

Clinical Commentary/Current Concept Review

Elite Figure Skaters Return to Sport Strategy Following Sports-Related Concussion: A Clinical Commentary

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Background

The Concussion in Sport Group (CISG) developed the 6th Consensus Statement on Concussion in Sport following the international conference held in Amsterdam in 2022. Their published statement provides recommendations and an updated Return to Sport (RTS) Strategy that can be adapted for different sports/disciplines.

Description

Given the unique demands of figure skating—such as high-speed spins, jumps, inversions, and overhead lifts—this clinical commentary offers sport-specific guidance for healthcare practitioners (HCPs) managing elite figure skaters recovering from sports-related concussions (SRC). This adaptation focuses on reintroduction timing of vertical, rotational, and inversion elements. Further considerations regarding elite athletes and factors impacting recovery are also provided. While scientific evidence of SRCs continues to evolve, these recommendations were derived from the current and available research.

Clinical Relevance

Given the complexity of figure skating and variability amongst multiple disciplines, the purpose of this clinical commentary is to provide recommendations and examples of how to apply the current RTS strategy to elite figure skaters following a SRC.

Level of Evidence

5

INTRODUCTION

Sports-related concussions (SRCs) are classified as mild traumatic brain injuries (mTBIs), characterized by a complex pathophysiological cascade triggered by biomechanical forces.¹ In the United States alone, approximately 3.8 million SRCs occur annually.² While epidemiological studies have detailed incidence rates for various contact and non-contact sports,³⁻⁵ data on SRC rates in figure skating remain scarce.⁶ A cross-sectional survey, presented via poster presentation, found 27% (n/N = 24/88) of their figure

skating sample had experienced at least one concussion. Notably, 42% did not seek medical attention. The most common mechanism of injury was a fall during on-ice activities.⁷

Typically, symptoms from SRCs are resolved within 7 to 10 days.⁸ However, following the implementation of the 11 “R’s”, including the Return to Learn (RTL) and Return to Sport (RTS) strategies in 2016,⁹ the duration for unrestricted RTS has increased fivefold.¹⁰ While the RTS strategy minimum duration is seven days, unrestricted RTS generally occurs within one month of injury.¹⁰ A systematic

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Table 1. Return to Sport (RTS) Strategy, by the Concussion in Sport Group (CISG).¹⁰

Step	Exercise Strategy	Activity at Each Step	Goal
1	Symptom-limited activity.	Daily activities that do not exacerbate symptoms (e.g., walking).	Gradual reintroduction of work/school.
2	Aerobic exercise 2A – Light (up to approx. 55% max HR) then 2B – Moderate (up to approximately 70% max HR)	Stationary cycling or walking at slow to medium pace. May start light resistance training that does not result in more than mild and brief exacerbation* of concussion symptoms.	Increase heart rate.
3	Individual sport-specific exercise NOTE: if sport-specific exercise involves any risk of head impact, medical determination of readiness should occur prior to step 3.	Sport-specific training away from the team environment (e.g., running, change of direction and/or individual training drills away from the team environment). No activities at risk of head impact.	Add movement, change of direction.
Steps 4-6 should begin after resolution of any symptoms, abnormalities in cognitive function, and any other clinical findings related to the current concussion, including with and after physical exertion.			
4	Non-contact training drills.	Exercise to high intensity, including more challenging training drills (e.g., passing drills, multiplayer training). Can integrate into team environment.	Resume usual intensity of exercise, coordination, and increased thinking.
5	Full contact practice.	Participate in normal training activities.	Restore confidence and assess functional skills by coaching staff.
6	Return to sport.	Normal game play.	

review encompassing 57 studies estimated a pooled mean RTS duration of 19.8 days.^{11,12}

In 2023, the Concussion in Sport Group (CISG) published an updated consensus statement, including the revised RTS Strategy.¹⁰ This strategy, detailed in [Table 1](#), provides a standardized framework for healthcare practitioners (HCPs) managing athletes with SRCs. Although adaptable across various sports and disciplines, it is not intended as a prescriptive guideline.¹⁰

SPORT OVERVIEW

Figure Skating is the oldest sport in the Winter Olympic Games.¹³ In the United States, figure skating is governed nationally by U.S. Figure Skating, which is recognized by both the United States Olympic and Paralympic Committee (USOPC) and the International Skating Union (ISU). International competitions are structured by skill levels, ranging from advanced novice to senior (elite). Disciplines that qualify for Olympic games include: women's singles, men's singles, pairs, and ice dance. While the synchronized skating discipline is not currently an Olympic sport, it is part of national and international specialty competitions.

