MATT TABERNER, DSportExSci, CSCS, RSCC*D, BASES HPSA[1] • TOM ALLEN, MSc, CSCS[3,4]
JASON O'KEEFE, MPhil[2] • MEREDITH CHAPUT, PhD, PT[5] • DUSTIN GROOMS, PhD, ATC[6,7,8] • DANIEL DYLAN COHEN, PhD[9]

Evolving the Control-Chaos Continuum: Part 2—Shifting "Attention" to Progress On-Pitch Rehabilitation

In part 1, we explored the foundational knowledge behind the revised *control-chaos continuum* (*CCC*), emphasizing the importance of practice design and physical-cognitive interactions to improve the planning, delivery, and progression of on-pitch rehabilitation.[38] In part 2, we integrate these updates into the original model, guiding practitioners through the *CCC*'s phases, including how to adapt *High Chaos* to facilitate the transition to full team training and return to competition.

BACKGROUND: On-pitch rehabilitation is key to supporting return to sport in elite soccer (football). The *control-chaos continuum* (*CCC*) guides practitioners through the sport-specific components of return to sport. There is a need to update the framework with recent research in injury neurophysiology, soccer performance, and coaching science.

CLINICAL QUESTION: How do practitioners integrate the insights from injury neurophysiology, soccer performance, and coaching science discussed in part 1 of this 2-part series into an updated version of the *CCC*, to enhance the planning and execution of on-pitch rehabilitation for elite soccer players?

KEY RESULTS: The revised *CCC* framework emphasizes the design and delivery of progressive training in increasingly *chaotic* conditions. The updated framework supports practitioners to incorporate elements of visual-cognitive challenges, attentional challenges, decision making, and progression representation of the game model when players are preparing to return to sport.

CLINICAL APPLICATION: The updated *CCC* outlines training progression from *High Control*, which involves returning to on-pitch linear running, to *High Chaos*, which simulates the team environment at game speed. The *High Chaos* phase can be tailored to support players during their reintegration into team training. The model is adaptable for both short- and long-term injuries, integrating physical-cognitive load monitoring and strength and power diagnostics to enhance decision making throughout return to sport. *J Orthop Sports Phys Ther 2025;55(3):1-11. Epub 17 January 2025. doi:10.2519/jospt.2025.13159*

KEY WORDS: *control-chaos continuum, elite soccer, injury, rehabilitation, return to sport*

EVOLVING THE CCC

The updated *CCC* emphasizes effective practice design to facilitate progressive training for the injured player (**FIGURE 1**).[36,38] Our revised model integrates progressive visual-cognitive dual-task challenges established in the *Visual-Cognitive CCC* (*VC-CCC*) framework[8] with decision-making elements, while incorporating components of the game model under increasingly *chaotic* conditions.[38] The goal is to align the session and drill objectives to what the player experiences during competition.[14] Key task constraints, including the size of the pitch areas and the availability of coaches, players, and support staff, are now integrated into the updated model and tailored to address the specific needs of the injury case and the club context (**FIGURE 1**).

We recommend that practitioners involve coaches as early as in the *Moderate Control* phase, incorporating targeted drills that maintain player attributes related to their specific roles in the game model. *Moderate Control* also begins integrating visual-cognitive challenges using the *VC-CCC*, with practitioners given the autonomy to blend visually mediated dual-task challenges on a drill-specific level (**FIGURE 1**).[8]

We account for injury-specific and phase progression criteria. However, due to the dynamic nature of elite soccer and the need to balance risk and reward,[20] players may return to competition even if they have not met all progression criteria.[39] We advise practitioners to tailor the *CCC* to meet the specific needs of each injury case by adjusting (ie, duration

[1]Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, UK. [2]Arsenal Performance and Research Team, Arsenal Football Club, London, UK. [3]Institute of Coaching and Performance, University of Central Lancashire, Preston, UK. [4]School of Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, UK. [5]Cognition, Neuroplasticity, & Sarcopenia Lab, University of Central Florida, Orlando, FL. [6]Ohio Musculoskeletal & Neurological Institute (OMNI), Ohio University, Athens, OH. [7]Department of Athletic Training, College of Health Sciences and Professions, Ohio University, Athens, OH. [8]Department of Physical Therapy, College of Health Sciences and Professions, Ohio University, Athens, OH. [9]University of Limerick, Limerick, Ireland. ORCID: Taberner, 0000-0003-3465-833X. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article. Address correspondence to Matt Taberner. E-mail: matthewtaberner@btinternet.com

