

Chapter 10

FITNESS ASSESSMENT AND INTERVENTION

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INTRODUCTION

The effects of dizziness, imbalance, pain, and overall fatigue may render it less likely that a service member will maintain his or her accustomed level of conditioning, let alone sufficient conditioning to meet the comprehensive fitness needs for military responsibilities, following concussion/mild traumatic brain injury (c/mTBI). One role of physical therapists is to encourage active lifestyles and to

provide recommendations for service members whose injuries do not allow participation in previous fitness, sport, and leisure activities. Exercise may improve mood and aspects of health status in individuals with TBI.¹ Physical activity that results in increased cardiovascular fitness may improve cognitive status, including attentional control,² memory, and learning.³

RETURN TO SPORT

Guidance on a return to activity and sport following concussion is found in the sports medicine literature.⁴⁻⁶ Current guidelines suggest that athletic activity should not resume until after the physical signs and symptoms of concussion are no longer present at rest or with physical exertion, and cognitive deficits are fully resolved.^{5,6} The consensus statement on concussion in sport provides a six-stage return-to-play protocol.⁶ Return to play is a gradual process in which the individual is monitored for symptom complaints and cognitive function at each level of increased activity. Progression through stages occurs only if the individual is asymptomatic at the current level. Typically each stage requires 24 hours, and if symptoms return at a given stage, the individual is returned to the previous stage and progressed again 24 hours later. The stages include:

1. rest/no activity: complete physical and cognitive rest.

2. aerobic exercise only, consisting of light, short duration (10–15 minutes) activity, such as swimming, walking, or stationary cycling (less than 70% maximal predicted heart rate).
3. sport-specific training (eg, running, skating).
4. noncontact drills (including cutting and other lateral movements).
5. full contact, controlled training (requires medical clearance).
6. full contact game play.

These return-to-activity guidelines for sports concussion are typically based on symptom resolution, neuropsychological tests, and balance assessments, often with preinjury tests to determine a return to baseline function prior to resuming an activity. Additional study has been called for to facilitate understanding of the pathophysiological changes and recovery of cerebral blood flow and brain metabolism following concussion.⁷

POSTCONCUSSION SYNDROME

Persistent concussive complaints have been described as postconcussion syndrome (PCS). The World Health Organization defines PCS as persistence (beyond 4 weeks) of three or more of the following symptoms at rest: headache, dizziness, fatigue, irritability, or difficulties with sleep, concentration, or memory.⁸ Although concussion management guidelines developed in sport do not recommend exercise until symptoms have resolved at rest,^{5,6} these guidelines do not address treatment options when symptoms do not resolve at rest or return during exertion.

Investigators at University of Buffalo are conducting studies to address alternatives for individuals with persistent symptom complaints. Progressive aerobic exercise has been used to treat individuals with PCS 3 to 6 weeks after concussion

who have symptoms at rest and experience exacerbated symptoms with exercise.⁹⁻¹² This protocol begins with an incremental treadmill exercise test (standard Balke protocol) administered until the first sign of symptom exacerbation, which is then set as the athlete's maximum exercise intensity (heart rate and blood pressure). Supervised repetitive training is conducted at 80% of this predetermined symptom threshold, often resulting in improved function and reduced symptoms.¹⁰

The theory behind this treatment is that physiologic dysfunction affects the autoregulation of cerebral blood flow, mediated by autonomic dysfunction. This dysfunction causes exacerbated symptoms during exercise. Exercise at a level below the onset of symptom exacerbation is theorized to improve autonomic balance necessary for cerebral

blood flow autoregulation, thereby reducing symptoms during exercise and at rest.

In the University of Buffalo protocol, athletes are carefully monitored during all exercise and use both personal heart rate monitors and graded symptom reports to maintain exercise intensity at subsymptom exacerbation levels.^{10,12} Athletes retest at 2- to 3-week intervals to determine changes in their maximum exercise intensity level that produces onset of PCS symptoms. The athlete continues to exercise at 80% of the determined maximum intensity level. Evidence supports the safety of this subsymptom threshold aerobic exercise.^{9,10,12,13}

A commonly used symptom checklist (Graded Symptom Checklist) for sports concussion is provided in the return-to-play consensus document⁶ and is used during the University of Buffalo maximum exercise testing protocol. The Neurobehavioral Symptom Inventory-22¹⁴ is an alternative to this symptom checklist that has been studied to a greater degree following military mTBI.¹⁵

Based on the University of Buffalo study, service members with PCS of at least 3 to 6 weeks duration may be referred for a symptom-producing exercise test to determine individual subsymptom threshold for use in an exercise program.¹⁶ This type of program may be adapted using a bicycle ergometer (watts or other workload measure) instead of a treadmill, although the safety of this modification has not been evaluated.

