CLINICAL PRACTICE

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Sport-Related Concussion

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This Journal *feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author s clinical recommendations.*

A 17-year-old female high school soccer player presents to the primary care office 5 days after striking the back of her head on the ground during a game. She did not lose consciousness but had a headache and dizziness and had been observed to have a wobbly gait as she walked off the field. She has had persisting symptoms (dizziness, nausea, trouble falling asleep, photosensitivity, and headache) that have kept her out of school. She had had a concussion 2 years earlier that took 4 weeks to recover from fully. On examination, her vital signs are normal, but she reports lightheadedness on standing. On confrontation visual testing, her eye movements are not smooth, and she has increased dizziness while finger-tracking back and forth slowly across her visual field (smooth-pursuit eye movements). Motion of the cervical neck is painful, with muscle tenderness. During tandem gait testing for balance assessment, in which the patient walks in a straight line with one foot in front of the other, she takes a sidestep multiple times. During a tandem stance test, in which the patient stands with one foot in front of the other, she takes a sidestep four times in a 20-second period. How would you further evaluate and treat this patient? When can she return to school and soccer?

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CME

THE CLINICAL PROBLEM

The recent American Congress of Rehabilitation Medicine diagnostic criteria[1] define concussion as a mild traumatic brain injury (TBI) and indicate that these terms can be used interchangeably when results of neuroimaging are normal or when neuroimaging is not clinically indicated. The descriptor mild does not mean that the brain injury is trivial, rather that no trauma-related intracranial abnormality is seen on computed tomographic or structural magnetic resonance imaging (MRI) scans.[1] The consensus statement from the Sixth International Conference on Concussion in Sport,[2] held in Amsterdam in 2022, defines sport-related concussion as a traumatic brain injury caused by a direct blow to the head, neck, or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities . Symptoms and signs may present immediately, or evolve over minutes or hours, and commonly resolve within days, but may be prolonged. Preexisting and cooccurring health conditions (e.g., migraine and depression) should not fully account for the clinical signs, acute symptoms, or clinical examination findings.[3] These formal definitions are consensus definitions to facilitate research.

KEY POINTS

SPORT-RELATED CONCUSSION

- Sport-related concussion is a mild traumatic brain injury that typically resolves within weeks, but symptoms may persist beyond 1 month.
- Diagnosis depends on relevant signs and symptoms appearing within 72 hours after injury as well as on vestibular and oculomotor findings. Adjunctive tests such as exercise testing are not typically necessary for making the diagnosis.
- Cervical injury often accompanies concussion and, if untreated, may delay recovery.
- Cognitive, mood, and sleep problems frequently have psychosocial origins that may be preinjury conditions that were exacerbated by the concussion.
- Strict cognitive and physical rest (referred to as cocooning) does not facilitate recovery.
- Light physical activity and graduated aerobic exercise that are tailored to symptoms and heart rate and that are initiated within 24 to 72 hours after injury facilitate recovery and reduce the incidence of symptoms persisting beyond 28 days.

Concussion or mild TBI affects approximately 42 million persons worldwide each year,[4] including 1.6 to 3.8 million sport-related concussions in the United States.[5] Risk factors include previous concussion, game or match play (as opposed to practice sessions), adolescent age, attention deficit hyperactivity disorder or learning disability, and personal or family history of migraine or mental health problems.[6] In a recent cohort study, female soccer players had a higher incidence of concussion than male soccer players, and regardless of sex, the incidence of concussion was higher among goalkeepers than among forwards.[7] The acute clinical signs and symptoms of concussion largely reflect a physiological disturbance rather than structural injury, so no traumatic abnormalities are seen on standard neuroimaging studies.[2]