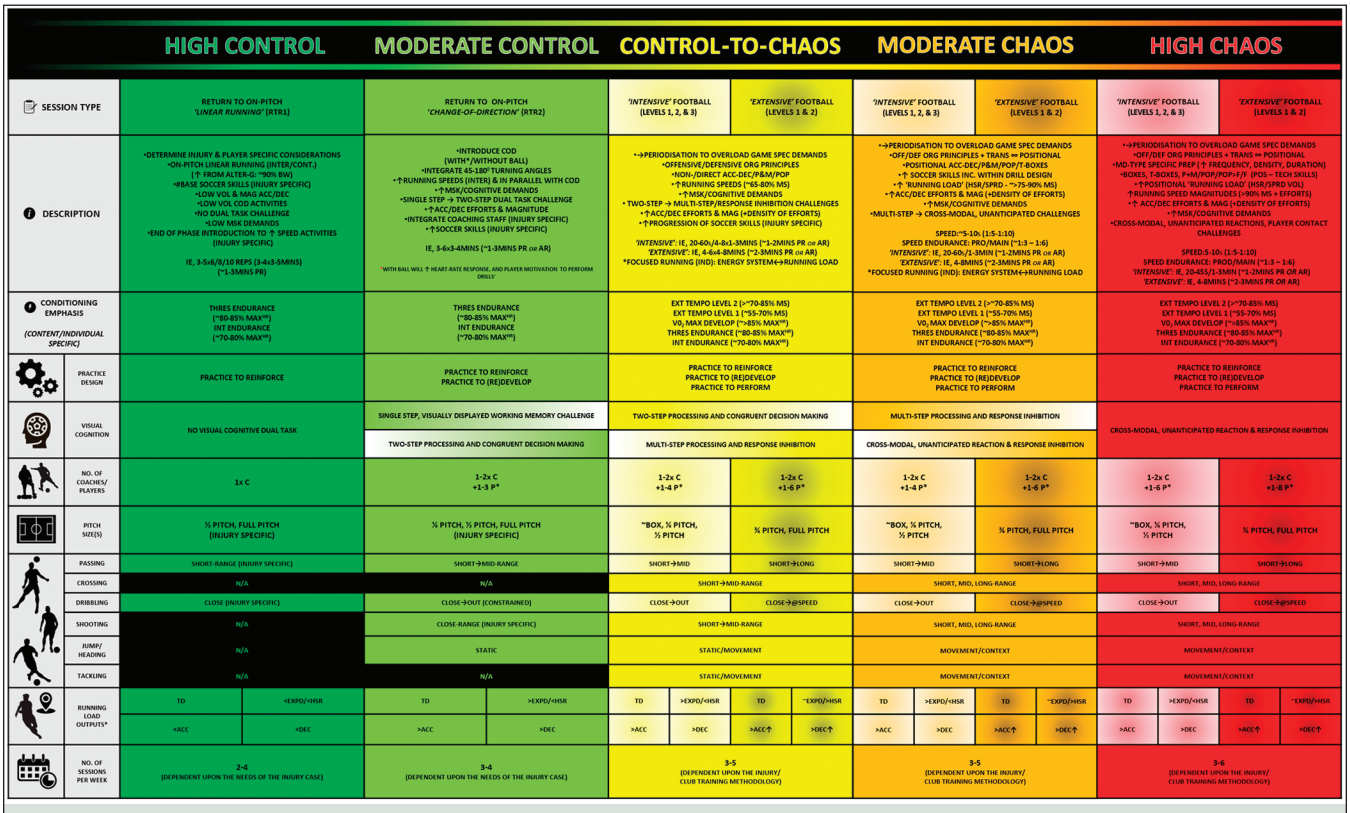

FIGURE 1. On-pitch rehabilitation framework—*control-chaos continuum*. The framework should be adjusted according to the specific injury, estimated healing time frames, and expected return to team training. Abbreviations: ↑, increase; →, progress to; #, maintain; ∞, linked to, ie, defensive into attacking transition; +, addition of; ACC, accelerations; ACC↑, acceleration magnitude; AR, active recovery; BW, body weight; C, coach(es); COD, change of direction; count, continuous; DEC, decelerations; DEC↑, deceleration magnitude; DEF, defensive; develop, development; EXP-D, explosive distance; Ext, extensive; F, finishing; focused running, complementary conditioning without the ball; HSR, high-speed running; INC., including; IND, individual; Int, intensive; inter, intermittent; MAG, magnitude; MAX^{HR}, maximal heart rate; min(s), minute(s); MS, maximal speed; MSK, musculoskeletal; non-/direct, nondirectional and directional drill application; OFF, offensive; ORG, organizational; P, player(s); P&M, pass and move; POP, pattern of play; POP>F, pattern of play to finish; PR, passive recovery; RTR1, return to running level 1; RTR2, return to running level 2; S, seconds; SPEC, specific; SPRD, sprint distance; T-BOXES, transition boxes; TD, total distance; Thres, threshold; TRANS, transitional.

within a phase) or removing phases based on clinical presentation and injury severity. For example, a center forward with a biceps femoris long head injury classified as grade 1a (British Athletics Muscle Injury Classification) may only require 1 or 2 training sessions within each of the *High Control* and *Moderate Control* phases before transitioning to the *High Chaos* phase. Before returning to full training, the objective for the player would be to meet injury-specific loading requirements under representative situations (eg, high-speed counterattack before the player sets up for a shot at a goal while under pressure from a defender). The *High Chaos* phase of the *CCC* can be adjusted to offer a more ecologically valid training stimulus through both partial and full team interactions (**FIGURE 2**).[35] Implementing this approach may be challenging depending on the coaching team's perspective on how injured players reintegrate with their team.[20,39]

INTEGRATED APPROACH TO MONITORING PHYSICAL-COGNITIVE LOAD, PLAYER LOAD-RESPONSE, AND TRAINING PROGRESSION

In part 1, we recommended the use of a simplified NASA Task Load Index to monitor physical-cognitive interactions.[11,38] For comprehensive monitoring, we recommend that practitioners also track running load outputs, cardiovascular responses, and load-response data to inform progression and regression decisions.[32,36,45] Running load outputs reflect the impact of the training prescription, and practitioners should monitor variables that align with the club's training methodology and the imposed running load demands.[39,41,43,44]

Running load outputs also offer feedback on planned session content as well as quantifying training progression from session to session, week after week, and over defined periods (ie, a 10-day set or rolling period per the club's monitoring approach). Load-response data obtained from strength and power (S&P) diagnostics provide tissue-specific and global

