

Development of Clinical Recommendations for Progressive Return to Activity After Military Mild Traumatic Brain Injury: Guidance for Rehabilitation Providers

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Abstract:

Objective: Previously published mild traumatic brain injury (mTBI) management guidelines provide very general recommendations to return individuals with mTBI to activity. This lack of specific guidance creates variation in military rehabilitation. The Office of the Army Surgeon General in collaboration with the Defense and Veterans Brain Injury Center, a component center of the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury, convened an expert working group to review the existing literature and propose clinical recommendations that standardize rehabilitation activity progression following mTBI.

Participants: A Progressive Activity Working Group consisted of 11 Department of Defense representatives across all service branches, 7 Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury representatives, and 8 academic/research/civilian experts with experience assessing and treating individuals with mTBI for return to activity. An expert working group meeting included the Progressive Activity Working Group and 15 additional subject matter experts.

Methods: In February 2012, the Progressive Activity Working Group was established to determine the need and purpose of the rehabilitation recommendations. Following literature review, a table was created on the basis of the progression from the Zurich consensus statement on concussion in sport. Issues were identified for discussion with a meeting of the larger expert group during a July 2012 conference. Following development of rehabilitation guidance, the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury coordinated a similar process for military primary care providers.

Results: End products for rehabilitation and primary care providers include specific recommendations for return to activity after concussion. A 6-stage progression specifies activities in physical, cognitive, and balance/vestibular domains and allows for resumption of activity for those with low-level or preinjury symptom complaints.

Conclusions: The clinical recommendations for progressive return to activity represent an important effort to standardize activity progression across functional domains and offer providers

duty-specific activities to incorporate into intervention. Recommendations were released in January 2014.

Keywords: balance; cognition; concussion; exertional progression; mild traumatic brain injury; military mild traumatic brain injury; progressive return to activity; vestibular

Many service members (SMs) in deployed and garrison settings experience traumatic brain injury (TBI). More than 294 000 SMs sustained TBI between 2000 and 2013.¹ The majority (82.5%) of these injuries were mild (mTBI), also known as concussion.¹ Early identification and treatment of mTBI may mitigate impairments and decrease disability; however, clinicians lack evidence-based guidance for optimal progression of activity during recovery.²

Military medical practitioners currently rely on published guidance developed by the civilian sector, the Department of Veterans Affairs (VA), and/or the Department of Defense (DoD) to inform clinical return to duty decisions after mTBI. The widely accepted Zurich Consensus statement³ and recent revision⁴ and the VA/DoD clinical practice guideline (CPG) for management of concussion/mTBI⁵ recommend that patients with mTBI gradually return to normal activity after subjective symptoms resolve. The Zurich guideline^{3,4} focuses on sports-related physical activity, and was an important foundation for development of the VA/DoD guideline, incorporating clinical experience and expert consensus. Although SMs share similarities with athletes, guidance for sports-related concussion is not always relevant to military contexts and does not incorporate the complexities of military demands, decision making under stressful conditions, and multitasking in extreme environments. Progression of nonphysical activity is also not clearly addressed in current guidelines, even though SMs with mTBI may demonstrate dysfunction in other domains such as cognitive and balance/vestibular function.

The DoD developed the Concussion Management Algorithms (CMAs) to provide guidance on screening, diagnosis, and basic symptom management after acute concussion.⁶ Current DoD policy, DoDI 6490.11,⁷ prescribes a set of commander actions after defined potentially concussive events, and mandates a 24-hour rest for any SM involved in such events. A minimum 7 days of rest is required for those diagnosed with 2 concussions in the past 12 months. Those who sustain 3 concussions within a 12-month period must undergo rest and a recurrent comprehensive concussionevaluation.

For those with a first concussion, a gradual return to activity is recommended once the SM is free of concussionsymptoms after the 24-hour rest. Although the CMAs provide guidance for screening and diagnosis of acute concussion as well as basic symptom management and referral, they *do not specify activity progression for SMs who remain symptomatic* after the initial 24-hour rest period nor do they address specific guidance for mTBI acute management in the nondeployed setting. The Department of the Army published analogous guidelines for the nondeployed setting in June 2013.⁸ These also did not address specifics of activity progression.