Some additional considerations when evaluating a service member's fitness and developing exercise programs for use during recovery are as follows.

- It is important to assess a service member's pre- and postinjury level of participation (specifically frequency and duration) in aerobic and strengthening exercises.
- General exercise recommendations advise healthy adults aged 18 to 65 years get 30 minutes of moderate-intensity aerobic physical activity for a minimum of 5 days each week and muscular strength and endurance activities for a minimum of 2 days each week.¹⁷
- Therapists should determine a service member's ability to self-monitor exercise intensity through such measures as heart

rate, rate of perceived exertion, and metabolic equivalents. One method to monitoring exercise intensity is to use the guideline of 50% to 85% of age-predicted maximum heart rate as the target zone for exercise, which can be found at The American Heart Association's website (www.heart.org).

- It is important to screen patients for health risk factors prior to beginning or resuming an exercise or fitness routine.¹⁸ Service members with risk factors should be referred for medical clearance before resuming an exercise program. Information on risk factors is also included on the American Heart Association website, including risk factor calculators for heart attack and high blood pressure (www.heart.org). Risk factors that cannot be modified include increased age (over 65), heredity (both family history of heart disease and race), and sex (males are at greater risk). Modifiable risk factors include:
 - high blood cholesterol and triglyceride levels
 - high blood pressure
 - diabetes and prediabetes
 - overweight and obesity
 - smoking
 - lack of physical activity
 - unhealthy diet
 - stress
- Service member fitness testing standards and requirements can be accessed via the Human Performance Resource Center, a Department of Defense initiative under the Force Health Protection and Readiness Program.¹⁹
- Guides to testing and training for the Army include the Army Physical Readiness Training Quick Reference Card (GTA 07-08-003)²⁰ and the *Army Physical Readiness Training Manual* (Training Circular 3-22.20).²¹
- The Comprehensive Soldier Fitness Program and requirements can be used as a fitness target as soon as appropriate in a service member's rehabilitation program to encourage military readiness (see Warfighter Fitness, below).

WARFIGHTER FITNESS

As a service member recovers from c/mTBI and resumes fitness training, the therapist should encourage activities that stress agility, flexibility, stability, speed, power, balance, coordination, and

posture. These factors are promoted as essential for injury prevention and performance optimization in the Comprehensive Soldier Fitness program. This program, introduced in 2010, focuses

on meeting the comprehensive needs for soldier readiness and expands beyond the prior emphasis on muscular endurance (push-ups, sit-ups) and cardiorespiratory fitness (1- to 2-mile runs) that was intended to prepare service members for annual fitness testing. All branches of the military are focused on total force fitness, noting the importance of mind, body, family, and environment for overall fitness.²²

Newer fitness training protocols recognize the need for training specificity depending on individual military occupation specialty and mission

tasks.²² Therapists should consider the following four components of physical fitness training²³ when implementing training activities (Table 10-1). The Army Medical Department has developed detailed training regimens for service members training for duty and those who are injured (available on the Army Medical Department’s intranet).²⁴ These resources are extensively illustrated and recommend exercises and how to progress them, as well as guide ongoing training regimens based on fitness level and stage of deployment preparation or injury recovery (Form 10-1).

TABLE 10-1
COMPONENTS OF PHYSICAL FITNESS TRAINING

Physical Fitness Components	Example Activity Types
Endurance training (repetitive activities at low workload)	Swimming Long-distance running Cycling Elliptical trainers
Mobility training (speed, balance, jumping, directional change)	Plyometrics Speed (sprint) training, including directional change
Strength training (increase ability to generate force and power)	Weight training regimes adjusting: Load Repetitions Rest time between sets Core stability programs
Flexibility training (avoid hypo- or hypermobility)	Muscle-specific static stretching programs

FORM 10-1
EXERCISE LOG

Exercise log for week of _____

Weekly Exercise Goals:				
		Goals Set	Goals Met/Not Met	
Number of Days of Cardiovascular Exercise				
Number of Days of Strength Training				
Date	Type of Exercise	Intensity	Duration (minutes)	Comments
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 	<ul style="list-style-type: none"> ✓ Heart Rate ✓ RPE ✓ Repetitions/sets 		
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training 			

	<ul style="list-style-type: none"> • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			
	<ul style="list-style-type: none"> • Aerobic • Strength Training • Other 			

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