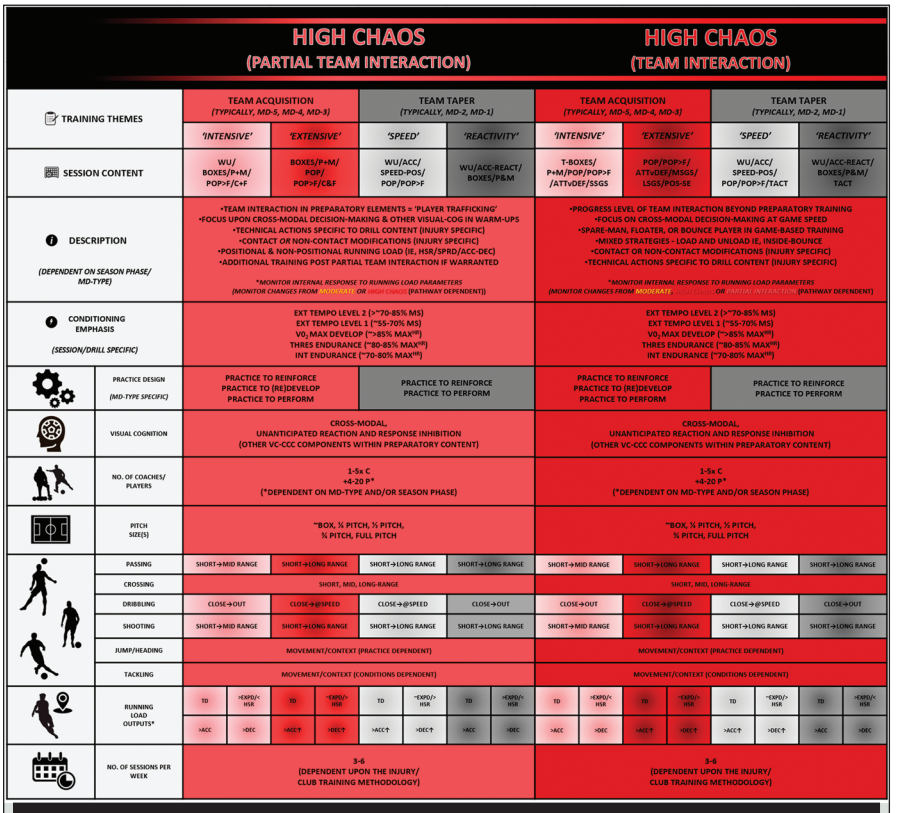

FIGURE 2. Subphases of the *High Chaos* phase of the *control-chaos continuum* to support progressive reintegration into team training: (1) *High Chaos: Partial Team Interaction* and (2) *High Chaos: Team Interaction*. Subphases should be adjusted to the specific injury, estimated healing time frames, and expected return to full team training. Internal response refers to heart rate responses, ie, time > 85% MAX^{HR}/heart rate exertion/training impulse to loading demands of the training session. Abbreviations: ACC, accelerations; ACC↑, acceleration magnitude; ACC-POS, positional acceleration; ACC-REACT, reactive acceleration; ATT vs DEF, attack versus defense situations; C, coach(es); C&F, crossing and finishing; DEC, decelerations; DEC↑, deceleration magnitude; EXP-D, explosive distance; HSR, high-speed running; LSGs, large-sided games; MAX^{HR}, maximal heart rate; MD, match day; MS, maximal speed; MSGs, medium-sized games; No., number of; P, player(s); P+M, pass and move; POP, pattern of play; POP>F, pattern of play to finish; POS-SE, positional speed-endurance; SPRD, sprint distance; SSGs, small-sided games; TACT, tactical; T-Boxes, transition boxes; Visual-cog, visual-cognitive challenge; VO_2max, maximal oxygen uptake; WU, warm-up.

neuromuscular responses to on- and off-pitch reconditioning.[1,36,40,43–47] Additionally, S&P diagnostics can be used more regularly through strategic placement within micro- and mesocycles to evaluate player status and monitor progress (**FIGURES 3**, **4**, and **5**).[36,44–47] Clinical markers, such as the absence of pain or swelling (rated <2/10 on a numerical scale) and/or joint effusion, also play a vital role in monitoring player response to load as well as assisting in decision making regarding exercise and phase progression or regression, especially in mid- to long-term injury cases.[1,6,40,43,44,46,47]

HIGH CONTROL

Aims

- Practice to reinforce task performance (specific to the individual and their injury)
- Focus on task stability and movement control (*VC-CCC* phase 1)—no visual-cognitive dual-task challenge
- Return to running with *High Control* over tasks
- Limit change-of-direction and soccer-specific skills (injury-specific)
- Build player confidence and training foundation

Practitioners must identify key injury-specific factors (eg, for a hamstring injury), the progression of running intensity (% maximal speed), running intensity volume (sprint distance volume), competition movement representation, and relevant S&P diagnostics (**FIGURES 3** and **5**).[36,40,43–47] This information, combined with player-specific factors (ie, positional demands/role in the game model), development plans (ie, positioning and passing range), estimated healing times, and potential risk factors for reinjury, is critical for planning the on-pitch rehabilitation process. Practice design, along with musculoskeletal (MSK) loading, should emphasize reinforcing task performance while presenting an appropriate level of difficulty challenge.[14]

A key goal of the initial return to on-pitch activity is to gradually increase the volume and intensity of linear running, prescribed through either intermittent or continuous formats, thereby progressively increasing MSK demands. After a hamstring injury, returning to running is crucial for reestablishing normal neuromuscular function.[13] Practitioners should, depending on the severity of the strain, exercise caution when progressing running speeds, as the musculotendinous strain on the hamstring at higher velocities may jeopardize the healing process.[13,31] While low-magnitude accelerations and decelerations occur naturally during intermittent running formats, change-of-direction activities should be limited, particularly for joint-related injuries (eg, knee injuries) during this phase.[9]

Reintroducing low-level, soccer-specific skills (when appropriate) increases player engagement and motivation. These activities may include short-range passing (<10 yards) and close control dribbling, with the practitioner maintaining a level of control (closed skills – blocked practice) over the volume and intensity of actions through appropriate drill design. For instance, following an adductor or quadriceps injury short-range passing may not be suitable at this stage. Skill-related activities can be incorporated into the main session content, such as running with