TRAINING AND PERFORMANCE REQUIREMENTS

NEEDS ANALYSIS

Figure skating is a multifaceted sport that places significant physiological, technical, and psychological demands on its

athletes. An effective performance requires a complex interplay of energy systems, movement precision, artistic expression, and mental resilience.

Competitors of all disciplines (see [Table 2](#)) perform a short program (approximately 2 minutes and 40 seconds) and a long program (approximately 4 minutes and 10 seconds), with combined scores determining the final standings or ranking. Competitive levels are based on skill rather than age, however, with recent rule changes for Olympic qualification disciplines, skaters must be 17 years old for the 2024-2025 season and beyond.¹⁴

PHYSIOLOGICAL DEMANDS

Figure skating routines demand both anaerobic and aerobic energy system engagement. Anaerobic power and capacity are critical for executing explosive elements such as jumps and spins, which require short bursts of maximal effort. Simultaneously, a well-developed aerobic base is essential for maintaining stamina and performance quality throughout the entire routine.

Strength, particularly in the lower body, underpins the athlete's ability to generate height and rotational velocity during jumps. In pair skating, upper-body strength is equally vital for lifts and throws. Flexibility plays a crucial role in achieving the required range of motion for spins, spirals, and aesthetically pleasing movement lines. Balance and coordination are foundational to virtually all elements in figure skating—from edge work and intricate turns to

Table 2. Figure Skating Disciplines.

<i>Singles</i>	Perform multiple revolution jumps and spins, spiral sequences, choreography, and unique inverted acrobatic moves. For the 2024-2025 season, back flips are permitted.
<i>Pairs</i>	Skate as a traditional pair, executing synchronized multi-revolution jumps and spins while incorporating a variety of high-risk maneuvers, including throw jumps and overhead lifts.
<i>Ice dance</i>	Skate as a traditional pair, showcasing intricate deep-edged footwork, diverse dance holds, spins, and distinctive acrobatic lifts, all based on an artistic interpretation of the music. The rules limit the height of overhead lifts and restrict jumps to no more than one revolution.
<i>Synchronized</i>	Synchronized skating teams typically comprise 16-20 skaters who are interconnected through various upper body holds and release techniques, while performing complex skating maneuvers in close formation at varying speeds. At the elite senior level, the competitive program incorporates elements also seen in singles and pairs skating (spirals, lifts, jumps, spins) but are judged according to criteria specific to synchronized skating and do not include partnered throws or multi-rotational jumps. ¹⁵

stable landings. Core stability supports these movements by enhancing posture, control, and spin mechanics.

TECHNICAL DEMANDS

Figure skating is highly technical, requiring mastery of a diverse set of skills. Jumps such as the Axel, Toe Loop, and Lutz demand precise timing, explosive leg power, and in-air control. Spins challenge an athlete's balance, flexibility, and proprioception, while intricate footwork sequences test agility, speed, and edge precision. Artistic components are equally significant. Figure skaters must integrate choreography with musicality, demonstrating emotional expressiveness and interpretive depth—elements that are heavily weighted in scoring.

PSYCHOLOGICAL DEMANDS

As a judged sport, figure skating places considerable psychological stress on athletes. Competitors must perform under pressure, often in front of large audiences and panels of judges. Mental focus is essential to execute routines with precision and consistency. Additionally, the sport demands resilience, as athletes must recover quickly from errors or falls and maintain composure throughout their performance.

TRAINING COMPONENTS

Elite athletes may devote up to 45 hours each week to their sport, with 15–30 hours spent on the ice, divided into multiple on-ice sessions, typically at 2-hour intervals. Sessions typically include an on-ice warm-up, technical elements practice (jumps, footwork), specialty drills (specific elements, combinations), program run-throughs (sequences, full/partial routines), skill refinement, and a cool down. Additionally, athletes may participate in off-ice conditioning for 5-15 hours each week, which commonly includes ballet and other complimentary strength and conditioning methods (i.e. Pilates, strength training, metabolic training).^{16,17} Annually, competitive demands span 7-8 months and invited touring ice show participation may span an additional two months during any calendar year.

