IJSPT

CLINICAL COMMENTARY

PEDIATRIC SPORTS SPECIFIC RETURN TO PLAY GUIDELINES FOLLOWING CONCUSSION

Keith H. May, PT, DPT, SCS, ATC, CSCS[1]
David L. Marshall, MD[1]
Thomas G. Burns, PsyD, ABPP/CN[1]
David M. Popoli, MD[1]
John A. Polikandriotis, PhD, MBA, MPH, FACHE[1]

ABSTRACT

Purpose/Background: In 2010, the American Academy of Pediatrics officially adopted the recommended return to play guidelines proposed by the International Conference on Concussion in Sport. The guidelines include a six-step process that provides structure to guide an athlete who is recovering from a concussion in a gradual return to play (RTP) by allowing participation in increasingly difficult physical activities. Unfortunately, the guidelines fail to take into account the variability that occurs within different sports and the resulting challenges medical professionals face in making sure each athlete is able to withstand the rigors of their specific sport, without return of symptoms. Therefore, the purpose of this clinical commentary is to expand upon the current general consensus guidelines for treatment of concussed pediatric athletes and provide sport specific RTP guidelines.

Description of Topic: The intention of the sport specific guidelines is to maintain the integrity of the current six-step model, add a moderate activity phase highlighted by resistance training, and to provide contact and limited contact drills specific to the athlete's sport and/or position. The drills and activities in the proposed seven-step programs are designed to simulate sport specific movements; the sports include: football, gymnastics, cheerleading, wrestling, soccer, basketball, lacrosse, baseball, softball, and ice hockey. These activities will provide sports specific challenges to each athlete while simultaneously accomplishing the objectives of each stage of the RTP progression. The final RTP determination should occur with documented medical clearance from a licensed healthcare provider who has been trained in the evaluation and management of concussions.

Discussion/Relation to Clinical Practice: There have been significant strides in the management and care of concussed athletes. However, there continues to be a lot of confusion among, athletes, parents, and coaches regarding the proper management of an athlete with a concussion, particularly in the pediatric population. In an effort to eliminate ambiguity and help further promote adherence to the RTP guidelines, the authors developed several sports-specific RTP guidelines.

Level of Evidence: 5

Keywords: Concussion, pediatric, return to play guidelines, sports

CORRESPONDING AUTHOR
Keith H. May, PT, DPT, SCS, ATC, CSCS
Clinical Outcomes Project Manager Sports Medicine Program
Children's Healthcare of Atlanta
5445 Meridian Mark Rd. NE Atlanta, GA 30342
office # (404) 785-5701
Email: keith.may@choa.org

[1] Children's Healthcare of Atlanta, Atlanta, GA, USA

BACKGROUND/PURPOSE

Attention to sports related head injuries, specifically concussions, has increased over the last ten years.[1] The increased interest is likely multi-factorial, occurring due to the impact of concussions on high profile professional athletes coverage in the popular media, and the large number of teens participating in contact and collision sports. More than half of all high school students, over 7.7 million boys and girls, participated in sports during the 2012-2013 school year compared to 6.8 million during the 2002-2003 school year.[2]

Consequently, the overall number of reported head injuries continues to rise. In fact, Langlois et al reported that at least 1.6-3.8 million sports related concussions occur each year in the United States.[3] While the majority of concussion symptoms resolve within 10 days to two weeks,[4] the consequences of returning an athlete to play too soon following a concussion are now beginning to be understood. For example, there is a significant risk for a second concussion whose compounding effects can be detrimental to the adolescent athlete.[5-13]

In 2001, a multidisciplinary group of sport and medical professionals met in Vienna, Austria at the International Conference on Concussion in Sport (ICCS) and has since met three additional times with the specific objective of improving the evaluation, management, and return to play of concussed athletes.[14-17] Interestingly, the pediatric and adolescent athlete was not considered until the 2008 conference that occurred in Zurich, Switzerland where three significant questions were raised: 1) Which symptom reporting scale is the most appropriate for this age group?; 2) Which tests are useful and how often should baseline testing be performed?; and 3) What are the most appropriate return to play criteria for the elite and non-elite child and adolescent athlete? In 2012 and in response to the 2008 conference, the ICCS developed the child SCAT 3 (for ages 5-12) for sideline use, recommended that neurophysiological testing be used broadly the same as adults with consideration made toward age appropriate cognitive development, recommended that children make a complete return to school prior to a return to play, and recommended a more conservative return to play progression, secondary to a child's physiological response to a head injury and their tendency to take longer to recover.[17]