To address these clinical guidance gaps, the Office of The Army Surgeon General requested the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE) to develop a clinical recommendation to specifically standardize a progressive or graded return to activity after mTBI. The purpose of this article is 3-fold: (1) to summarize the development process used and recommendations for guiding return to activity for SMs after mTBI who have symptoms that persist beyond 24 hours regardless of the environment (deployed or garrison); (2) to discuss how this clinical recommendation relates to previously established guidelines and mandates developed by the DoD and VA; and (3) to describe how the recommendations for rehabilitation providers relate to guidance developed subsequently for military primary care providers.

Methods

Target population and questions

The Progressive Return to Activity Following Mild TBI Working Group (PAWG) was charged with developing a clinical recommendation for progressive rehabilitation activities that relate to return to military duty after mTBI. Objectives of the PAWG were to develop guidance for primary care providers, and therapists regarding activity progression for SMs with postconcussive symptoms persisting beyond the initial 24-hour rest period. A subgroup of the PAWG included DoD representatives (across service branches), DCoE representatives, and rehabilitation specialists from academic/research/civilian sectors, all with experience assessing and treating individuals with mTBI for return to activity. In April 2012, the PAWG subgroup began an iterative process via regular teleconferences to implement preliminary steps to meet the overall PAWG charge. Terminology and definitions were selected, literature was selected and reviewed, and a plan was devised for a face-to-face meeting of the Expert PAWG in July 2012 that involved additional subject matter experts to refine work by the PAWG subgroup.

Literature review

Numerous consensus position and policy statements for sports-related concussion describe graded exercise assessment and staged return to activity. Current guidelines have generally been developed on the basis of literature review, clinician experience, and expert consensus, even those that are widely accepted as the best practice. These guidelines require that patients be *asymptomatic* before returning to activity and advocate rest to reduce symptoms. The PAWG clinical recommendation development process included a systematic literature review conducted by the Defense and Veterans Brain Injury Center (DVBIC). A systematic search strategy used search terms as noted in Supplemental Table 1 (<http://links.lww.com/JHTR/A130>).

Article inclusion criteria were limited to original articles written in English or translated into English, published between 2002 and 2012 (older articles were included when needed to provide necessary background information or seminal findings), studies involving return to duty/activity and patients with mTBI, moderate TBI, and/or severe TBI, as well as prevalence studies/literature related to return to duty from mTBI or concussion. Only studies of humans aged 16 years and more were included in the review.

After the initial literature search, 2 independent DVBIC reviewers examined 50 abstracts and recommended full article review if the article or study included the mild TBI/concussion population and components of a progressive or graded approach to return to activity after mTBI identifying 31 recommended sources. A full review and summary of 31 sources identified by the 2 reviewers was completed. The summaries were reviewed by the PAWG subgroup for strength of evidence, applicability to the mTBI population, and inclusion of activities related to physical, cognitive, or vestibular/balance domains. Twenty-two articles, consensus statements, and CPGs were used as foundation for the development of the clinical recommendation. Because the final recommendation was not made available until 2014, additional literature that related to the guidance was reviewed by the DVBIC and considered in the final products.

Key findings from literature review

Source articles were graded using the United States Preventative Services Task Force (USPSTF)⁹ criteria assigning the level of evidence:

- At least one properly done randomized controlled trial
- Well-designed controlled trial without randomization
- Well-designed cohort or case-control analytic study, preferably from more than one source
- Multiple time series evidence with/without intervention, dramatic results of uncontrolled experiment
- Opinion of respected authorities, descriptive studies, case reports, and expert committees

Levels of evidence were determined on the basis of the study design, including categories of systematic reviews, case-control studies, randomized controlled trials, cohort studies, and diagnostic accuracy studies (see Table 1).^{3, 10-30} The majority of the literature published pertinent to this process was the lowest level, III, including 13 articles that were consensus or position statements. Four articles represented the highest level of evidence in this review of II-2, followed by 5 articles at the II-3 level. There were no clinical trials or controlled trials without randomization to guide return to activity after concussion. In addition, there was an absence of agreement in the definition of concussion, and a paucity of literature involving military cohorts.