ASSESSMENT

Concussion assessment continues to evolve in pursuit of a gold-standard. A comprehensive evaluation should include rink-side administration of the Sport Concussion Assessment Tool – 6th edition (SCAT6), a thorough examination of the cervical spine, a neurological assessment (i.e., cranial nerves, dermatomes, myotomes, and deep tendon reflexes),¹⁰ an oculomotor assessment (i.e., VOMS, King-Devick test)¹⁰ and greater dual-task testing.¹⁸ The presence and severity of symptoms should guide the need for advanced diagnostics; While emerging objective tools, including pupillometry¹⁹ and salivary biomarkers,²⁰ are advancing in current research, they are not yet standard in clinical practice.

REHABILITATION

HEALTHCARE TEAM

The healthcare team commonly includes physicians, athletic trainers, physical therapists, neuropsychologists, and other healthcare professionals trained in SRC management. The healthcare team should identify a gatekeeper to oversee the athlete's recovery and to promote interprofessional collaboration with all those involved in the care. Interprofessional collaboration should include consistent, coherent messaging to ensure the goals for clinical management are achieved. These goals commonly entail a holistic, multifaceted and individualized approach to concussion management and resolution.^{21,22}

A local clinician should lead the athlete through the daily protocol, monitoring symptoms throughout their recovery, and evaluating their readiness to progress to the next step.²³ Before unrestricted RTS, a HCP should provide documentation of readiness to RTS, as directed by local and state laws, federations such as National Federation of State High School Associations, and/or sport national governing bodies.¹⁰

PATIENT EDUCATION

Patient education is essential to the athlete's recovery. Specifically, patient education involving the prognosis and

Table 3. Example of Biomedical Patient Education for a Sports Related Concussion.²⁵

What's wrong with me?	How long will it take?
You've had a concussion; a mild traumatic brain injury usually caused by a blow or fall – setting off a chemical cascade within the brain disrupting how your brain works. Common symptoms include headache, dizziness, nausea, blurry vision, memory issues and sensitivity to light or noise. Right now, your brain needs time to heal.	Each individual is unique as is each concussion; there are no guarantees on a timeline, as there are many factors (history of a previous concussion, number of symptoms at time of injury, etc.) impacting one's prognosis. Your symptoms may resolve in 7-14 days, but it takes an average of 20-30 days to return to full sport without any health care provider restrictions. It is also important to note, you will need to fully Return to Learn without new academic support (average 10 days) before you can return to sport.
What can I do for it?	What will you [physical therapy] do for it?
1. Falling and hitting your head again too soon will be detrimental. It is important to follow the outlined stepwise progression provided to you by your health care provider. 2. Do your outlined exercises prescribed by your Physical Therapist. 3. Be aware of red flags. Go to the Emergency Department if your symptoms progress to a severe headache, repeated vomiting, undergo a seizure, you have slurred speech, or lose consciousness.	1. Evaluate your neck, vision, dizziness, balance, nerves, reflexes, cognition/memory, and ability to multi-task. 2. Treat your symptoms (i.e., neck pain, vestibular) via manual therapy techniques and specific exercises. 3. Provide a Home Exercise Plan for you to work on your own. 4. They will track your symptoms to guide your progress and to bring you through the stepwise progression – specific to you and your sport. 5. Will communicate with the Interdisciplinary Healthcare team, coaches, and school to help return to sport and academics, safely.

proposed recovery timeline is crucial for an athlete's mental health. Literature has discovered a strong linear association between poor recovery expectations and poor recovery.²⁴ While the CISG proposed RTS strategy suggests a minimum of seven days to unrestricted RTS, it is important to educate the athlete that unrestricted RTS in seven days is not the expectation. Supporting evidence may be shared: symptoms may resolve in seven days; however, it takes an average of 20-30 days until unrestricted RTS to allow for realistic expectations and to promote a state of mental well-being throughout the recovery process.