STRATEGIES AND EVIDENCE

DIAGNOSIS

Concussion is a clinical diagnosis that is based on a detailed history, a concussion-relevant physical examination,[8] and adjunct testing (e.g., exercise testing)[2] when indicated. Obtaining some of the history from an observer is helpful. Loss of consciousness is uncommon after sport-related concussion, is typically brief (<1 minute), and as opposed to post-traumatic amnesia, is not associated with worse outcome.[9] After a plausible mechanism of injury (e.g., vigorous acceleration deceleration of the head, the head being struck by a hard object, or the head striking the ground), concussion-related symptoms and signs (Table 1) typically appear or worsen within minutes to hours but sometimes may be delayed for up to 72 hours.[1] The 72-hour time frame for headache to appear and to count toward a diagnosis of concussion or mild TBI is shorter than the 7-day period that is allowed for the diagnosis of post-traumatic headaches.[10] Abnormal vestibular findings (e.g., on the tandem gait test, in which the patient walks in a straight line with one foot in front of the other) and oculomotor findings (e.g., abnormal repetitive saccades) are common on examination and help to establish the diagnosis beyond subjective symptoms.[11] Lightheadedness on standing suggests orthostatic intolerance from autonomic nervous system baroreflex impairment.[12] Exercise intolerance (i.e., the inability to exercise to the maximum level expected for the patient owing to the exacerbation of concussion symptoms) is common. If there is uncertainty about the diagnosis, exercise testing (e.g., with the Buffalo Concussion Treadmill Test)[13] within 14 days after injury has excellent sensitivity (94.4%; 95% confidence interval [CI], 90.8 to 97.2) and specificity (94.6%; 95% CI, 91.1 to 97.3) as compared with the standard of expert clinical examination for the diagnosis of sport-related concussion.[14]

Athletes should be removed from activity immediately if a concussion is suspected in order to avoid another such event, which would worsen the concussion and prolong recovery.[15] A study of the natural history of concussion involving athletes in the National Collegiate Athletics Association (NCAA)[16] showed that many athletes returned to participation within the same game or 1 day after the concussion and often had another concussion within 7 to 10 days after returning to play. Now, athletes are given additional time for brain recovery, which has reduced

Table 1. Signs and Symptoms of Concussion or Mild Traumatic Brain Injury.

Domain	Symptoms	Signs
Cognitive	Confusion, feeling in a fog or zoned out, inability to focus	Anterograde amnesia, retrograde amnesia, loss of consciousness, disorientation, delayed verbal and motor responses, vacant stare, slurred or incoherent speech
Somatic	Headache, dizziness, nausea or vomiting, visual disturbances, photophobia or blurry or double vision, phonophobia	Balance disruption, abnormal eye tracking, abnormal vestibulo-ocular reflex, abnormal near-point convergence
Affective	Emotional lability, irritability, fatigue, anxiety, sadness	Irritable behavior, flat affect
Sleep disturbance	Trouble falling asleep, sleeping more or less than usual	Excessive drowsiness

the risk of repeat concussion during the critical period of early cerebral vulnerability.[17]

Most athletes recover within days to a few weeks after sport-related concussion.[18] Nevertheless, approximately one third of untreated adolescents will have symptoms that persist for more than 4 weeks.[19] The term post-concussion syndrome is no longer used; the current preferred term is persisting symptoms after concussion. Patients often have multiple causes of persisting symptoms (e.g., vestibular dysfunction and cervical injury), and the symptoms frequently overlap.[20,21] The differential diagnosis of persisting symptoms depends on a symptom assessment that is temporally related to a TBI, as well as on the medical history (e.g., anxiety or migraine), abnormal examination findings in the vestibular and oculomotor subsystems (objective abnormalities and symptom exacerbation),[8] and examination of the cervical spine.

Cervical injury frequently accompanies concussion,[22] produces similar symptoms (e.g., dizziness and cervicogenic headache),[23] and is a risk factor for persisting symptoms.[22] Early treatment of cervical injury facilitates symptom resolution and medical clearance to return to sport after concussion.[22]

Cognitive, mood, and sleep problems frequently have psychosocial origins that may be exacerbated by concussion.[2,20] Measurement of these symptom burdens with the use of validated instruments to assess mental health and sleep quality (e.g., the Sport Mental Health Assessment Tool 1[24]) can be useful.

The strongest predictor of persisting symptoms is the burden (i.e., number and severity) of symptoms in the first days after injury.[2] The 5P (Predicting and Preventing Postconcussive Problems in Pediatrics) study,[19] which involved 3063 patients (median age, 12 years) who were seen in the emergency department a mean of 3 hours after injury, developed a clinical score for the risk of persisting symptoms beyond 28 days (range, 0 to 12, with higher scores indicating a higher risk of persisting symptoms after concussion) (Table 2). The score was validated in the original study[19] and in a subsequent study conducted in an outpatient setting.[25] A score of 4 to 8 points, consistent with medium risk, had high sensitivity, and a score of 9 to 12 points, consistent with high risk, had high specificity for predicting symptoms persisting beyond 4 weeks. In a prospective cohort study involving 230 children (mean age, 15 years; 50% of whom were female) who were seen within 1 week after injury in the clinical office setting, 82% of the participants with a 5P score of 9 to 12 points had symptoms that persisted for more than 28 days (area under the curve, 0.75; 95% CI, 0.66 to 0.84).[25]