Insert TABLE 1

Rest is a primary recommendation for the management of mTBI in most guidelines, but guidance on what defines rest and the optimal duration of rest is often nonspecific.²⁷ Rest seems to benefit high school and collegiate athletes at various points after injury. One week of cognitive and physical rest improved cognitive scores and symptom reports no matter when rest was prescribed.³¹ However, others question the blanket use of rest for treatment beyond the acute period postconcussion, using graded exercise guided by careful physiologic monitoring even when symptoms persist.²²

The PAWG subgroup members identified relevant new literature as it was being published during the process. One example was Silverberg and Iverson³² that recommended gradual resumption of preinjury activities as soon *as can be tolerated*, with the exception of high-risk activity that could result in another concussion. The authors raised the possibility that prolonged rest for those with persistent symptoms may have *negative effects*, consistent with the deleterious effects of inactivity for other health conditions such as chronic pain, chronic fatigue syndrome, and vestibular dysfunction.³² Consistent with this message, case series and case-control studies have demonstrated that graded exercise at levels below concussion symptom exacerbation seems to be beneficial for those with persistent concussive symptoms.^{12, 23, 24}

Most of the literature suggested using a conservative approach after sports concussion, advocating additional rest as feasible and sensible in civilian settings with activity resuming when the patient is asymptomatic. This approach in the military context is more challenging, particularly in a combat environment. Current DoD CPGs provide recommendations for return to full activity for SMs with mTBI without specific activity and rest parameters. The VA/DoD CPG for Management of Concussion/mTBI recommends that patients with mTBI gradually return to normal activity as soon as possible.⁵ However, details of the return to activity protocol are not provided. In addition, once asymptomatic, exertional testing is recommended to confirm that return to duty is appropriate. An array of possible exercises such as sit-ups, push-ups, running in place, step aerobics, stationary bike, treadmill, and/or hand crank are described for exertional

testing but without clear guidance for implementation.⁵ Concussion Management Algorithms outline DoD policy that specifies the amount of rest *time* but not the nature of rest itself. The CMAs do not provide a graduated protocol for return to preinjury activity or duty.⁶

Progression draft development

The subgroup of the PAWG group examined 5 protocols that included specific guidance for return to activity or provided guidance pertinent to the military population: (1) US Army Special Operations Command (USASOC) Guidelines for Post-Concussion Rehabilitation,²⁷ (2) TBI Exertional Testing Procedure for the Joint Theater Trauma System CPG for Management of mTBI/Concussion in the Deployed Setting,³³ (3) Graduated Return to Play Protocol from the 3rd International Conference on Concussion in Sport in Zurich Consensus Statement,³ (4) Graduated Exertional Return to Play Protocol From University of North Carolina at Chapel Hill,³⁰ and (5) British Columbia Concussion Rehabilitation Program.¹⁸ These protocols describe exercise progression in 2 to 6 stages with levels of exertion inconsistently defined by the target heart rate. Although the Zurich return to play protocol is often cited,³ the descriptors in the staged exercise table are quite broad, even in the revised form published in 2013.⁴ Nevertheless, the 6-level activity progression from the Zurich consensus conference³ served as a framework for the PAWG clinical recommendation. On the basis of literature review and expert consensus, the table was expanded to include objective benchmarks and parameters for 6 stages of activity. Progressions for physical exertion and sports activities, cognition, and balance/vestibular function were outlined in detail for the PAWG to discuss and modify. After literature review, teleconference discussions, and subgroup activities, several issues and questions had not been resolved including best practice for symptom monitoring, clarification of appropriate rest and activity, and optimal timing of stages of exercise. These issues were posed for the Expert PAWG meeting to discuss and arrive at consensus recommendations(see Table 2).

Table 2

Symptom monitoring	Rest and activity clarification	Timing of exercise stages
<ul style="list-style-type: none"> ● Provide clear definitions for describing symptoms that address (1) those who may have preinjury symptoms and/or (2) low-level symptoms that may be unrelated to concussion (eg, fatigue, dehydration, excess caffeine or nicotine use or withdrawal, acute or chronic stress reactions) ● Include relevant tools to provide guidance for progression such as symptom rating scales, ratings of perceived exertion, target heart rate levels, and others as appropriate 	<ul style="list-style-type: none"> ● Clarify what is meant by “rest” after injury including physical, cognitive, and functional activities ● Expand activity progression to include cognitive, physical, and balance/vestibular components consistent with impairments commonly seen after mTBI in the military context ● Include duty-specific activities in activity progression as well as exercises that are familiar across branches of service to enhance military relevance ● Assure that guidance is understandable to targeted providers ranging from combat medics to primary care providers as well as more specialized professionals 	<ul style="list-style-type: none"> ● Outline specifics of speed of progression through each stage ● Clarify how this guidance coordinates with other existing military guidelines for management of mTBI