A qualitative study exploring patient expectations related to physical therapy outcomes found patients were interested in gaining a better understanding of, their symptoms, strategies for self-improvement, their prognosis and the clinician's role in their recovery. [Table 3](#) provides examples of biomedical patient education,²⁵ to improve patient expectations.

SYMPTOM-BASED CLASSIFICATION

Concussion symptom-based classifications have been documented in the literature as: clinical profiles,^{26,27} clinical trajectories,²⁸ and concussion sub-types.²⁹ The literature predominantly describes five different symptom-based classifications: ocular-motor, headache/migraine, vestibular, anxiety/mood, cognitive/fatigue with two modifiers including: sleep and cervical/neck^{26,29}; One study revealed the frequency of clinical profiles (N = 236): migraine (26%), motor anxiety/mood (24%), vestibular (19%), ocular (16%), cognitive/fatigue (11%).³⁰ While some athletes may present with one classification or a clearly defined profile, many athletes will present with multiple clinical classifications or profiles.³⁰ As with any symptom-based classification system, it is important to recognize and treat the impairments specific to the individual athlete. [Table 4](#) provides symptom-based classification system examples.

DUAL-TASK PARADIGM

The dual-task paradigm has gained great attention over the past years and should not only be considered in the assessment but in the treatment or intervention as well. Dual-task assessment research shows athletes can demonstrate competence at singular tasks, but when performed simultaneously, their deficits become evident, including decreased gait velocity, increased medial-lateral displacement,³¹ decreased stride length, increased double-leg stance time,^{32, 33} and greater cognitive errors.³¹ Dual-task assessment deficits should be addressed with dual-task training (DTT). Dual-task training has been shown to improve gait velocity and stride length both in single-task and dual-task environments in other neurological conditions.^{34,35} Tandem gait with subtraction equations or spelling words backward are examples of DTT that demonstrate strong dual-task effects.¹⁸

With the demanding necessities of the sport, such as undergoing elements at high speeds with the requirement for precise balance while cognitively preparing for the next steps in their complex choreography to be performed in time with the music, it is important to integrate cognitive and physical tasks simultaneously to prepare athletes for a safe return to sport. DTT can begin with Step 2. For example, if an athlete is in the ocular-motor symptom-based classification, the HCP can challenge the athlete with an eye tracking exercise while balancing concurrently. Progression can include a moving target, such as a Marsden ball. [Figures 1-6](#) offer clinical examples of DTT. It is important that DTT progresses as the athlete progresses through the RTS Strategy Steps to truly replicate the necessities of the sport. For example, stroking – is a figure skating skill that incorporates gliding steps to move smoothly across the ice. Once could progress from stroking (Step 2B) to stroking while listening to their musical selection and vocalizing their choreography/sequence.

Table 4. Symptom-Based Classification Examples.

Symptom-Based Classification	Common Symptoms	Assessment	Considerations
Ocular-motor	• Blurred vision • Difficulty tracking • Diplopia • Symptom increase with eye tracking (i.e., increased headache with reading) • Pressure behind eyes	• Cranial Nerves • Vestibular/Ocular Motor Screening (VOMS) • King-Devick test	• Vision therapy • Limit screen time • Referral to neuro-optometrist if persistent • Academic accommodations • Physical exercise
Headache/migraine	• Migraine • Tension • Cervicogenic	• Cervical spine • Craniofacial exam • Posture analysis • Outcome measures (i.e., Migraine Disability Assessment Test, Headache Impact Test, International Headache Society criteria)	• Manual therapy • Headache hygiene (sleep, hydration) • Limit triggers (i.e., bright lights) • Pharmacologic treatment (referral) • Physical exercise • Academic accommodation • Referral to neurologist if persistent
Vestibular	• Dizziness • Nausea • Balance impairments	• Balance Error Scoring System • Vestibular/Ocular Motor Screening • Peripheral Vestibular Assessment (i.e., Dix-Hallpike) • Central Vestibular Assessment (i.e., VOR, Head Impulse Test, Dynamic Visual Acuity Test) • Dual-task balance/gait tests	• Vestibular rehabilitation • Behavior regulation • Academic accommodations
Anxiety/mood	• Anxiety • Sadness • Irritability • Excessive focus on symptoms • Hypervigilance • Overwhelmed	• Clinical interview • Symptom inventories (i.e., Patient Health Questionnaire – 9, Generalized Anxiety Disorder-7, Beck Anxiety Inventory, Beck Depression Inventory)	• Referral to mental health professional • Behavior regulation • Structured routine • Sleep / Mood journal • Medication (referral) • Psychosocial support
Cognitive/fatigue	• Decreased attention • Executive dysfunction • Memory impairment	• Neurocognitive testing (i.e., Standardized Assessment of Concussion (SAC), Cognigram, ImPACT) ◦ Review individual's baseline (if available) • School performance reports	• Referral to cognitive/speech therapy • Sleep journal • Physical exercise • Academic accommodations