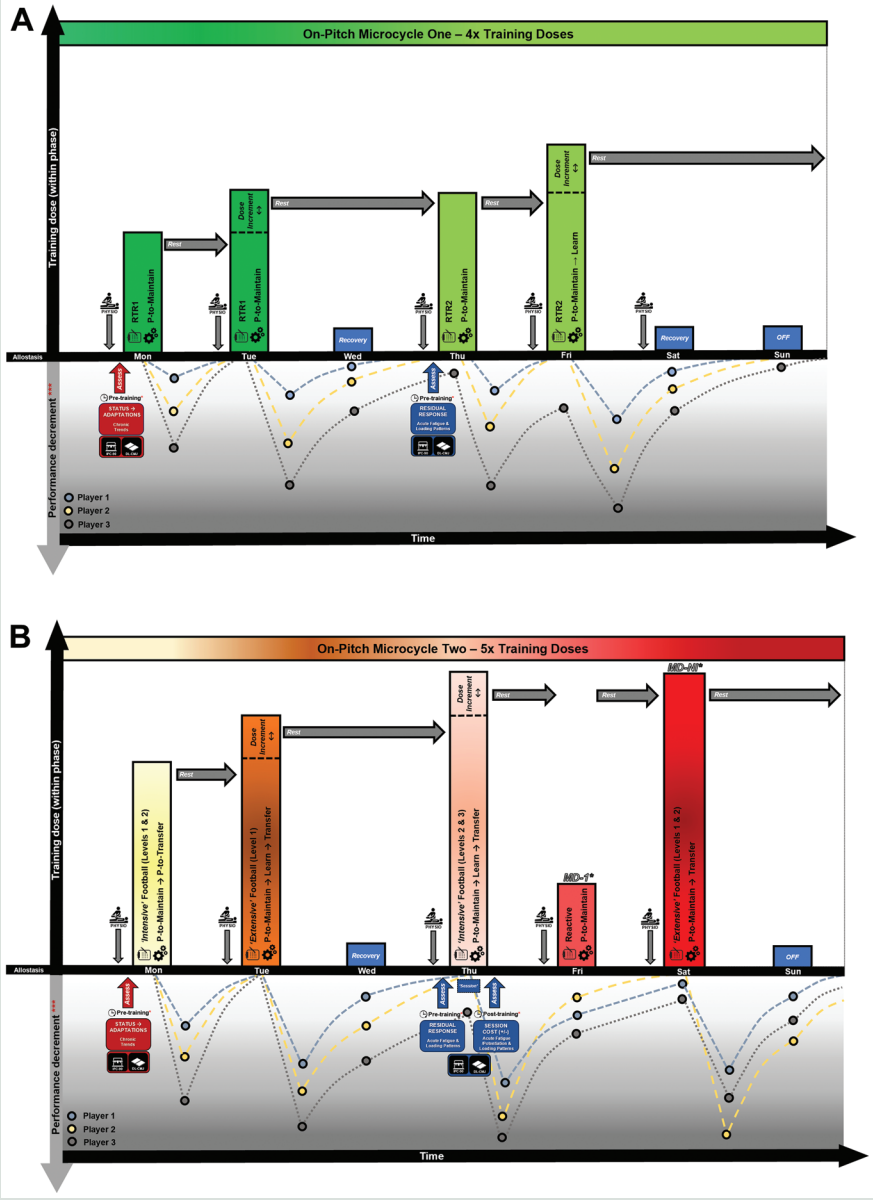

FIGURE 3. Example of a weekly planning template during (A) early on-pitch training (*High Control* and *Moderate Control* phases) and (B) return to soccer-specific periodized training (*Control-to-Chaos* phase onward) blended with partial and full team interaction (*High Chaos* subphases). Physio ↓ indicates daily assessment point prior to activity including subjective feedback, pain and range of motion. The color-coded bars indicate the control-chaos continuum (CCC) phase, daily session themes, and practice design aims/objectives. The color-coded bars indicate a delivered training dose relative to practice design and physical (physiological, mechanical, and metabolic) aims/objectives of the session. The height of the bars represents dose magnitude and is adjusted according to the CCC phase. *** indicates training induced acute performance decrement. A low dose results in a smaller decrement and performance benefit compared with a larger training dose.[25] Each dose perturbs the allostatic state of the player, recognizing individual differences in dose-response (3 player examples are displayed with differing perturbations in response to the training dose).[17] Integrating strength and power diagnostics within the microcycle can assist in quantifying player status and response.[45] These concepts are described in **FIGURE 4**. Abbreviations: DL-CMJ, double-leg countermovement jump; Extensive, extensive football; Intensive, intensive football; IPC-90, isometric posterior chain–90 degrees; Off, off day; Physio, chartered physiotherapist/physical therapist; Recovery, recovery day.

the ball under close control, or included between interval bouts as part of active recovery. The exercise-to-rest ratio and inter-set recovery periods should be adjusted based on the desired energy system stimulus and exercise mode (ie, intermittent) (**FIGURE 1**).

No visual-cognitive dual tasks are incorporated within drill design as the aim is to reinforce task behavior under *controlled* conditions. Tasks should be performed at the player's discretion following practitioner communication over the desired requirements, ie, repetition timing (please refer to **FIGURE 1** in part 1).[8,38] Reinforcing desirable movements/behaviors during task performance is critical for increasing player confidence.[14,42]

MODERATE CONTROL

Aims

- Practice to reinforce and (re)develop (specific to the individual)
- Introduce specific change-of-direction activities (with and without the ball)
- Challenge simultaneous working memory (*VC-CCC* phase 2)
- Manipulate constraints to reduce the level of control within drills (*controlled* chaos)
- Increase the level of soccer-specific skills within drill design (injury-specific)
- Integrate coaching staff to support session delivery

Practice design continues to reinforce task performance with the introduction of specific change-of-direction activities (45°-180°) based on the constraints of the specific injury (**FIGURE 1**).[14,36] Following severe knee injuries (eg, anterior cruciate ligament reconstruction [ACLR] or patellar tendon rupture), progression of turning angles and intensity of turns should be carefully planned based on the desired knee joint loading.[4,12,33] Practice to reinforce may only guide drill design within part of practice rather than the whole session. Part of the session may have a practice-to-(re)develop focus (increasing task difficulty and specificity), which may be delivered in collaboration with or led by a soccer coach. For