Table 1. *Graduated Return-to-Play Protocol, with additional Step 6*[18]

Graduated Return-to Play Protocol		
Step	**Rehabilitation Stage**	**Objective of Stage**
1	No activity	Recovery
2	Light aerobic exercise	Increased heart rate
3	Sport-specific exercise	Add movement
4	Non-contact training drills	Exercise, coordination, cognitive load
5	Full-contact practice	Restore athletes confidence, coaching staff assess functional skills
6	Return to play	

In 2010, the American Academy of Pediatrics (AAP) published basic concussion management guidelines for children and adolescents, adapted from the ICCS recommendations that emphasized a graduated return to play (RTP) protocol and the importance of having an athlete follow a stepwise progression in their RTP.[18] Table 1, adapted from the AAP guidelines, shows the recommended RTP progression.

According to the recommended protocol, a concussed athlete begins the 6-step protocol and moves through the progression at 24-hour intervals as long as no symptoms occur. If an athlete develops symptoms the progression should be stopped and the athlete must be returned to the previous phase. The final RTP determination should occur with documented medical clearance from a licensed healthcare provider who has been trained in the evaluation and management of concussions.

It is important to recognize that the mechanisms of concussive injury and force of collision vary among sports. In football, for example, helmet-to-helmet collisions are common, whereas contact from a stick, puck or ball can occur in ice hockey, lacrosse, or soccer. For this reason, every concussion is unique and athletic medical providers should consider sport specific RTP guidelines utilizing symptom reports, as well as cognitive and balance examination data to track recovery. Ultimately, this will assist in developing detailed understanding regarding how and when to return pediatric athletes back their sports activities. Therefore, the purpose of this clinical commentary is to expand upon the current general consensus

guidelines for treatment of concussed pediatric athletes and provide sport specific RTP guidelines.

DESCRIPTION OF TOPIC

The following sports specific RTP criteria developed by a multidisciplinary sports medicine team at Children's Healthcare of Atlanta was written and implemented into the Atlanta, GA metro service area in 2012 (Appendices 1-10). The intention was to maintain the integrity of the current 6-step basic progression suggested by the ICCS and adopted by the AAP, spanning the time period from no physical activity to full RTP. The authors propose adding a moderate activity step highlighted by resistance training and modifying steps three and four to include noncontact and limited contact drills specific to the athlete's sport.

Assessing an athlete's tolerance to resistance training is important because weight training can increase intracranial pressure and exacerbate post concussive symptoms.[19] Resistance training should be introduced with low weight/high repetition exercises.[20] The specific sports chosen for this new 7-step program were known to be of high risk for head injury and included football, gymnastics, cheerleading, wrestling, soccer, basketball, lacrosse, baseball, softball and ice hockey. Each sport was considered for drills and activities that could be completed by the athlete that would simulate sport specific movements while simultaneously accomplishing the objectives of each stage of the RTP progression. As with the basic guidelines, each step represents a 24-hour period unless an athlete develops symptoms. A pediatric or adolescent athlete should begin the RTP progression once they have achieved a full return to school (cognitive activities). If symptoms occur, the progression should be stopped and the athlete returned to the previous phase where symptoms did not occur. A list of common concussion symptoms described by the AAP is included in Table 2.

To reiterate, the final RTP determination should occur with documented medical clearance from a licensed healthcare provider who has been trained in the evaluation and management of concussions. This could include a physician, nurse practitioner, physician assistant, certified athletic trainer, or board certified sports physical therapist.

Table 2. *Signs and Symptoms of a Concussion*[18]

Signs and Symptoms of a Concussion	
Headache	Change in sleep patterns
Dizziness	Vision changes
Nausea/Vomiting	Difficulty concentrating
Sensitivity to light	Difficulty remembering
Loss of balance	Numbness or tingling anywhere in the body
Irritability	Feeling more emotional

DISCUSSION

The pathophysiology, recognition and treatment of concussions are becoming far better understood than in years past. Most concussion management programs now stress cognitive rest, physical rest, the use of neurocognitive testing, and utilization of return to play guidelines. Despite these improvements in the care of athletes, there continues to be a lot of confusion among athletes, parents, and coaches as to the proper management of a concussion, particularly those that occur in children. In an effort to eliminate ambiguity and help further promote adherence to the RTP guidelines, the authors developed these sequential sports-specific RTP guidelines. Further research is warranted in order to validate these guidelines and their potential impact on return to play adherence and overall success. Adherence to even the current general return to play recommendations continues to be a challenge in the pediatric and adolescent sporting community. In 2009, Yard and Comstock found that one in six athletes failed to follow a standardized RTP guideline and thus frequently returned to their sport prematurely.[21] Furthermore, Hollis et al reported that in a group of 296 rugby athletes with suspected concussions only 66 returned to play with medical clearance.[12] Similarly, Sye et al reported 145 of 187 rugby players were only compliant with the initial rest period.[23]

