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***Title of article:***

Damaging nature of DECELERATIONS: do we adequately prepare players?

***Authors and Institutions:***

Damian J Harper<sup>1,2</sup>

John Kiely<sup>2</sup>

<sup>1</sup> *School of Sport, York St John University, York, UK.*

<sup>2</sup> *Institute of Coaching and Performance, School of Sport and Wellbeing, University of Central Lancashire, Preston, UK.*

***Contact Details for Corresponding Author:***

***Name:*** Damian Harper

***Mail Address:*** School of Sport, York St John University, Lord Mayor's Walk, York, North Yorkshire, YO31 7EX, UK

***Telephone Number:*** 01904 876438

***Email Address:*** d.harper@yorks.j.ac.uk

***Twitter:*** Follow Damian Harper @DHMov and JohnKiely @simplysportssci

***Contributors:*** DH and JK both contributed equally to the planning and development of this editorial. DH was responsible for writing the editorial with JK making revisions.

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Damaging nature of DECELERATIONS: do we adequately prepare players?

## **AN EVOLVING UNDERSTANDING OF MATCH DEMANDS**

Frequent and intense accelerations and decelerations are crucial elements of match play.<sup>[1-4]</sup>

Both accelerations and decelerations expose players to high levels of mechanical stress, are recognized as key contributors to overall biomechanical load,<sup>[5]</sup> and may exert a significant impact on performance potential (e.g., ability to sustain high force output and attenuation).

Consequently, accelerations and decelerations are recognized as important variables to monitor.<sup>[6]</sup>

The use of newly available motion tracking technologies has permitted a more comprehensive characterisation of the external loads associated with whole-body biomechanical loading.<sup>[6]</sup>

This information can, in turn, be used to inform and refine training prescription and management processes. Although evidence suggests that the mechanical stressors imposed during accelerating and decelerating activities are fundamentally different,<sup>[6]</sup> current recommendations for optimal load monitoring seemingly treat the consequences of these loads — in terms of potential tissue damage and subsequent adaptations — as equivalent.<sup>[5]</sup>

Evolving an optimally perceptive load monitoring paradigm, however, demands that if different loading activities impose differentially and disproportionately damaging consequences, we should identify the external loads posing the most significant threats to both performance and injury risk, and weight them accordingly.<sup>[7]</sup>

## **THE DISTINCT DEMANDS OF ACCELERATION AND DECELERATION**

Recent match analysis data obtained from GPS and tri-axial accelerometers highlight two core distinctions between accelerations and decelerations. Firstly, when examining the comparative frequencies of accelerations and decelerations it is clear that more accelerations occur within low to moderate intensity ranges than similarly intense decelerations<sup>[4]</sup>. Beyond, high-intensity thresholds however, decelerations evidently occur more frequently than

equivalently intense accelerations. In soccer, for example, high intensity decelerations are up to 2.9 times more frequent than high intensity accelerations.<sup>[3]</sup> Presumably, this discrepancy is a feature of competitive match play, such that accelerations to higher running velocities may frequently occur gradually, without crossing a defined high-intensity threshold. Whereas, in contrast, a larger proportion of decelerations are suddenly imposed, thereby enforcing rapid velocity reductions within constrained time-frames and spaces.

Secondly, when compared to more ‘concentrically-dependent’ accelerations, the sudden braking activity implicit in severe decelerations demands intense eccentric and quasi-isometric contractions. These contraction modes are capable of generating higher muscular tensions than concentric actions. Nevertheless, presumably as a consequence of the elevated mechanical loads experienced during decelerations, the fatigue and cumulative tissue micro-trauma imposed following deceleration activities is greater than that following similarly intense accelerations.<sup>[1-3]</sup> Consequently, the load per meter experienced during decelerations is up to 65% greater (effect size = 2, very large) than any other match play activities, and approximately 37% more than when accelerating.<sup>[4]</sup>

## **DECELERATION SPECIFIC LOAD: COULD THIS BE A CRITICAL MEDIATOR?**

A recent BJSM editorial called for exploration of the *mediators* driving load related injuries, and more training-specific data informing injury resilience protocols.<sup>[8]</sup> In responding to this call, we propose that the mechanical stressors, implicit in deceleration activities, are critical *mediators* serving as potent drivers of both neuromuscular fatigue and tissue damage.

Increasing fatigue and accumulative tissue micro-trauma, subsequently, both act to further diminish the coordinative capacities underpinning an ability to skilfully dissipate braking loads. Consequently, increasing volume or intensity of deceleration activity contributes to a

vicious cycle of ever-increasing fatigue, diminishing coordinative proficiency and subsequent risk of accumulating tissue damage (figure 1).