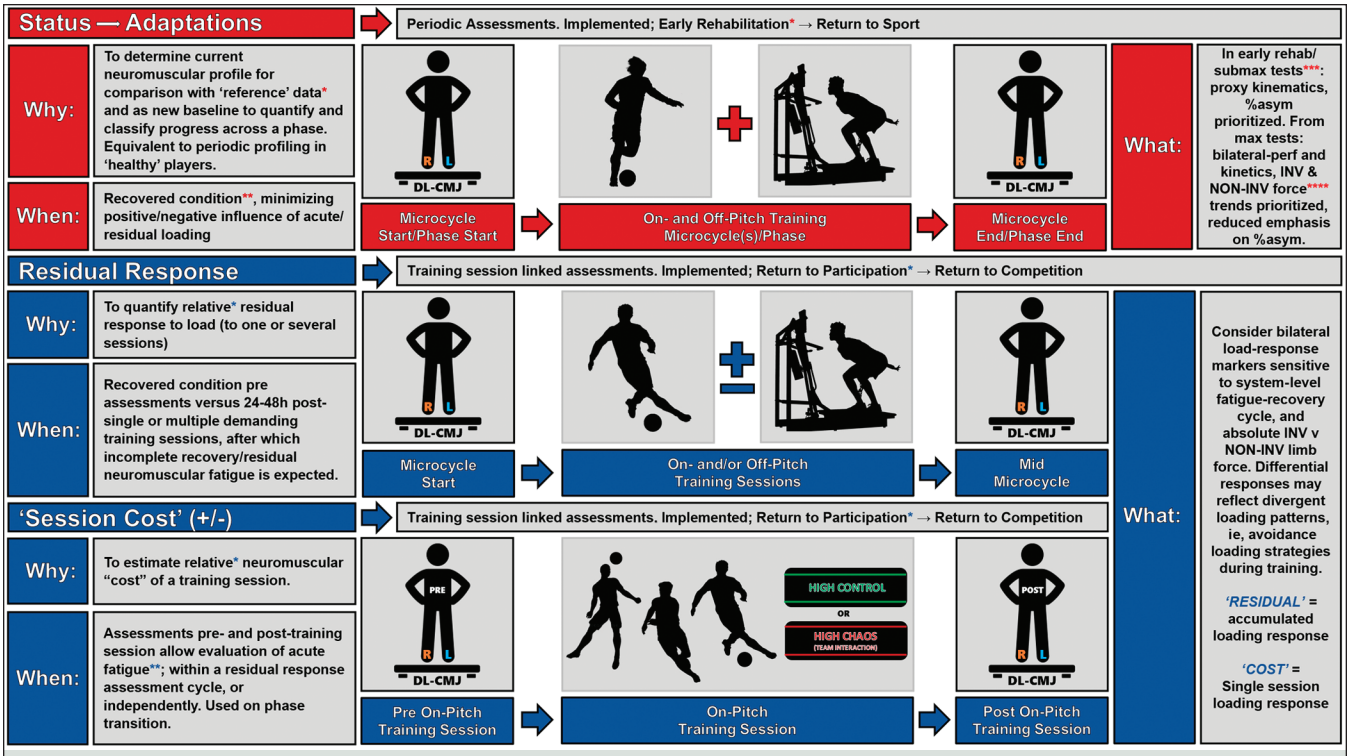

FIGURE 4. Overview of the strategic implementation of strength and power (S&P) diagnostics across the return to sport (RTS) continuum (the double-leg countermovement jump shown as an example). See **FIGURE 5** for other jump and isometric tests used within the RTS continuum. During rehabilitation, S&P diagnostics provide objective data and insights on neuromuscular load-response specific to the injury site, and for mid- to long-term injuries, global neuromuscular adaptations to training.[36,40,43–47] Placement of testing under specific conditions can enhance insights on player status and response, informing training prescription.[45] **Reference data* provide context to status and progress at a given time point. Ideally, preinjury benchmarks are used (bilateral performance, kinetics and 'proxy kinematics', involved and noninvolved limb outputs, and asymmetries). If not available, contralateral limb performance and asymmetries and, potentially, external cohort-specific data are used. In elite players, while asymmetry values from "professional" players are a useful guide,[18] their performance, kinetics and 'proxy kinematics' are not appropriate reference points, due to substantially lower values. ***Recovered conditions* refer to testing under standardized conditions at least 72 hours after intense training. ****Submaximal tests* refer to assessments where, due to pain and/or a lack of confidence, willingness, or capacity, the player may self-limit downward velocity/depth (deemphasize preinjury or externally referenced targets). *****Force metrics* refer to peak, mean, rate of force development, and impulse variables. **Relative* refers to the comparison of the response in involved versus noninvolved and bilateral metrics to a training session with similar demands at a later time point in the rehabilitation or relative to a more demanding training session. ***Acute fatigue*[34] pertains to fatigue estimated as $\chi\text{metric}_{post} - \chi\text{metric}_{pre}$, with posttraining performance equating to the SUM of potentiation (+) – fatigue (–) responses whereby bilateral performance may ↑ and fatigue is not observed. However, involved vs noninvolved limb trends may diverge.

example, a central defender's development plan may involve positioning and passing distribution. A coach may use a mini goal positioned as a false full-back, focusing on positioning to receive a pass before distributing into the channel. Delivery would be initially unopposed, allowing the player to perform the drill at a discretionary tempo with practitioner-player communication. Progression, if appropriate to the injury case, may involve a staff member or player receiving the pass in the target area, increasing attentional difficulty, ie, timing of the pass played into the player's path. The addition of support staff and/or players across session content (if available) increases practice specificity.

Drill content should progress MSK loading demands relevant to the injury, manipulating the volume (number of efforts), intensity of acceleration/deceleration efforts, and level of control (increased or decreased movement variability) by adjusting task constraints.[36] Running intensity (speed) may be progressed in parallel or independently with change-of-direction activities depending on the injury type. Following medial ligament injury, linear running intensity can be progressed more readily than change-of-direction activities, with particular attention to progression of medial cutting (↑intensity, ↑volume, ↑complexity). These components could be progressed intermittently or via the fartlek method while integrating soccer-specific skills such as dribbling from close → out of feet (**FIGURE 1**). This might be achieved in the presence of a practitioner, ie, *controlled* 1v1 situation, constraining speed but increasing movement variability, ie, off-line running and a level of uncertainty. We recommend