Expert working group methodology

The DCoE convened the Progressive Return to Activity Expert Working Group Meeting on July 16 to 17, 2012, in Crystal City, Virginia, involving 17 members of the subgroup of

PAWG/DCoE team, and 15 additional SMEs from the DoD, VA, civilian, research, and academic settings with experience assessing and treating patients with mTBI for return to activity. Experts represented the professions of nursing, neurology, primary care, neuropsychology, occupational therapy, physical therapy, athletic training, speech-language pathology, psychology, physiology, and neuropsychology. Representatives from all military branches participated in the meeting. Additional SMEs were sought after the meeting as needed for specific topics and questions generated by the group.

After a brief discussion of the meeting purpose and pre-meeting activities, participants modified the draft progressive activity table and agreed on clinical guidance to assist military medical practitioners with managing return to activity after mTBI. Agreement on general issues occurred in the large group, whereas smaller subgroups revised progressions in specific exercise stages. The DCoE/DVBIC maintained records of discussions and modifications to the developing table of staged activities, prepared a meeting report, and led the effort to develop clinical tools in the appropriate format on the basis of the input from the expert group. The subgroup members of the PAWG and key expert consultants provided additional guidance on the content and format of the clinical tools after the Expert PAWG meeting, before the release of the clinical tool and summary in January 2014.

Results

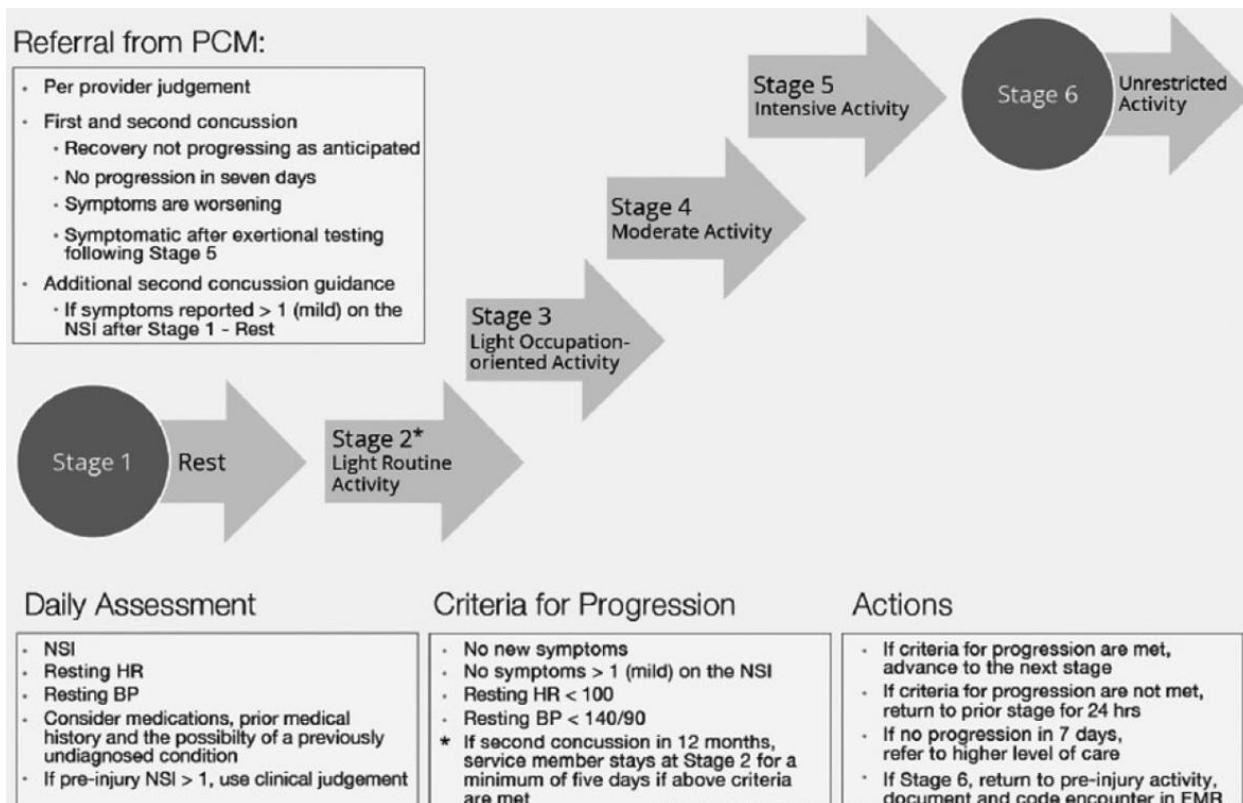
Key process milestones occurred in 2 distinct phases: preparation for the expert working group meeting and the conference of the Expert PAWG. Literature review highlighted gaps in guidance and ambiguous/conflicting evidence and provided questions for conference discussion with the intent of clarifying recommendations. Specific recommendations from the meeting included the integration of graded activity recommendations with other DoD guidelines, symptom monitoring, activity descriptions for physical, cognitive, and vestibular/balance domains, timing, and progression of stages.