MANAGEMENT

The Amsterdam statement[2] recommends that all patients with concussion be followed serially in the clinical office setting beyond 72 hours after injury and in the following weeks. New freely available tools, such as the Sport Concussion Office Assessment Tool 6 (SCOAT6), which is used in adults and adolescents (Fig. S1 in the Supplementary Appendix, available with the full text of this article at NEJM.org), and the Child SCOAT6, which is used in persons younger than 13 years of age (Fig. S2), are clinical guides to management, although they await prospective validation.[26] A suggested clinical approach to the

Table 2. 5P Risk Score for Persisting Symptoms after Concussion in Children and Adolescents.*

Factor and Description	Score
Age	
13 to <18 yr	2
8 to <13 yr	1
5 to <8 yr	0
Sex	
Female	2
Male	0
Longest duration of previous concussion	
Symptoms lasted ≥1 wk	1
No previous concussion or symptoms lasted <1 wk	0
History of migraine	
Yes	1
No	0
Slowness in answering questions	
Yes	1
No	0
Balance errors on tandem stance testing	
≥4 Errors or could not complete	1
0 3 Errors	0
Headache	
Yes	1
No	0
Sensitivity to noise	
Yes	1
No	0
Fatigue	
Yes	2
No	0

* Adapted from the Children s Hospital of Eastern Ontario Research Institute (https://www.cheoresearch.ca/research/projects/clinical-risk-score-for-persistent-postconcussion-symptoms-among-children-with-acute-concussion-in-the-ed/). The 5P (Predicting and Preventing Postconcussive Problems in Pediatrics) risk score is a clinical score for assessing the risk of symptoms of concussion persisting beyond 28 days. Total scores range from 0 to 12, with a score of 0 to 3 indicating low risk, 4 to 8 indicating medium risk, and 9 to 12 indicating high risk.
In the tandem stance test, the patient stands heel to toe on a firm surface with the nondominant foot (defined as the leg opposite the preferred kicking leg) in the back. The heel of the dominant foot should be touching the toe of the nondominant foot. Hands are on the hips, and eyes are closed. The patient should attempt to hold the position for 20 seconds. Any of the following counts as an error: a step, stumble, or fall; moving the hands off the iliac crests; opening the eyes; abduction or flexion of the hip beyond 30 degrees; lifting the forefoot or heel off the testing surface; or remaining out of the proper testing position for more than 5 seconds.

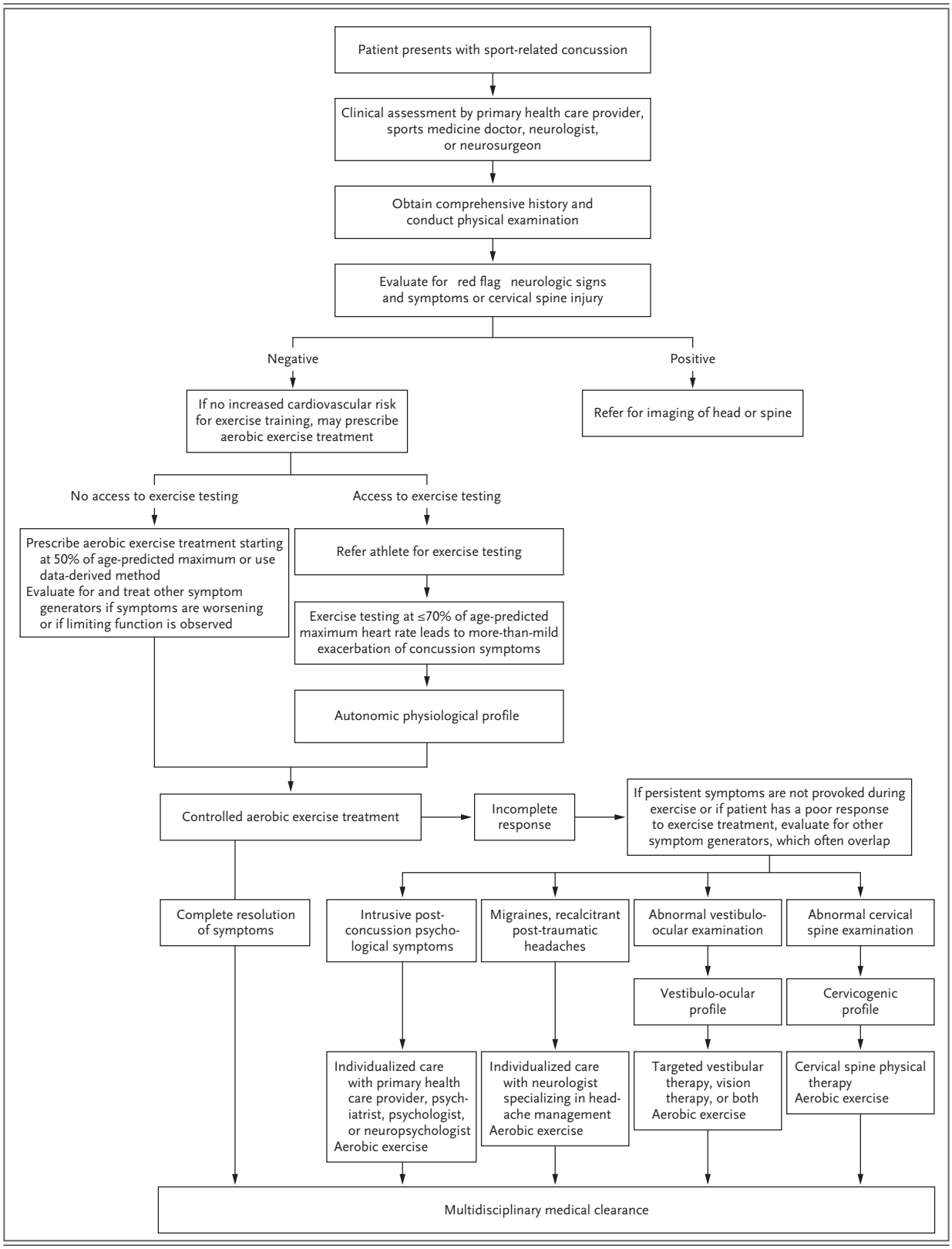
evaluation and management of concussion is presented in Figure 1.