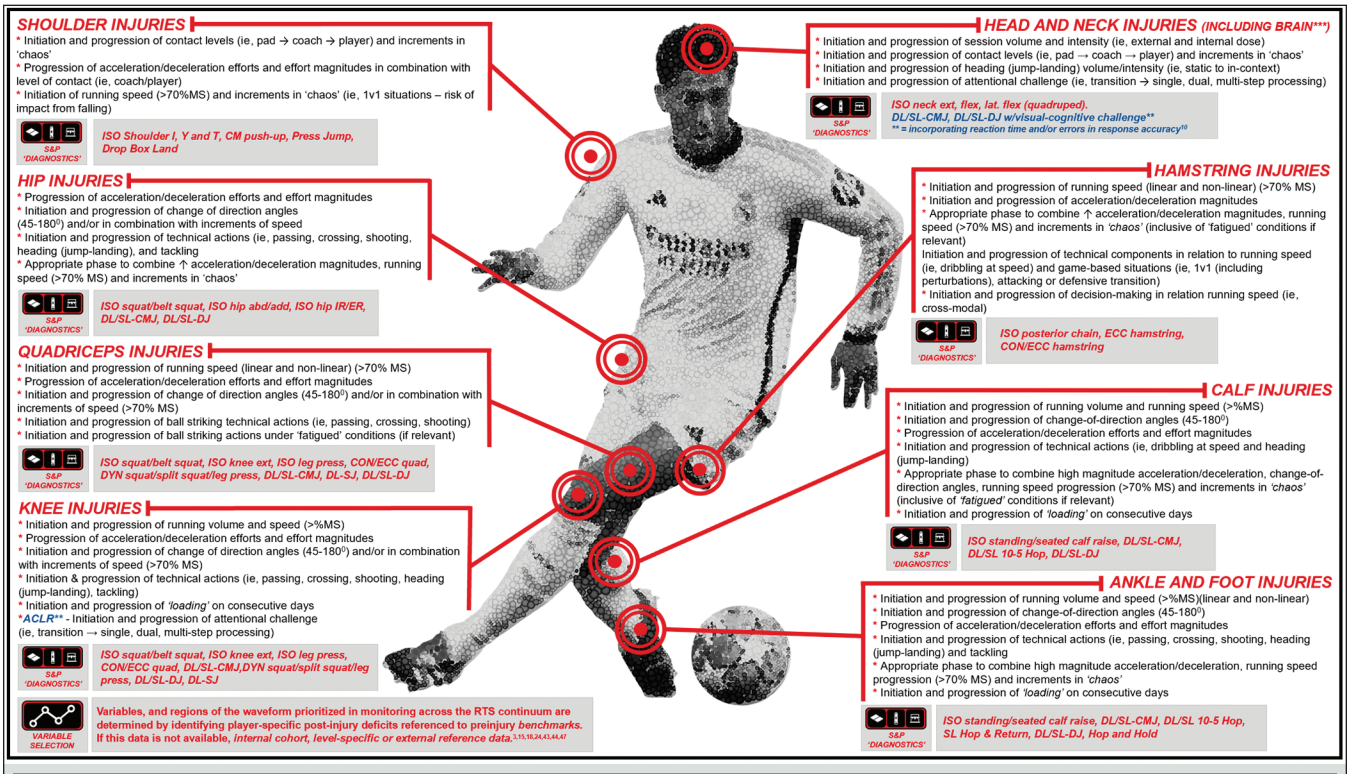

FIGURE 5. Injury-specific planning considerations and associated strength and power (S&P) diagnostics to be used to support decision making throughout the return to sport continuum. For more details on S&P diagnostic assessments and variable selection in profiling and monitoring during rehabilitation, see TABLE 1 in Taberner et al.[45] Brain injuries may include concussion or altered neuroplasticity such as after ligament injury.[10] Abbreviations: abd, abduction; add, adduction; CM, countermovement; CMJ, countermovement jump; CON, concentric; DJ, drop jump; DL, double-leg; DYN, dynamic; ECC, eccentric; ER, external rotation; ext, extension; flex, flexion; IR, internal rotation; ISO, isometric; lat., lateral; quad, quadriceps; SJ, squat jump; SL, single-leg.

that practitioners prescribe appropriate exercise-to-rest ratios in combination with the intended demands, ie, intensity-derived running load to deliver the desired physiological stimulus within drills.

Continuous visual-cognitive dual tasks, creating a mild perceptual-motor challenge through divided attention, should now be integrated into drills (**FIGURE 1** in part 1).[8,38] Introductory drills where soccer-specific skills are reinforced, such as short- to mid-range passing drills, provide ideal opportunities while encouraging visual exploration.[16] For example, a 4-way *pop-off* drill (**FIGURE 1** in part 1)[38] requires a player to react to a color signal (visual scanning) before altering their body position to offload a pass (action) into the appropriate mini goal.[38] Even during mild perceptual-motor challenges, such as the 4-way *pop-off* drill, practitioners should recognize the potential cognitive effects on motor skills, including *perception delays*—hesitation (ie, time lag) in providing movement solutions—which may also promote a higher error rate.[23,29,38]

CONTROL-TO-CHAOS

Aims

- Practice to reinforce, (re)develop, and/or perform (specific to the individual)
- Introduce soccer-specific periodization to overload game-specific demands
- Ensure sessions and drill content reflect a transition from control to chaos (inclusion of limited volume of movements with unanticipated actions)
- Incorporate 2-step problem solving and congruent decision making (*VC-CCC* phase 3)
- Incorporate principles of the game model within drill design

In the *Control-to-Chaos* phase, training specificity increases to (1) introduce practice to mimic difficulties/challenges anticipated during competition, (2) differentiate physiological training focus to overload game-specific running load demands through *intensive* and *extensive* soccer,[36,48] (3) incorporate position-specific elements of the game model in relation to offensive and defensive organization,[27,28] and (4) integrate visual-cognitive challenges involving 2-step problem solving and congruent decision making.[8,38] Practice design goals should alter within sessions and be planned in accordance with the physiological training focus and visual-cognitive challenge applied at the drill level. Varying drill difficulty/specificity across sessions provides opportunities for (1) reinforcing success/competence; (2) increased difficulty, providing further opportunity to develop, considering development plans; and (3)

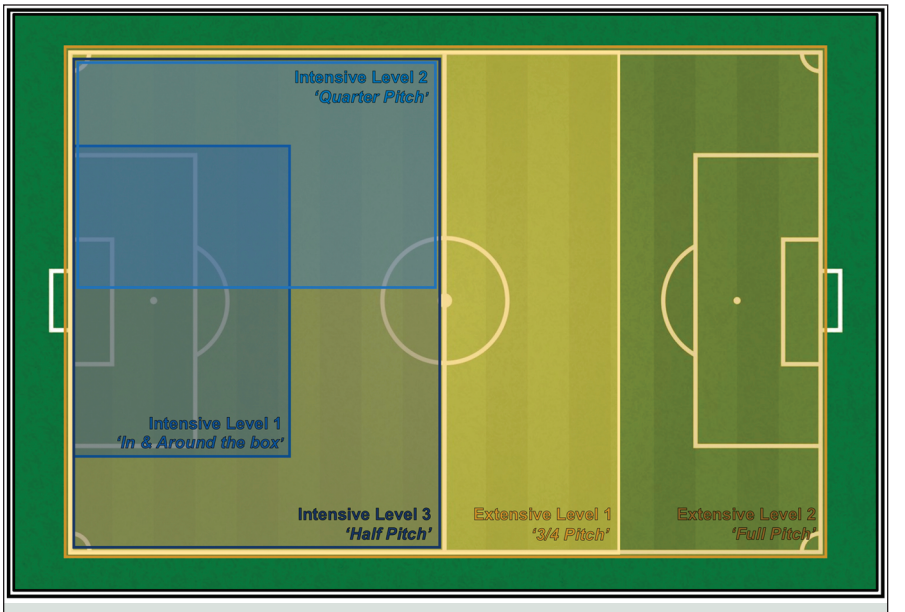

FIGURE 6. On-pitch areas to overload game-specific demands. *Intensive* football is composed of 3 levels: level 1—*in and around the box*, level 2—*quarter pitch*, and level 3—*half pitch*. *Extensive* football is composed of 2 levels: level 1—*3/4 pitch* and level 2—*full pitch*. Levels are a guide to area dimensions in relation to the specific training focus. Generalized session content may take place in the space allocated, ie, *intensive* level 1, but may not take place explicitly in the penalty area. Club game model dependent: *intensive* football sessions = defend own half of the pitch/attack the opponent's half of the pitch; *extensive* football sessions = defend the opponent's half of the pitch/attack from own half of the pitch.

higher specificity, to challenge the player representative of their game demands.[14,38]

We recommend layering practice design aspects across drills, ie, initially reinforcing actions prior to progressing toward time-constrained and/or attentional challenges. Physiological focus differentiates within a weekly microcycle, with ~1-2x 2-day *acquisition* blocks within a cycle depending on the injury and healing status (**FIGURE 3**).[36] For example, given that 2 key attributes for bone adaptation are progressive and novel loading stimuli,[21,47,49] following a tibial stress fracture, the first week within the *Control-to-Chaos* phase may only include a 1x *acquisition* block. The subsequent week may then include a 1x *acquisition* block plus a stand-alone *intensive* session before progressing to 2x *acquisition* blocks within a training microcycle. *Intensive* soccer overloads the MSK and specific energy systems through explosive movement characterized by acceleration, deceleration, and change-of-direction components in restricted spaces.[36,48]

Intensive soccer can be classified by area size, ie, level 1—*in and around the box*, level 2—*quarter pitch*, and level 3—*half pitch*, dependent upon the drill and required aims/objectives (**FIGURE 6**). *Extensive* soccer reflects typical match running load demands relative to position, using larger areas to produce higher speeds and greater distances.[36,48] *Extensive* soccer can be classified by area size, ie, level 1—*3/4 pitch* and level 2—*full pitch* (**FIGURE 6**). Drill durations (and rest periods) should be tailored to the training focus, the intended physiological adaptation, and the degree of attentional challenge (**FIGURE 1**).