Expert working group recommendations: integration of graded activity progression with other DoD guidelines

Current literature, expert inputs, and DoD policies recommend the assessment of clinical symptoms and domains that include physical signs, cognition, and vestibular/balance. The CMAs provide a specific structure for return to activity if an SM is exposed to a potential concussive event and is free of symptom complaints after the required 24-hour recovery period *and* remains free of symptoms after an exertional test.⁶ Individuals in this category would not participate in the graded return to activity progression.

Consistent with the Figure, SMs exposed to a potential concussive event who remain symptomatic after the 24-hour recovery period or are free of symptoms at rest, but become symptomatic after initial exertional testing, are candidates for the progressive return to activity clinical recommendation. Each stage lasts a minimum of 24 hours and provides specific activities that are permitted.

Figure 1



Coordination of care with primary care providers was an important objective of the process. As the Figure reflects, individuals who have sustained more than one concussion in a 12-month period would be managed more conservatively. These individuals would require additional days at stage 1 or stage 2 for a total of 7-day period of symptom resolution before finishing the remaining progressive activity stages.

Symptom monitoring

Previous protocols have used the term “asymptomatic” to indicate when a SM can progress to a higher level of activity. However, recent literature has noted that individuals who are not concussed often report the presence of general symptoms that may be associated with mTBI.¹¹ After literature review, the members of the PAWG agreed that symptoms fail to resolve completely in many cases, and agreed to avoid the use of the term “asymptomatic” in the clinical recommendation. As an alternative, symptom resolution was defined as return to self-reported preconcussion symptom baseline. The use of the Neurobehavioral Symptom Inventory (NSI-22)³⁴ tracks 22 common concussion symptoms, and has been used widely in veteran populations. The NSI-22 is composed of 3 or 4 factors identified with factor analysis. Meterko et al³⁵ provided justification for a 4-factor model in a large sample of veterans with mTBI: (1) 8 items—somatosensory complaints including pain; (2) 6 items— affective domain; (3) 4 items—cognitive function; and (4) 3 items—vestibular function. The use of these 4 factors may allow categorization of symptom profiles post-mTBI and improve understanding of treatments appropriate for each profile.

At the onset of the recovery period (mandatory 24 hours of rest), the NSI-22 is administered. Scoring criteria for the NSI are summarized in Table 3. NSI ratings must not be greater than “1” for any item before progression from one activity stage to the next. Before attempting each stage

of the progression, the NSI is readministered to ensure symptoms have not increased. Symptoms must *not be exacerbated* beyond the baseline level, including number, frequency, severity, or intensity of symptoms, before starting the next stage of the progression. If the criteria for progression are not met, activity returns to the prior stage that was tolerated without symptom increase for 24 hours. Individuals whose symptoms are worsening, are not progressing as anticipated, or do not progress in 7 days are referred to a higher level of care.