Sport-related concussion was traditionally managed with strict cognitive and physical rest until all symptoms resolved (colloquially referred to as cocooning).[27] However, in a randomized, controlled trial[28] involving patients with concussion who were seen in the emergency department within 24 hours after injury (99 participants; median age, 14 years), participants who had been assigned to strict rest for 5 days did not have better neurocognitive function or balance at 10 days after injury than those who had been assigned to usual care (defined as 1 to 2 days of rest, followed by a stepwise return to activity). Participants who had been assigned to usual care, however, may have underreported their symptoms in order to get back to sport faster. The requirement for the resolution of all symptoms before a return to activity failed to account for the daily life symptoms that substantially overlap with postconcussive symptoms (e.g., fatigue and sleep problems).[29] Clinicians must consider that postconcussive symptoms may be preexisting, concussion-related, or both.[1,20]

A more active, individualized approach to concussion management has emerged, with a focus on early physical activity and graduated aerobic exercise (initiated within 24 to 72 hours after injury) that are tailored to symptoms and heart rate.[30] In an approach modeled after cardiac rehabilitation, the heart rate at the patient s threshold for more-than-mild concussion-symptom exacerbation on exercise testing is used to prescribe an aerobic exercise as medicine rehabilitation program.[13] More than mild is defined as an increase of more than 2 points in the severity of concussion symptoms at any stage during testing or treatment as compared with the preactivity resting value on a scale from 0 to 10 (with

Figure 1 (facing page). Clinical Approach for the Classification and Treatment of Sport-Related Concussion.

Red flags for urgent referral include seizure or convulsion; double vision at a distance; loss of consciousness (especially if duration was >30 seconds); weakness or paresthesia in both arms or in the legs; deteriorating consciousness; uncontrolled vomiting; severe or increasing headache; increasingly restless, agitated, or combative status; Glasglow Coma Scale score below 15 (on a scale from 3 to 15, with a score of <13 indicating moderate or severe brain injury); visible deformity of the skull; and focal neurologic deficit.



higher scores indicating greater symptom severity).[30] A strong, consistent relationship exists between increased heart rate during exercise and the degree of concussion-symptom exacerbation, and aerobic exercise treatment alleviates emotional and vestibular symptoms as much as it does headache or fatigue.[13,31,32]

In a randomized, controlled trial,[31] symptomatic adolescents who had received a prescription for controlled aerobic exercise treatment 2 to 10 days after concussion had a faster recovery than those who had been assigned to placebo-like stretching exercise (median recovery time, 13 days [interquartile range, 10 to 18.5] vs. 17 days [interquartile range, 13 to 23]; P=0.009). In a similar randomized, controlled trial,[32] 21% of adolescents who had been assigned to aerobic exercise 2 to 10 days after injury had persisting symptoms beyond 28 days, as compared with 32% of those who had been assigned to stretching exercise (P=0.04). Persisting symptoms have been associated with impaired academic performance and quality of life.[33]