Of special concern is that there are currently no suggested RTP guidelines for athletes under the age of 13. The consensus guidelines are described to be applicable for adolescents 13 years of age and older. An age appropriate physical, cognitive testing and symptom checklist is recommended as a component of the assessment as patients below age 13 tend to report concussion symptoms different from adults.[17] Consensus in the literature is that those who manage a younger athlete with a concussion should be prepared to extend the recovery timeline.[17,24] The

extended time is a product of the different physiological response that children and adolescents demonstrate as a result of a concussion (e.g. diffuse cerebral swelling). The actual recovery time may vary based on the individual patient.[17,24] Additionally, RTP guidelines may need to be adjusted for those who have experienced a prior head injury. Multiple authors have described that those who have suffered a prior injury have up to a 5.8 fold increased rate of re-injury.[6-13] Therefore, treating an athlete with multiple concussions involves emphasizing the need to consider the long-term consequences and recovery prior to RTP.[25-27]

Lastly, many states have passed legislation designed to address the growing concern of traumatic brain injuries and concussion among young athletes. In addition to the legislative efforts that may govern RTP guidelines, a team approach that involves health care providers, parents, athletes, and coaches is key for the long-term health of the athlete.

REFERENCES

1. Graham R, Rivara FP, Ford MA, Spicer CM, eds. Sports Related Concussions in Youth: Improving the Science, Changing the Culture. Washington DC: National Academies Press; 2014.
2. National Federation of State High School Associations. 2012-2013 high school athletics participation survey. http://www.nfhs.org/. Accessed September 8, 2013.
3. Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: a brief overview. *J Head Trauma Rehabil.* 2006 Sep-Oct;21(5):375-378.
4. D`Hemecourt P. Subacute symptoms of sports-realted concussion: outpatient management and return to play. *Clin Sports Med*. 2011;30:63-72.
5. McCrea M, Guskiewicz K, Randolph C, et al. Effects of a symptom free waiting periods on clinical outcome and risk of reinjury after sport-related concussion. *Neurosurgery.* 2009;65(5):876-882.
6. Schulz MR, Marshall SW, Mueller FO et al. Incidence and risk factors for concussion in high school athletes, North Carolina, 1996-1999. *Am J Epidemiol* 2004;160:937-44.
7. Colvin AC, Mullen J, Lovell MR, et al. The role of concussion history and gender in recovery from soccer-related concussion. *Am J Sports Med.* 2009;37:1699-704.
8. Emery C, Kang J,Shrier I, et al. Risk of injury associated with bodychecking experience among youth hockey players. *CMAJ* 2011;83:1249-56.
9. Guskiewicz KM, Marshall SW,Bailes J, et al. Recurrent concussion and risk of depression in retired professional football players. *Med Sci Sports Exerc*. 2007;39:903-9.
10. Guskiewicz KM, McCrea M, Marshall SW, et al. Cumulative effects associated with recurrent concussion in collegiate football players: The NCAA concussion study. *JAMA* 2003;290:2549.
11. Guskiewicz KM, Weaver NL, Padua DA, et al. Jr. Epidemiology of concussion in collegiate and high school football players. *Am J Sports Med*. 2000;28: 643-50.
12. Hollis SJ, Stevenson MR, McIntosh AS, et al. Incidence, risk, and protective factors of mild traumatic brain injury in a cohort of Australian nonprofessional male rugby players. *Am J Sports Med*. 2009;37:2328-33.
13. Kristman VL, Tator CH, Kreiger N, et al. Does the apolipoprotein epsilon 4 allele predispose varsity athletes to concussion? A prospective cohort study. *Clin J Sport Med*. 2008;18:322-8.
14. Aubry M, Cantu R, Dvorak J, et al. Summary and agreement statement of the first international conference on concussion in sport, Vienna 2001. *Br J Sports Med*. 2002;36:6-7.
15. McCrory P, Johnston K, Meeuwisse W, et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. *Br J Sports Med*. 2005;39:196-204.
16. McCrory P, Meeuwisse W, Johnston K, et al. Consensus Statement on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2008. *Br J Sports Med.* 2009;43 Suppl 1:i76-90.
17. McCrory P, Meeuwisse W, Aubry M, et al. Consensus statement on Concussion in Sport-The 4th International Conference on Concussion in Sport held in Zurich, November 2012. *J Sci Med Sport* 2013;16:178-89.
18. Halstead ME, Walter KD, and the Council on Sports Medicine and Fitness. Sports-Related Concussion in Children and Adolescents. *Pediatrics*. 2010; 126(3): 597-615.
19. Haykowsky M, Eves N, Warburton D, et al. Resistance exercise, theValsalva maneuver, and cerebrovascular transmural pressure. *Med Sci Sports Exerc*. 2003;35:65-68.