RECOVERY FACTORS

Return to play timelines have not been established for the figure skating population. Factors impacting recovery following SRC should be considered. Specifically, there is literature describing differing RTS timelines based on age,³⁶ gender,³⁷⁻⁴⁰ acute clinical presentation/number of symptom-based classifications,⁴¹ premorbid/postmorbid factors,⁴²⁻⁴⁴ and psychosocial factors.⁴⁵

AGE

There is early evidence suggesting that younger age is associated with prolonged recovery times.³⁶ However, one study comparing high school to collegiate athletes did not find age to be a clinically significant variable with SRC recovery.⁴⁶ Recent literature suggests there is not a significant difference in recovery based on age.¹¹ Further, RTL and RTS strategies can be implemented amongst different age groups with minimal differences in recovery patterns.¹¹

GENDER

In adolescent athletes, females were found to have a greater number of symptoms and symptom severity following a concussion.³⁷ Similar reports were found in adolescent female rugby athletes.³⁸ In a collegiate athletic setting, female athletes had symptoms for a longer duration, however, RTS timelines were similar.⁴⁷ In elite European football, females were found to return to play in 20 days compared to their male counterparts, who returned in 10 days.³⁹ A systematic review found females to be more susceptible to SRC secondary to biomechanical and hormonal differences.⁴⁰ Another systematic review exploring the relationship between gender and recovery time and prolonged symptoms revealed mixed findings. Sex differences such as injury rates, differences in neck strength, injury biomechanics, and symptom reporting trends may contribute to the mixed findings.¹² However, the consensus of the literature supports females having longer recovery times and having persistent symptoms.¹² Conversely, a systematic review by Putukian et al¹¹ found that all cohorts (i.e., age and gender)



Figure 1. Single-leg balance on unstable surface with eye tracking exercise, utilizing a clock.



Figure 3. Tandem walking on an unstable surface, with cervical rotation/eye tracking to target, while vocalizing words (i.e., sticky notes on the wall).



Figure 2. Tandem walking with varying ocular-motor tasks.



Figure 4. Slide board with cognitive exercise involving a deck of cards.

had similar recovery patterns. However, taking into consideration previous medical history, pre-existing factors, and postmorbidity factors can modify recovery timelines.¹¹

The total membership of U.S. Figure Skating for the 2023-24 season reached a milestone of 246,213 members, regardless of age. A detailed analysis revealed that the membership is composed of 69% females, 28% males, and

3% undeclared.⁴⁸ While evidence is mixed, medical professionals working with figure skaters recovering from a concussion should consider gender as a potential factor impacting their prognosis.



Figure 5. Resisted rotation and then vocalizing words seen on flash cards.



Figure 6. Jumping onto an unstable surface then vocalizing the word seen on the flash card.

SYMPTOM-BASED CLASSIFICATION

The number and severity of acute symptoms are a consistent predictor of a prolonged recovery.¹² This inverse relationship has been further supported by evidence suggesting that symptom classification plays a significant role in recovery outcomes. For instance, a study involving 27 differ-

ent sports within the PAC-12 found that the number of clinical profiles was positively associated with longer recovery times.⁴¹

Identifying the athlete's symptom-based classification(s) will aid in the clinician's application of the RTS strategy. For example, if an athlete is experiencing vestibular and ocular-motor type symptoms, the athlete may spend more time in Step 3. Classification will also enhance patient education by providing clearer insights into prognosis and the expected recovery timeline.