Table 3

NSI score	Symptom severity	Symptom frequency	Impact on function
0	None	Rarely if ever present	Not a problem at all
1	Mild	Occasionally present	Does not disrupt activities SM can usually continue activity Does not concern SM
2	Moderate	Often present	Occasionally disrupts activities SM can usually continue activity with effort SM is somewhat concerned
3	Severe	Frequently present	Disrupts activities SM can only do things that are fairly simple and take little effort SM feels the need for help
4	Very severe	Almost always present	SM is unable to perform at work, home, or school SM indicates that he/she probably cannot function without help

In addition to monitoring symptoms that inform readiness to continue step-wise activity progression, providers continually assess for “red flags” that may indicate an acute neurologic condition requiring urgent specialty consultation.^{5,6} These possible signs or symptoms are provided to the SM in patient education materials as reasons to contact the primary care manager immediately (see Box 1).

Box 1

- Altered consciousness
- Progressively declining neurological examination
- Pupillary asymmetry
- Seizures
- Repeated vomiting
- Double vision
- Worsening headache
- Cannot recognize people or is disoriented to place
- Behaves unusually or seems confused and irritable
- Slurred speech
- Unsteady on feet
- Weakness or numbness in arms/legs

Throughout the progression activity is graded in duration, but followed by rest to assess the effect of various activities on symptom complaints.

Activity descriptions

Table 4 provides an abbreviated summary of the activity progression, each stage requiring at least 24 hours to complete.

Table 4

Rehabilitation stage	Description of stage	Exertion level
1. Rest	Objective(s): <ul style="list-style-type: none"> Limit activity to promote recovery Restriction(s): <ul style="list-style-type: none"> No video games, study, driving 	Extremely light: <ul style="list-style-type: none"> RPE rating: extremely light, 6–8 HR not to exceed 40% of the age-adjusted theoretical maximum heart rate
2. Light routine activity	Objective(s): <ul style="list-style-type: none"> Initiate and promote limited effort in physical, cognitive, and balance/vestibular domains Restriction(s): <ul style="list-style-type: none"> Physical activity demands not to exceed 30 min, followed by 4-hr rest Cognitive activity for 30 min, followed by 1-hr rest No resistance training, video games, driving 	Extremely light to light: <ul style="list-style-type: none"> RPE rating: light, 7–11 HR not to exceed 55% of the age-adjusted theoretical maximum heart rate
3. Light occupation-oriented activity	Objective(s): <ul style="list-style-type: none"> Full body, complicated, coordinated movements Restriction(s): <ul style="list-style-type: none"> Activity demands not to exceed 60-min periods, followed by rest Lifting not to exceed 20 lb No valsalva, combatives, collision sports, video games, driving 	Light: <ul style="list-style-type: none"> RPE rating: 10–12 HR not to exceed 65% of the age-adjusted theoretical maximum heart rate
4. Moderate activity	Objective(s): <ul style="list-style-type: none"> Increase intensity and complexity of exercise and cognitive activity Improve ability to hold gaze stable during higher-level balance skills Restriction(s): <ul style="list-style-type: none"> Physical activity not to exceed 90-min intervals; follow activity with rest in 1:4 ratio Cognitive activity 20–40 min, with rest 1:2 ratio 	Somewhat hard to hard: <ul style="list-style-type: none"> RPE rating: somewhat hard, 12–16 HR 70%–85% of the age-adjusted theoretical maximum heart rate
5. Intensive activity	Objective(s): <ul style="list-style-type: none"> Duration and intensity of activity parallels SM typical role function(s) and tempo Resistance training to maximum Restriction(s): <ul style="list-style-type: none"> No combatives, no contact, or collision sports Cognitive activity up to 50 min 	Very hard to maximal exertion: <ul style="list-style-type: none"> RPE rating: very hard, ≥ 16 HR 85%–100% of the age-adjusted theoretical maximum heart rate
6. Unrestricted activity	Objective: <ul style="list-style-type: none"> Normal duty Restriction(s): <ul style="list-style-type: none"> None 	As required to accomplish duty

The clinical support tool³⁶ describing detailed demands and activities in 3 areas—physical, cognitive, and vestibular/balance—is provided in Supplemental Table 2 (<http://links.lww.com/JHTR/A131>). For complete information on multiple rehabilitation components developed to guide the use of the progression including the clinical recommendation, clinical support tool and patient education tool, refer to <http://dvbic.dcoe.mil/resources/progressive-return-to-activity>.