20. Kissick J, Johnston KM. Return to play after a concussion principles and practice. *Clin J Sport Med.* 2005;15:426-431.

21. Yard EE, Comstock RD. Compliance with return to play guidelines following concussion in US high school athletes, 2005-2008. *Brain Inj.* 2009;23:888-98.

22. Jack K, McLean SM, Moffett JK, Gardiner E. Barriers to treatment adherence in physiotherapy outpatient clinics: A systematic review. *Man Ther.* 2010;15:220-8.

23. Sye G, Sullivan SJ, McCrory P. High school rugby players' understanding of concussion and return to play guidelines. *Br J Sports Med.* 2006;40:1003-5.

24. Karlin AM. Concussion in the pediatric and adolescent population: "Different population, different concerns". *Pm&R.* 2011;3:S369-79.

25. Harmon KG, Drezner JA, Gammons M, et al. American Medical Society for Sports Medicine position statement: concussion in sport. *Br J Sports Med.* 2012;47:15-26.

26. Laker SR. Return-to-play decisions. *Phys Med Rehabil Clin N AM.* 2011;22:619-34.

27. Doolan AW, Day DD, Maerlender AC, Goforth M, Gunnar Brolinson P. A Review of Return to Play Issues and Sports-Related Concussion. *Ann Biomed Eng.* 2011;40:106-13.

Appendix 1

Return to Physical Activity Following Concussion--Cheerleading

Stage	Activity	Cheerleading Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at gym, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Vertical work (No inversion)	• Moderate conditioning jumps (toe-touch, Herkie, double hook), 15 yard sprints (as in tumbling pass), stunting with feet on ground *No tumbling	• Maximize aerobic activity • Introduce head movements • Monitor for symptoms
5	Intro level tumbling	• Round-off • Walkovers • Handspring (1) • Light tumbling • Progress from non-inverted lifts to inverted lifts • Cradle catch	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Introduce inversion – vestibular stress • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Unrestricted workouts	• Return to competition	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 2

Return to Physical Activity Following Concussion--Gymnastics

Stage	Activity	Gymnastic Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at gym, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Vertical work	Level 1-2- handstands, choreography on low beam no jumps/turns, swings on bar, no vault Level 3-4- vault run with peel off, glide swings on bars, cast to block on bar, tap swings Level 5-6- cast above horizontal Level 7-8- cast to HS return to block Level 9+- any skill listed above Note: it is acceptable of a higher level skilled athlete to perform a lower level skill	• Maximize aerobic activity • Introduce rotational head movements • Monitor for symptoms
5	Intro level tumbling	L1-2- cartwheel, bridge kick-overs, backward and forward rolls, jumps and leaps, turns and spins, competition vault, round-off on tumble track L3-4- walkovers, backward roll to HS, vault drills- no full vaults, round-off, kips on bars, back and front hip circles, front and back HS on tumble track L5-6- clear hips, stalder, sole circles, long hang pullover, tumbling on tumble track with saltos L7-8- giants on bars, handsprings on vault, back handsprings on low beam L9+- straight tumbling on tumble track no twisting (may progress to full twist provided symptom free), no releases on bars. Handsprings on vault, Yurchenko timers (vaulting preferably into pit)	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Unrestricted workouts	• Return to competition	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 3

Return to Physical Activity Following Concussion

Football

Stage	Activity	Football Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging w/helmet • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact football-specific drills	• Moving in/out 3 point stance, bear crawls through tunnel, tires, step over bags (vertical and lateral), QB/center exchange, QB drop backs, passing, break downs and plant, jump cuts, backpedaling, match the hips, up/downs *Start w/o helmet; progress to helmet and shoulder pads if symptom free	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact football drills	• Stage 4 workout in full pads • Hit/push pads then sled (focus on technique-head up, square up, stay low), step and hit, run and hit, leverage drill, punch drill	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full contact practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms • Consider one side of the ball only, no special teams play

