

Infographic. Progressing rehabilitation after injury: consider the 'control-chaos continuum'

Matt Taberner ¹, Tom Allen, ² Daniel Dylan Cohen ³

Return to sport (RTS) is a dynamic process, during which practitioners must balance the risk that early reintegration to training/match-play increases reinjury risk with the benefit to the team of having key

players available.¹ Medical and performance staff must work together to formulate a plan considering the individual, the specifics of the injury, tissue healing time and potential risk factors for reinjury.

A key element of this plan is the management and prescription of external running loads using global positioning systems (GPS) to return players to previous levels of chronic load prior to injury, relatively quickly and safely.^{2,3} Alongside the quantitative elements of load, practitioners should also consider the qualitative nature of movement in competition that is, highly variable, spontaneous and unanticipated movements ('chaos'), reflecting the unpredictable nature of sport. During the early stages of rehabilitation, however, control should be maintained using appropriate constraints to control movement variability. By balancing control parameters and dynamic movement, the practitioner can influence physical performance outcomes by implementing appropriate task and environmental constraints throughout the RTS process.⁴ We therefore suggest a framework designed to provide a base for the practitioner to use progressing from high control to high chaos, interlinking GPS metrics while incorporating greater perceptual and reactive neurocognitive challenges to simulate competition demands.⁵

The 'control-chaos continuum' is embodied by five key phases which can be adapted to both long-term and short-term injuries using condensed or extended phases—particularly as progression is criteria based, not time dependent. These five key phases are as follows.

1. High control: return to running, with high control over running speeds/loads and low musculoskeletal impact forces, building player confidence.
2. Moderate control: introduce change of direction with the ball, reduce control (somewhat controlled chaos) and progress high-speed running (HSR) load.
3. Control > chaos: introduce sport-specific weekly structure to overload game-specific demands reflecting a transition from control to chaos (inclusion of movements with unpredicted actions, within limits).
4. Increase HSR under moderate chaos (unpredicted movements, minimal limitations), with the addition of pass and move and specific pattern of play drills.

REHABILITATION

considering the 'control-chaos continuum'

Reference: Taberner et al. BJSM 2019 Designed by @YLMsportScience

1 High control

- Gradual increase in the volume of running at lower speeds,
- Limited high-speed running exposure (<60% max speed),
- Minimised high acceleration/deceleration magnitudes,
- Minimised sport-specific tasks (with a ball)

2 Moderate control

- Increase in explosive distance,
- Increased linear high-speed running (70% max speed)
- Increase in change-of-direction activities with and without the ball to increase movement variability

3 Control to chaos

Extensive Football

Larger areas to produce higher speed and distance

Running at higher speeds (>65%–80% max speed) using aerobic power interval runs to target the required energy systems

Intensive Football

Acceleration, deceleration and change-of-direction components in restricted areas

More reactive passing and movement, as well as progressive, positional-specific acceleration/deceleration to replicate explosive movements

4 Moderate chaos

Extensive Football

High-speed running loads increase further under both control and chaotic conditions

- High-speed running (>75% max speed) including subtle directional changes,
- Progressive increments in sprint distance based on the player's relative match demands,
- Minimise 'spikes' — large/acute increments in load

Intensive Football

Pass & move drills of increasing specificity alongside pattern of play drills to address technical skill progression

5 High chaos

- Technical considerations: passing/ crossing and shooting; from short/mid/long range while jumping/ heading and tackling; graded in intensity as static/movement/in-context
- Volume of technical actions progressively increased, player & injury specific
- Positional specific speed/speed-endurance drills

Return to Sport

5. Return the player to preinjury weekly training demands and include drills designed to test worst-case scenarios (high speed/high chaos).

While we have found this framework helpful in football, we hope it may add value to practitioners working across other sports including rugby, basketball, Australian rules football, hockey and American football.

¹Performance Department, Everton Football Club, Liverpool, UK

²Arsenal Performance and Research Team, Arsenal Football Club, London, UK

³Faculty of Health Sciences, University of Santander, Bucaramanga, Colombia

Correspondence to Matt Taberner, Performance Department, Everton Football Club, Liverpool, UK; matt.taberner@evertonfc.com

Collaborators Yann Le Meur.

Contributors YLM contributed to the design and layout of the infographic.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.



OPEN ACCESS

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.



To cite Taberner M, Allen T, Cohen DD. *Br J Sports Med* 2020;**54**:116–117.

Accepted 31 May 2019

Published Online First 21 June 2019

Br J Sports Med 2020;**54**:116–117.
doi:10.1136/bjsports-2019-100936

ORCID iD

Matt Taberner <http://orcid.org/0000-0003-3465-833X>

REFERENCES

- van der Horst N, Backx F, Goedhart EA, *et al*. Return to play after hamstring injuries in football (soccer): a worldwide Delphi procedure regarding definition, medical criteria and decision-making. *Br J Sports Med* 2017;**51**:1583–91.
- Blanch P, Gabbett TJ. Has the athlete trained enough to return to play safely? The acute:chronic workload ratio permits clinicians to quantify a player's risk of subsequent injury. *Br J Sports Med* 2016;**50**:471–5.
- Cummins C, Orr R, O'Connor H, *et al*. Global positioning systems (GPS) and microtechnology sensors in team sports: a systematic review. *Sports Med* 2013;**43**:1025–42.
- Handford C, Davids K, Bennett S, *et al*. Skill acquisition in sport: some applications of an evolving practice ecology. *J Sports Sci* 1997;**15**:621–40.
- Grooms DR, Myer GD. Upgraded hardware—What about the software? brain updates for return to play following ACL reconstruction. *Br J Sports Med* 2017;**51**:418–9.