PREMORBID/POSTMORBID FACTORS

Pre-morbid factors, including concussion history,⁴² migraines,⁴² anxiety,⁴³ learning disability,¹⁰ and mental health condition⁴⁴ can impact RTS timelines. With the history of concussion being the greatest predictor of prolonged recovery.⁴² Post-morbid factors including increased time getting into a HCP and number of symptoms and symptom severity have a positive correlation with prolonged recovery times.¹⁰ With early symptoms being the most robust predictor.¹⁰ Specifically, light sensitivity, fatigue/low energy, balance problems, difficulty remembering, and difficulty concentrating were the symptoms with the greatest positive correlation to RTS timeframes.⁴² Initiating care and early physical activity play a pivotal role in an athlete's recovery. Strict rest, cocoon therapy, and dark-room therapy are no longer considered effective treatments and have been found to impair recovery.⁴⁹

PSYCHOSOCIAL FACTORS

Psychosocial factors include contextual factors (i.e., loss of identity as an athlete, pressure from teammates, coaches, parents), emotional factors (i.e., depression, mental health, mood disturbance, anxiety, feelings of isolation), and fear (i.e., fear of another concussion, losing playing status).³⁶

These factors need to be taken into consideration when managing the athlete's recovery following a concussion. Clinicians should also be conscious of maladaptive behaviors and conditions such as Relative Energy Deficiency in Sport (RED-S).⁵⁰ Subsequently, these factors should be considered when determining psychosocial readiness to RTS. One may consider utilizing the Injury Psychological Readiness to Return to Sport Scale, while not concussion specific, it is a validated instrument.⁵¹

NUTRITION

Preliminary studies suggest creatine may be a beneficial supplement.⁵² However, weight gain is a potential side effect of creatine supplementation.⁵³ Recent literature suggests that an acute supplementation of creatine did not affect fat mass.⁵⁴ A study exploring short-term (3 weeks) creatine intake in swimmers did not impact body weight nor body composition.⁵⁵

A systematic review exploring the role of nutrition identified six nutritional areas related to concussion management: omega-3 fatty acids, melatonin, Enzogenol®, MLC901, ketogenic diet, and phytocannabinoids to be ben-

eficial.⁵⁶ Some potential benefits include improvements in cognition, sleep, Sport Concussion Assessment Tool scores, systolic blood pressure volume, physical ability, and anxiety.⁵⁶

While there is supporting evidence for some of these substances, HCPs working with elite athletes subjected to doping, need to ensure recommended supplements are compliant with the World Anti-Doping Agency (WADA) and the United States Anti-Doping Agency (USADA) in and out of competition. Further, HCPs making nutritional recommendations should understand which supplements are regulated. For instance, Melatonin is not a prohibited substance, but there is still an associated risk as it is not regulated by the United States Food and Drug Administration (FDA).⁵⁷ One article reviewing the content of 31 melatonin supplements revealed a range of -83% to +478% of the labeled ingredients being present, far exceeding the 10% margin of the label claim. For example, one sample of a chewable tablet had 9 mg of melatonin, though the label claimed 1.5 mg of melatonin. Furthermore, contaminants such as 5-hydroxytryptamine (serotonin) were found in 26% of the supplements.⁵⁸ Significant caution is recommended in the prescription or recommendations of medications or supplementation with elite level athletes as the risk of banned substances is high and the consequences of testing positive can be severe, potentially including suspension, disqualification, reputation damage, financial losses, psychological strain, and legal ramifications.^{59,60}

RETURN TO SPORT STRATEGY

The RTS framework outlined by the CISG is a graduated stepwise strategy that involves six steps, and a minimum of 24 hours must occur between each step. Before activity, each athlete should denote their current symptoms and their symptom score on the Numeric Pain Rating Scale (NPRS). While in Steps 1-3, if an athlete has an exacerbation of symptoms, more than two points on the NPRS for more than one hour, the activity should be ceased, and the step should be attempted the next day. There should be a full resolution of symptoms, concussion-related clinical findings, and abnormalities in cognitive function, both at rest and with activity, before progressing to Step 4. If concussion-related symptoms arise during Steps 4-6, they should return to Step 3.¹⁰ Return to Learn and RTS strategies can occur in parallel; however, an athlete cannot progress to Step 4 if they are experiencing concussion-related symptoms in the classroom.