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 4

Return to Physical Activity Following Concussion

Wrestling

Stage	Activity	Wrestling Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Minimal contact wrestling drills	• Shooting single/double leg, hand fighting, sit-outs from a referee's position, stand-up escapes, from referee's position, leg riding *All drills done at half speed	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact wrestling drills	• Full-speed take downs, break downs, outside carry, full speed shots, pinning combinations	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Live Wrestling	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Return to play	• Normal match play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 5

Return to Physical Activity Following Concussion

Soccer

Stage	Activity	Soccer Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact soccer specific drills	• Inside/inside, top tapping the ball, dribbling in a straight line, dribbling around cones, chipping, goal- keeper punts, goal-keeper catches, long and short passing (inside foot and instep), shooting, volleys	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact soccer drills	• Ball tossed headers from knees (progress to standing then jumping), goal-keeper dives from knees (progress to standing), 1 on 1 (progress to 2 on 2, 3 on 3 etc.)	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 6

Return to Physical Activity Following Concussion

Basketball

Stage	Activity	Basketball Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact basketball specific drills	• Passing, dribbling, stationary shooting (progress to jump shots), individual post moves, solo rebounding, tip drill, lay-up drill, 3 man weave, defensive slides, suicides, shadowing plays	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact basketball	• Post moves and rebounding with assisted pad contact (progress to player contact)	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 7

Return to Physical Activity Following Concussion

Lacrosse (Boys)

Stage	Activity	Lacrosse Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging with helmet and gloves • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact Lacrosse specific drills	• Cradling, catching, scooping, fielding ground balls, shooting, change of direction, give and go, waterfall drill, hamster drill, pinwheel drill, eagle eye drill *Start with helmet and gloves, progress to full pads if symptom free	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact Lacrosse drills	• Riding after the shot, riding off the end line, pick and roll, 1 v 1 scramble, 3 v 2, 3 v 4, * Full Pads	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Frequent assessments throughout the practice • Assess frequently during line changes • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 8

Return to Physical Activity Following Concussion

Lacrosse (Girls)

Stage	Activity	Lacrosse Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging goggles and stick • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact Lacrosse specific drills	• Cradling, catching, scooping, fielding ground balls, shooting, change of direction, give and go, waterfall drill, hamster drill, pinwheel drill, eagle eye drill	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact Lacrosse drills	• Riding after the shot, riding off the end line, pick and roll, 1 v 1 scramble, 3 v 2, 3 v 4, * Wearing goggles	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Frequent assessments throughout the practice • Assess frequently during line changes • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 9

Return to Physical Activity Following Concussion

Baseball/Softball

Stage	Activity	Baseball/Softball Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min jogging • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact baseball/softball-specific drills	• Interval throwing program, bullpen pitching, fielding ground balls, double plays, catching fly balls, running bases, pick off attempts, catcher coming out of the crouch, dry cuts, bunting, hitting off the tee	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact baseball/softball drills	• Hitting off a pitching machine with progression to live batting practice	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Reassess for symptoms every 30 minutes throughout the practice • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage

Appendix 10

Return to Physical Activity Following Concussion

Ice Hockey

Stage	Activity	Ice Hockey Specific Exercise	Objective of the Stage
1	No physical activity; Complete physical and cognitive rest	• No activity	• Recovery and elimination of symptoms
2	Light aerobic activity	• 10-15 min of walking at home or at field, or stationary bike	• Add light aerobic activity and monitor for symptom return
3	Moderate aerobic activity Light resistance training	• 20-30 min skating with helmet and gloves • Resistance training -body weight squats and push-ups 1 set of 10 reps each	• Increase aerobic activity and monitor for symptom return
4	Non-contact ice hockey specific drills	• Skating backward (all ages) skating laterally (8 and over), skating with the puck, stick handling, face off, passing, shooting, shadow positioning, goal keeper positioning	• Maximize aerobic activity • Accelerate to full speed with change of directions (cuts) • Introduce rotational head movements • Monitor for symptoms
5	Limited contact ice hockey drills	• Checking against held pad (10 and over); progress to Back in and cut off drill, curls, forecheck drill, open ice stand-up drill	• Maximize aerobic activity • Add deceleration/rotational forces in controlled setting • Monitor for symptoms
6	Full practice (after medical clearance)	• Normal training activities	• Assess frequently during line changes • Monitor for symptoms
7	Return to play	• Normal game play	• Assess frequently • Monitor for symptoms

- Progress to the next stage may occur every 24 hours as long as symptoms do not return.
- It is recommended that you seek further medial attention if you fail more than 3 attempts to pass a stage