Depending on the availability of other players and/or support staff, session content should now reflect team sessions and flow, ie, warm-up, boxes, and pass and move. In addition, sessions now incorporate the player's positional role in the game model in offensive and defensive organizational situations (please refer to **FIGURES 3** and **4** in part 1).[38] For example, a drill for a full-back (*intensive* level 3 area; **FIGURE 6**) could focus on *building from the back* (offensive organization). This may specifically target *playing with width* (ie, stepping into play and offloading passes to the wide player) or stepping forward to drive with the ball up the pitch. These types of drills may develop into positional pattern-of-play practices, linking multiple players (in various positions) to increase the representative physical-cognitive demands.[50]

Focused running with a defined energy system stimulus/running load demand supports soccer-specific fitness (**FIGURE 1**). Focused running provides a more *controlled* mode of progressing MSK load demands.[40,43,44] This develops practitioner and player confidence before transitioning to higher intensity demands combined with greater physical-cognitive specificity. Ideally, focused running should be specific to the player's locomotor profile, tailoring training prescription: format (continuous or intermittent), interval duration (short or long), and recovery period (inter-rep recovery or inter-set recovery).[30]

Visual-cognitive dual tasks now challenge added selective visual attention, mediated through tasks requiring concurrent multistep problem solving and congruent decision making.[8,38] These aspects can be embedded within training content such as pass-and-move drills using 2-step processing: (1) congruent working memory task and (2) predetermined action.[8,38] Interpreting hand position (ie, hand up or down) indicating the desired touch condition (ie, touch and turn) (please refer to **FIGURE1** in part 1).[38] Practitioners should pay attention for any potential *perception delays*, declines in movement quality,

and/or an increased error rate, all of which may indicate impaired motor performance.[7,23,29,38] In transitioning to the next phase, dual-task drills performed with limited error can be progressed toward multistep processing by adding auditory constraints (ie, calls from staff and/or players).[8,38]

MODERATE CHAOS

Aims

- Practice to reinforce, (re)develop, and/or perform (specific to the individual)
- Increase volume, intensity, density, and variability of training under conditions of *Moderate Chaos* (unanticipated movements, minimal limitations)
- Incorporate multistep decision making and response inhibition (*VC-CCC* phase 4)
- Progress offensive and defensive organizational principles by incorporating transitional moments

Physical-cognitive constraints progress practice design requiring *live* problem solving, increasing movement variability, skill selection, and decision-making demands.[50] Soccer-specific skills are embedded within drill content using applied constraints, ie, an *intensive* level 1 pass-and-move drill → short-range passing (**FIGURES 1** and **6**). On *intensive* days, training should include actions such as pressing/counterpressing,[2,22,28] in addition to build-up session content, ie, positional acceleration, transition boxes, and crossing-finishing drills, increasing physical-cognitive demands. On *extensive* days, training should include counterattacking drills, allowing speed and speed-endurance qualities to be trained, with an option to also replicate transition moments between offensive and defensive situations with recovery runs. These may follow larger area pass-and-move and positional pattern-of-play drills (nonopposed → opposed).

Training sessions should involve other players (either *nonstarters* or fellow players returning from injury), coaches, and/or support staff to resemble team training. Multistep processing and response inhibition provide the main visual-cognitive challenges implemented beyond introductory session content.[38] Inhibiting intended movements and/or actions based on new sensory information is a critical component of sporting competition.[8,38] Drills such as *live* positional pattern of play to finish (also known as *waves of attack*) provide no-go situations incorporating visual and/or auditory distraction in an ecological format (**FIGURE 1** in part 1).[38] Player traffic increases cross-modal challenge exposure in the transition to the *High Chaos* phase.[35–38]

Depending on the coaching team's preferences for reintegrating injured players to team training and the performance team's assessment of risk relative to reward,[20,35,39] *High Chaos* could take 1 of 2 pathways: (1) guided by the rehabilitation practitioner with support from the coaching team (**FIGURE 1**) or (2) guided by the coaches and performance team to support the player's transition to unrestricted team training and return to competition (**FIGURE 2**).[35,36]

HIGH CHAOS

Aims

- Practice to reinforce, (re)develop, and/or perform (specific to the individual)
- Consider alternative chaos as part of planning
- Mimic club-specific structure with periodization
- Integrate cross-modal decision making, unanticipated reactions, and response inhibition at game speed (*VC-CCC* phase 5)
- Design drills to challenge the most intense *game moments*
- Return player to preinjury *chronic* running load demands (if applicable)

As the player draws closer to returning to sport, additional context should be considered as part of a biopsychosocial approach.[2,5] Expectation and pressure accumulate, and other commitments may also start to form part of the player's schedule. Consider media commitments and acclimating to travel, which place additional stress on the player. Practice aims/objectives should now align with a typical weekly team microcycle. The *taper* block may blend development elements, particularly from a tactical perspective (delivered by the coaching team), before elements are transferred into *live* situations. Sessions include position-specific and game-based drills raising the level of training specificity in preparation for return to sport. Position-specific drills now reflect the most intense *game moments* under opposed conditions, for example, a full-back providing an offensive overlapping run (before possession is lost) and completing a transitional recovery run to defend an opposition counterattack in a 1v1 situation (*extensive* level 2; **FIGURE 6**). Positional drills of this nature disguise the physical demands and distract the player,[36,42] subsequently improving confidence without the requirement for psychological assessments.[42] Drill content should also challenge soccer-specific skills via appropriate practice design, acknowledging that reinforcement-based drills may not transfer to game situations but still build confidence.[14,38]