Twenty-four hours following a sport-related concussion, an athlete can begin Step 1 involving activities of daily living and walking. Step 2A & Step 2B introduce aerobic exercise at 55% maximum heart rate (HR) and 70% maximum HR, respectively. It is important to incorporate exertion testing to be able to appropriately prescribe aerobic exercise in Stage 2 and beyond. The Buffalo Concussion Bike Test⁶¹ or the Buffalo Concussion Treadmill Test⁶² will identify a safe heart rate zone for aerobic activity.

In Step 3, the athlete may begin sport-specific exercises, such as running and change of direction; at this step, elite



Figure 7. Scratch Spin (Video in Supplementary materials)

competitive figure skaters may begin stroking, edge work, step sequences, and choreography (this does not include multi-rotation or high velocity rotation).

It is important to note that Step 3 should occur outside of the team setting (i.e., away from partnered elements) to minimize the risk of head impact. In figure skating, both skaters and coaches should evaluate the potential for self-injury when progressing and integrating skills, considering the likelihood of falls and the risk of secondary contact with the ice or uncontrolled coup/contrecoup mechanisms. Additionally, the risk of collisions with other skaters during on-ice sessions should be assessed, especially when interacting with athletes of lower skill levels or performing high-risk skills within the on-ice team environment. To progress beyond Step 3 the athlete must be asymptomatic, have cognitive function restored, and be free of any other clinical findings related to the current concussion.¹⁰

In Steps 4-6, instead of non-contact training drills and the progression to full-contact practice and games, it is advised to start with figure skating vertical elements. Progressing to rotation by revolution, then lastly, inversion, to mirror the development for the sport of figure skating. When initiating rotation, the onsite clinician should ensure a safe environment (i.e., spinner, pole harness, spotting); [Figures 7-9](#) offer a progression of rotational elements from a neutral head position to cervical extension and inversion positioning.

In elite hockey, 4-5 full training sessions are warranted in Step 5, before competition readiness.⁶³ In company dancers, there is a progressive loading into performance schedules, advancing from 2-3 pieces per night, to the full production.²³ Similarly, figure skaters need to tolerate normal/customary training loads, which commonly include the



Figure 8. Layback Spin (Video in Supplementary materials)



Figure 9. Death Spiral

completion of program elements according to their discipline and level and the integration of these elements during program run-throughs (i.e., jumps, spins, lifts, choreography). This may include the completion of multiple on-ice sessions within the same day, off-ice training within their daily training, and the completion of both short and long programs. Figure skaters will need to have several full days of training to establish physiological and psychological adaptation to obtain full clearance for unrestricted sport and build to return to competition readiness. Prior to final clearance HCPs should consider measures such as the Gapski-Goodman test⁶⁴ and the Injury Psychological Readiness to Return to Sport Scale.⁵¹ A HCP should provide documentation, as directed by local and state laws, federations such as National Federation of State High School Associa-

tions, and/or sport national governing bodies, to allow unrestricted RTS.¹⁰

CONCLUSION

Sports-related concussion and mild traumatic brain injury research continues to evolve; however, the findings and return-to-sport guidelines remain scarce within the figure skating population. This clinical commentary shared an adapted RTS strategy for elite figure skaters following a concussion. As stated by the CISG, these recommendations and examples are not meant to be prescriptive guidelines but rather meant to aid the healthcare team in their clinical decision making. Amongst the multidisciplinary team, there should be a gatekeeper promoting interprofessional collaboration throughout the athlete's recovery. A local member of the healthcare team should monitor the athlete daily and determine their ability to progress to the next step. Factors impacting SRC recovery timelines should be taken into consideration, including age, gender, acute symptom presentation, premorbid/postmorbid factors, psychosocial factors, and nutritional considerations. These recommendations were derived from current available evidence and sport specific clinical practice and will need to evolve as the research also evolves.

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Table 5. Return to Sport Strategy Adapted for Elite Figure Skaters.