Physical demands are guided by the use of Borg ratings of perceived exertion (RPE)³⁷⁻⁴⁰ and target heart rate ranges on the basis of the age-adjusted theoretical maximum heart rate⁴¹ that relate to workload metabolic equivalents.⁴²⁻⁴⁴ Activity at any stage is halted if the resting blood pressure exceeds 140/90 mm Hg or the resting heart rate exceeds 100. With objective benchmarks at each stage including Borg levels of perceived exertion, target heart rate ranges, and reference to activity on the basis of preinjury fitness testing, activity progression can be individualized.

Activity begins with rest in stage 1 with physical activity increases in 30-minute increments building to intensive activity in stage 5, before resumption of full duty, stage 6. The cognitive progression reflects environmental conditions (eg, exposure to light and noise), and visual and cognitive demands that could exacerbate symptoms. The balance and vestibular progression requires gradual resumption of head and body movement, increasing dynamic balance demands, activities that require gaze stabilization during movement, and movement during various terrain and visual conditions. An overview of considerations for each stage follows:

In accordance with the DoDI 6490.11,⁷ the CMA,⁶ and Department of the Army concussion/mTBI guidelines for the nondeployed setting,⁸ any SM who has sustained a concussion has a mandatory minimum 24-hour recovery period. If symptoms remain after this recovery period (for the first concussion) or it is the second concussion in 12 months, an additional 24-hour period of rest (stage 1) is required. If following this rest, the SM is asymptomatic, exertional testing is completed. If symptoms occur with exertion or the SM remains symptomatic at rest, the SM continues the return to activity progression.

Stage 1 (rest): It permits extremely light physical, cognitive, and vestibular-balance activity with the goal of symptom resolution. Sleep during this stage is encouraged as needed to foster recovery, but activities of daily living in a quiet environment with low light is recommended. Slow and limited head and body movement is encouraged to minimize vestibular symptoms.

Stage 2 (light routine activity): On the following day, if symptoms are not rated more than 1 on the NSI and are not increased over ratings in stage 1, stage 2 can be initiated. Stage 2 requires limited effort, including light aerobic activity such as treadmill walking and stationary cycling for up to 30 minutes. Activities that cause Valsalva or straining (sit-ups, pull-ups, push-ups) are not allowed. No repetitive lifting, resistance training, video games, driving, and time spent in crowded environments where jostling may occur are permitted. Familiar simple cognitive activities (reading, computer use) can be attempted for up to 30 minutes, followed by 60 minutes of rest between cognitive activities. Balance and vestibular activities that require bending, and gradual increases in head and body movement within the daily routine are encouraged. Periods of rest follow activity in each domain, to observe for symptoms or complaints clarifying areas where additional graded progression may be necessary.

Stage 3 (light occupation-oriented activity): If symptoms are not increased with stage 2 activities based on NSI ratings, stage 3 activities can begin. Stage 3 involves light occupation-oriented activities that combine physical, cognitive, and/or vestibular and balance skills that relate to SM occupational duties. Physical activity during this stage is not to exceed 60 minutes using RPE and heart rate guidelines, but may include elliptical trainer and stair climber aerobic exercise, followed by rest. Other exertional exercise is introduced gradually with sit-ups, pull-ups, and push-ups at no more than 25% of repetitions on most recent fitness test. More complex cognitive activities are allowed in 30-minute intervals, followed by 60 minutes of rest. Increased exposure

to light and noise distractions are recommended, along with increased balance and vestibular challenges that require visual focus during movement of the head or body, and navigation of more complex terrain and environments.

Stage 4 (moderate activity): If symptom reports remain stable and are not more than 1 on NSI items, progression to stage 4 can proceed the following day. The goal of this stage is to increase the intensity and complexity of exercise, cognitive, and balance activity. Physical activity duration increases up to 90 minutes in this stage, with only noncontact exercise including sports-specific skills (shooting basketball, jump rope, swimming including flip turns), followed by rest in a 1:4 (exercise/rest) ratio. Cognitive activity is challenged for a minimum of 20 minutes, not to exceed 40 minutes, followed by rest in a 1:2 (cognitive activity/rest) ratio.

