury. Sprinting should not only be considered as a part of the problem but also, and more importantly, as a part of the solution.

“SPRINT” to reduce the risk of hamstring injuries:

- **S**print! prepare/train the athlete to run/sprint at maximal velocity, individually through a loop of evaluation and intervention/preparation, with progressivity (e.g., “form first, load second”), diversity/variation, regularity and periodization/recovery, including preparation of the structure/system to sustain the sprinting constraints, drills and technical skills, and regular exposure to maximal sprints;
- **P**lurifactorial and plurimodal individualized approach, including physical, psychological and contextual/sociological approaches, including healthy and safe lifestyle, taking into account the context and the facilitators and barriers for intervention implementation, and with education of the athletes and stakeholders around them;
- **R**epair/rehabilitate all injuries, with a sprint-oriented strategy, from early stages and until maximal capabilities are recovered and return to sport is permitted, and continue to monitor that there is no sequel deficiency;
- **I**ncrease capacities of tissues by strengthening, stretching, and training sensorimotor control, going from isolated/non-functional to functional exercises;
- **N**ote/pay attention to pain and/or fatigue and take care of it properly, improve athletes’ ability to listen to their bodies, know their capabilities and limits, and learn warning signals to better self-efficacy in their daily practice;
- **T**rain smartly, individually adapt and monitor the load, increase volume and intensity progressively.

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