Game-based drills that challenge visual cognition at game speed represent a high proportion of team-based training methods and are a valuable inclusion.[26,38] Cross-modal integration, unanticipated reactions, and response inhibition provide the highest level of cognitive chaos with game-based formats (eg, a 2v2 possession game; please refer to **FIGURE 1** in part 1).[8,38] In addition, game-based drills provide opportunities for contact situations and player perturbations if warranted (ie, this may be avoided for players returning following contact-related contusion injuries to avoid potential setbacks). Position-specific drills should now reflect game speed, with accumulative within-session outputs in proximity to *acquisition* training day exposures, without requiring focused running. *Chronic* running load outputs should now also be in proximity of defined preinjury outputs (minimum, mean, or maximum).[39] Achieving *chronic* training loads may not always be an applicable goal of the rehabilitation process—it depends on the severity of the injury, the period of absence from team training, and/or case-specific context.[39]

HIGH CHAOS—PARTIAL TEAM INTERACTION

Aims

- Introduce the player to the preparatory elements of team training (risk assessment agreed)
- Link practice design to team training structure
- Incorporate cross-modal integration and unanticipated reactions with other visual-cognitive challenges within preparatory session content (*VC-CCC* phase 5)
- Deliver additional training following partial integration (specific to the individual)
- Increase player motivation and confidence in the final stages of rehabilitation

Partial training is characterized by integration within *controlled* elements of team training.[35] Modify drills to constrain the player and limit factors that may concern the performance and medical staff (ie, for a player returning after ACLR, managing contact involvement or the degree of interaction, to minimize exposure to uncontrollable high-risk situations and reduce the likelihood of motor errors) (**FIGURE 2**).[37] Close communication with the coaching staff helps practitioners understand the planned team training session design and theme. For a player returning after ACLR, involvement during an *intensive* session may mean participating in the team warm-up and interacting in boxes (6v2—remaining as an external player) before transitioning into an unopposed positional pattern-of-play drill to finish encouraging support play—a key attacking principle (**FIGURE 3** in part 1).[37,38]

Visual-cognitive components emphasized during the earlier phases of rehabilitation should be applied within team warm-ups to challenge simultaneous working memory, whereas specific football drills following the warm-up that involve player interaction, such as boxes, pattern-of-play drills, and crossing-finishing practices, provide cross-modal challenges.[8,38] Partial team interaction should be complemented by additional individual or small-group training with *nonstarters* to ensure that physical-cognitive oriented aims/objectives are achieved.[35] Complementary position-specific training should be linked to the session theme and, as per the *High Chaos* phase, challenge the most intense *game moments* with tactical context.[35,38]

Pay close attention to monitoring cardiovascular responses during this phase. Exposure to increased player traffic may elevate responses despite training being less physically demanding.[19,37,46] Subsequent responses to practice help inform progression/regression decision making in subsequent training sessions, ie, within a microcycle.[35–37,46]

HIGH CHAOS—FULL TEAM INTERACTION

Aims

- Involve the player in modified team training
- Ensure practice design is linked to team training structure and the phase of the season
- Incorporate cross-modal integration, anticipated reactions, and response inhibition at game speed (*VC-CCC* phase 5)
- Incorporate contact conditions (injury-specific)
- Provide opportunities for the player to fully integrate into the team environment

Balancing the return to full team training can be challenging.[20] *High Chaos* team interaction provides a bridge to acclimatize the player to the rigors of team training, with the type and level of modification influenced by the injury type, severity, and the length of absence from team training (**FIGURE 2**).[35] We recommend that performance staff collaborate and work closely with the coaching team to advise the level of interaction within training and how the imposed practice design aims/objectives impact the returning player. Modifications to game-based and opposed tactical training elements are a core element of practice design within this phase.[26] Modifications could include (1) acting as a *bounce* player (on the periphery of possession game drills, affording less pressure and contact situations), (2) acting as a *floater* (within a possession game, increasing pressure in possession and less space/time to make decisions while still under noncontact conditions), (3) altering training parameters such as volume by manipulating exercise-to-rest ratios, or (4) rotating between opposed and unopposed practice during tactical elements.

Modifications will alter movement demands and the level of cross-modal challenge within specific drills.[38] Modifying a possession drill will increase exposure to unanticipated reactions, no-go situations, and contact, if permitted. Other visual-cognitive challenges, such as challenging working memory, may also be applied to game-based formats via possession games. To modify the level of imposed physiological, MSK, technical, and cognitive stress, mixed loading strategies can be used effectively to increase or decrease exposure (alternating between a *bounce* player, a *floater*, or a *live* player) (**FIGURE 2**).

Consider the phase of the season during the planning process.[39] Team training can alter during a period of high-fixture density with/without short match turnarounds, which may warrant additional individual training linked to the game model.[39] To increase practice specificity, we advise using consequential actions in drill design (eg, intercepted passes, counterattacks during opposed patterns of play like playing out from the back). The level of movement variability and attentional demands will always be higher during this phase and cannot be completely controlled. Subtle, unanticipated, game-specific movements such as creating space and contact and tackling (as permitted), time-constrained decisions, and pressure of opponents create the chaos we recommend exposing the player to at this stage of their rehabilitation.

SUMMARY

On-pitch rehabilitation is a critical component of returning to sport. The updated *CCC* progresses from highly *controlled* to *chaotic* conditions, prescribing progressive training through thoughtful practice design while factoring in physical-cognitive interactions. We offer an enhanced framework to guide tailored on-pitch rehabilitation based on

the specific needs of the player, the nature of the injury, and the sport's context. The updated model retains the key elements of the original *CCC* and places greater emphasis on visual-cognitive challenges, decision making, and progressive representation of the game model. ◉

KEY POINTS

FINDINGS: We revised the *control-chaos continuum* (*CCC*) for elite soccer by incorporating insights from other disciplines and our expanded experience in elite environments. The updated *CCC* maintains the core elements of the original model while placing greater emphasis on the physical-cognitive dimensions of rehabilitation. It integrates principles of practice design, visual-cognitive and attentional challenges, decision making, and progression representation of the game model, creating a more comprehensive framework for player development within the context of injury constraints.

IMPLICATIONS: The updated *CCC* can be tailored to the type and severity of the injury, the stage of healing, and the player's challenge point, as well as the physical-cognitive demands of their role within the club's game model. The *High Chaos* phase can be adapted to align with the coaching team's approach to reintegrating players into team training while also considering the performance team's evaluation of risk versus reward.

CAUTION: Rehabilitation following injury in elite soccer is complex. When designing and adjusting the return to sport process, consider variability in injuries; competitive demands; and the individual player, their club environment, and their response to training.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: M.T. created the original *CCC* concept, updated the *CCC*, and wrote the initial draft. T.A., J.O.K., M.C., D.G., and D.D.C. provided feedback throughout an ongoing process until a final version was agreed upon by all authors. M.T. designed **FIGURES 1-3**, **5** and **6**. M.T. and D.D.C designed **FIGURE 4**.

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