Stage 5 (intensive activity): The following day, if symptoms remain stable and are not more than 1 on NSI items, stage 5 can begin. Combatives, contact, or collision activities are not allowed, but the intensity of physical, cognitive, and balance/vestibular challenges approaches full exertion, paralleling an SM's typical role and function. Cognitive and vestibular challenges are increased at this stage, with cognitive activities up to 50 minutes in duration that include environmental conditions that require exertion and include distractions. Balance and vestibular challenges should approach the duty demands for the SM, and therefore may include navigating rough terrain with a full load, running in low-light conditions, simulations, and virtual-reality environments. Progression across each of the physical, cognitive, and vestibular/balance domains in stage 5 is required before moving to stage 6. Individuals postconcussion have varied patterns of symptom complaints; therefore, progression along physical, cognitive, and balance/vestibular domains may be asymmetric (eg, a SM may have little to no symptom complaints with physical exertion, but require a slower progression to avoid symptoms with cognitive challenges).

Stage 6 (unrestricted activity): The goal of this stage is to return to duty and other life activities without restriction. Service members should return for provider assistance if symptoms return or increase in severity.

Timing of progression through stages

A standardized approach to graded activity was recommended by the workgroup. In general, if symptoms are exacerbated during a stage, the SM must stop the activity that increases symptoms and rest for the remainder of the day. The next morning they may attempt the stage from the previous day. If symptomatic, they must return to the prior stage where they were asymptomatic (scores of 0–1 on the NSI). This progression may be completed in as short as 6 days for the first concussion and 10 days or more for the second concussion. Recovery may take as long as needed for the SM to be at the preinjury symptom level or without symptoms reported above 1 on NSI items. The goal is to progress functional abilities across physical, cognitive, and balance/vestibular domains without exacerbation of symptoms. The use of adequate rest after activity, guided by objective and self-report parameters, encourages symptom resolution and full recovery. If an individual remains at any stage of the progression for 7 days or more, referral to a higher level of care is required.

In addition, if “red flags” are observed during or after exertion at any stage of the progression, referral to a higher level of care is required. If the progression increases demands systematically and progressively, providers must observe for any change that provokes symptoms and modify demands on the basis of the observed responses. This approach provides consistent monitoring to ensure safety while encouraging an expectation for recovery after mTBI. Duty requirements for

SMs vary widely in physical and cognitive demands. Sample activities and exercises for each domain of activity were generated to illustrate each phase of the progression. The panel also agreed that addressing musculoskeletal issues that could be a cause of concussion symptoms (eg, headache) should be a part of overall management.

Subsequent to the rehabilitation recommendation development, the DVBIC developed a companion clinical recommendation “Progressive Return to Activity Following Acute Concussion/Mild Traumatic Brain Injury: Guidance for Primary Care Manager in Deployed and Non-deployed Settings”⁴⁵ that provides a framework for primary care management of the SM with concussion, including when to refer to a rehabilitation provider. Both recommendations were carefully analyzed to maintain consistency with current DoD policies. A patient education brochure and stage-by-stage patient instructions for progressive activity were also developed. These tools are also available at dvbic.dcoe.mil.

Conclusion

This clinical recommendation synthesized published literature and expert experience and inputs representing the services, VA, and academic, research, and civilian sectors. The progression was further supported by review and approval of military stakeholders including the Defense Department's TBI Quad Services Cell, which includes Army, Navy, Marine Corps, and Air Force; DVBIC; National Intrepid Center of Excellence, VA; U.S. Central Command; and Force Health Protection and Readiness.

The activity progression is an expansion of previous expert recommendations, providing modifications in the rate of progression, specific durations of activity and rest, and illustrative examples of activities at each stage of the progression, on the basis of experiences of practitioners treating mTBI in the military and a diverse group of subject matter experts. Although these clarifications may be beneficial to standardize “best practice,” it is important to acknowledge that these recommendations are also based on expert inputs and have not been empirically tested. The recommended activity progression must be examined in a research context to determine the extent to which progressions in each area (physical, cognitive, and vestibular/balance) are required and to evaluate the outcomes associated with the progression.

It is likely that each individual who sustains mTBI has a specific profile of symptoms and impairments that requires treatment and activity progression related to their complaints. The activity progression, by standardizing language and challenges that are pertinent to the military, may allow for the complexity of postconcussion intervention to be studied more systematically, and for targeted treatments to be developed. Links to existing CMA guidance reduce existing gaps in care, to further standardize treatment.

Although the clinical recommendation tool provides a structure for the management of concussion, providers must continue to use expertise and judgment, consider patient history of concussion, response to activity progression, and operational requirements in designing treatment for an individual case. The safety of the SM with mTBI remains paramount.

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