< INSERT FIGURE 1 AROUND HERE >

## **INCREASING PLAYER RESILIENCE TO DECELERATIVE LOAD: SHOULD THIS BE A PRIORITY?**

Specifically in relation to the enhancement of deceleration abilities, few validated training recommendations currently exist. In prompting future discussion, we suggest priority should be given to:

1. ***Measurement and management of decelerative loads*** — Deceleration volumes and intensities, for example, are sensitive indicators of tissue loading,<sup>[6]</sup> the extent of tissue damage<sup>[2,3]</sup> and subsequent injury risk.<sup>[1]</sup> As such, careful consideration should be given to the selection of quantifiable variables and methodological procedures through which deceleration loads can be measured and managed. For example, more informative insights may be obtained by quantifying the deceleration impulse per foot strike (mass x deceleration) using newly available metrics, such as force load.<sup>[6]</sup>
2. ***Monitoring progressive exposure to decelerations*** — The basic training principle of gradual progressive overload suggests that optimal match play preparation should include incrementally progressive exposure to deceleration loadings.<sup>[1]</sup> Such accurate training prescription logically demands regular, and sensitive monitoring of deceleration-induced load, and subsequently imposed decrements. A decline in eccentric force, measured during a simple countermovement jump using force plates, for example, has been proposed as an insightful indicator of deceleration-induced fatigue.<sup>[3]</sup>
3. ***Selection of loading strategies enhancing deceleration capacity*** — Clearly, empirically informed training strategies focussed on increasing player resilience to the negative

consequences of repeated decelerations, is urgently required. We tentatively suggest that resilience to deceleration activity can be augmented via: (a) increasing the load-bearing capacities of lower-limb tissues, and (b) nurturing the coordinative skill of deceleration by exposing players to challenges enhancing more sensitive and accurate calibration of the muscular co-contraction patterns, and limb positioning strategies, essential to proficient deceleration activity (figure 1).

In closing: training-specific research, and training practice in general, has historically focussed primarily on enhancing acceleration and high-velocity running capacities. While such efforts are undoubtedly important, the future evolution of match-play preparation philosophy also requires that we develop training techniques focussed on enhancing deceleration-handling capacities; in tandem with aligned monitoring strategies enabling us to better discern and quantify the specific mechanical stressors driving deceleration-imposed deficits. Finally, these insights may hold especial relevance for those tasked with the management, delivery and monitoring of training interventions designed to enhance injury resilience and reduce injury risk.

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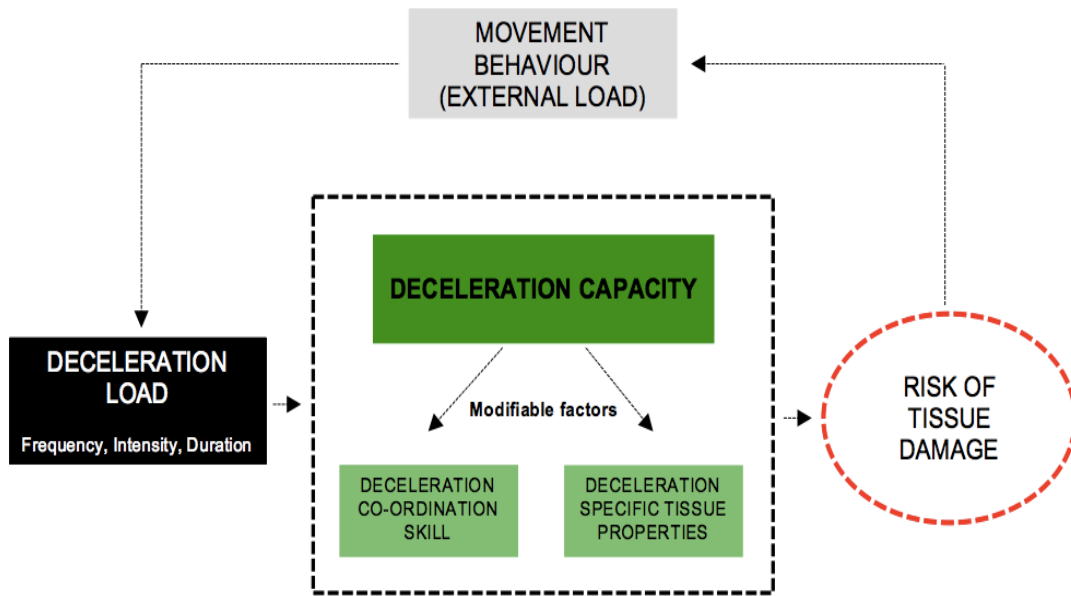


Figure 1. Deceleration capacity represented as a *critical mediator* moderating the performers risk of tissue damage