Step	Exercise Strategy	Activity Examples	Goal
1	Symptom-limited activity.	Activities of Daily Living (ADLs) Examples: Walking, stretching, stairs, upright yoga flow (upright only)	Gradual re-introduction of work/school/life activities.
2A	Aerobic exercise 2A – Light (up to approx. 55% max HR)	AM: Stationary Cardio Machine (Bike or treadmill) x 15 minutes Off-Ice: Return to functional strength exercises Examples: Ballet bar exercise, squats, lunges, single leg balance, core (avoid inversion positions and rotation) PM: Stationary Cardio Machine x 15 minutes	Increase heart rate tolerance. Regain normal heart rate variability.
2B	Aerobic exercise 2B – Moderate (up to approximately 70% max HR)	AM: On-Ice Strokings, up to 30 minutes Ice Skills- partial rotation only Examples: Mohawk, Choctaw, Rocker, 3-turn Off-Ice: Phase 2A with increased intensity and volume Examples: Stationary eccentric drops (bilateral to unilateral stance) Landing drills (bilateral to unilateral with excursion) Ballet skills (without rotation) PM: Cardio Activity x 30 minutes Examples: Biking, jogging (if tolerated: off-ice bounding)	Progress complexity of movement. Progress volume tolerance. Movement reintegration focus: Vertical Avoid: Jumps and spins
3	Individual sport-specific exercise NOTE: if sport-specific exercise involves any risk of head impact, medical determination of readiness should occur prior to step 3. ¹⁰	AM: On-Ice Strokings, + 15 minutes Phase 2B Integrate partial rotation skills with stroking Examples: Moves in the field, basic ice dance patterns, choreography (Mohawks, Choctaw, Rockers, 3-turns, dance patterns) Half revolution jumps to single revolution jump (Waltz jump, Toe Loop, Loops) Off-Ice: Progress 2B Examples: Plyos, multi-plane functional strengthening Ballet skills with single revolution rotation Rehearse choreography program (Single rotation only, no lifts) PM: Cardio or On-Ice Strokings + 15-minute Phase 2B Progress partial rotation skills session integration and tolerance **(May be in stage 3 more than 24 hours - to increase load tolerance)	Progress volume and intensity load tolerance. Progress complexity of movements. Integrate sports-specific skills. Movement reintegration focus: Rotation Avoid: Multi-revolution skills
Steps 4-6 should begin after resolution of any symptoms, abnormalities in cognitive function, and any other clinical findings related to the current concussion, including with and after physical exertion.¹⁰			
4	Training progression of vertical rotation tolerance on ice and introduction of inversion positioning off-ice.	AM: On-Ice Strokings, 1 hour Integrate vertical multi-rotational skills Examples: Single to double jumps; partnered elements with single to double rotation; high velocity edgework and patterns and step sequences Off-Ice: Progress Step 3 Load Tolerance Ballet skills with rotations Full choreography rehearsal	Progress to discipline-specific training skill development. Progress discipline-specific training load tolerance. Movement reintegration focus: Multi-revolution rotation

		Inversion positions without rotation Single plane lifts PM: Jog / Bike / Skate Session Progress spins separate from other elements Examples: Progress from vertical (Scratch spin) to positional (Sit or Camel) Progress revolution tolerance Partner spins (avoid inversion (i.e., Death Spiral)) Twizzles	Stationary inversion positioning Avoid: Spins with inversion positioning
5	Full practice: Jumping/twisting.	AM: On-Ice Skating, 1 hour + 15 minutes Jumps: double and beyond Single plane lifts, throws, complex choreography Partial program run-throughs with jump elements Off Ice: Full Participation PM: Jog /Bike/Skating Session Progress spins with inversion Examples: Layback spin or partnered Death Spiral Progress lifts with rotation Spins integrated with choreography Partial program run through with spinning and rotation elements	Progress advanced discipline load tolerance. Movement reintegration focus: Rotation and inversion
6	Return to sport.	AM: On-Ice Skating, 90 minutes (continue increasing time) Full participation with a focus on skill development execution, load tolerance, consistency for performance Off Ice: Full Participation PM: Full participation, continue increasing time Progress program choreography with full elements until conditioned to return to full run-throughs in preparation for return to competition.	Progress load tolerance for full return to sport and training for competition readiness. Movement reintegration focus: Choreography with full program elements

HR = Heart Rate



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SUPPLEMENTARY MATERIALS

Supplemental video - [Figure 7](#)

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Supplemental video - [Figure 8](#)

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