Aerobic exercise, as part of a multidisciplinary program, is effective regardless of initial symptom burden[34] and is effective in persons with persisting symptoms.[35] In situations in which access to exercise tests is lacking, light activity (e.g., activities of daily living and walking) that is started within 24 to 72 hours after injury (even in symptomatic patients) facilitates recovery more effectively than resting until symptoms resolve.[30,36] Exercise treatment can be prescribed without an exercise test with the use of a target intensity of 50% of the patient s age-predicted maximum heart rate in beats per minute (i.e., 220 minus patient age)[37] or with the use of a data-derived method with heart-rate training ranges that are based on patient sex and the time from injury.[38] The patient systematically advances through the program according to the degree of symptom exacerbation experienced during the previous exercise bout.

Reduced sleep quality early after concussion may prolong recovery,[30] so good sleep hygiene should be emphasized. Regarding electronic-device screen use, a randomized, controlled trial[39] involving 125 patients (mean age, 17 years) who presented to the emergency department with concussion showed that unrestricted screen use during the first 48 hours after injury resulted in a longer time to recovery than relative abstinence from screen use (8.0 vs. 3.5 days, P=0.03).

A recent systematic review that included seven randomized trials[40] showed that cervical and vestibular physical therapy facilitated a return to sport in adolescents and adults with dizziness, neck pain, or headaches persisting for more than 10 days after concussion (hazard ratio vs. rest, 3.91; 95% CI, 1.34 to 11.34). Rigorous studies involving humans to investigate whether medications or supplements facilitate concussion recovery have not been conducted, and the sustained use of short-acting analgesic agents increases the risk of headache due to medication overuse.[41]

RETURN TO SCHOOL AND SPORTS

Concussion management guidelines traditionally focused on a return to sport, but more important for children and adolescents is a return to school.[42] Abnormal vestibulo-ocular symptoms or physical findings (e.g., smooth pursuits and the vestibulo-ocular reflex) beyond 10 days are commonly associated with persisting symptoms of concussion and warrant vestibular physical therapy.[43] After concussion, adolescents (13 to 17 years of age) report more difficulty with school than do children (5 to 12 years of age) or adults (≥18 years of age), especially with regard to greater initial symptom burden, persisting symptoms, and specific symptoms such as difficulty in concentrating, headaches, dizziness, and fatigue; some patients will benefit from academic supports (Table 3).[42] Recent observational data show that early cognitive activity, including an early return to school, is associated with faster recovery, whereas prolonged absences from school and other life activities may delay recovery.[44] Students who are provided with a letter from the health care provider outlining specific academic supports (Fig. S3) are more likely to receive them.[42]

It has been shown that early (within 1 week after injury)[45] and weekly[31,32] medical follow-up facilitate recovery from sport-related concussion. In a systematic review (age range of participants, 5 to 22 years), the mean number of days until the participant was free from symptoms was 14.0 (95% CI, 12.7 to 15.4) and the mean number of days until the participant returned to school (including college or university) was 8.3 (95% CI, 5.6 to 11.1), with 93% of the students

Table 3. Return-to-School Strategy.*

Step No. and Activity	Example	Goal
1. Daily activities that do not result in more than mild exacerbation of symptoms related to the concussion	Typical activities during the day (e.g., reading) while minimizing screen time; start with 5 15 min at a time and increase gradually	Gradual return to typical activities
2. School activities	Homework, reading, or other cognitive activities outside the classroom	Increased tolerance to cognitive work
3. Return to school part-time	Gradual introduction of schoolwork; may need to start with a partial school day or with greater access to rest breaks during the day	Increase in academic activities
4. Return to school full-time	Gradually progress in school activities until a full day can be tolerated without more than mild exacerbation of symptoms	Return to full academic activities and catching up on missed work

* After an initial period of relative rest (24 to 48 hours after an injury at step 1), athletes can begin a gradual and incremental increase in their cognitive load. Progression through the strategy for students should be slowed when more than mild and brief exacerbation of symptoms occurs. Mild exacerbation of symptoms is defined as an increase of no more than 2 points (scale, 0 [no symptoms] to 10 [worst symptoms imaginable]) for less than 1 hour as compared with the baseline value reported before cognitive activity.

in school by 10 days without new academic supports.[42] Unrestricted return to sport is typically accomplished within 1 month after concussion but only after full school reintegration, especially for sports that involve risks of contact, collision, or fall.[46]

Blood biomarkers (e.g., glial fibrillar acidic protein and total tau) for aiding in making a diagnosis of concussion are under investigation but are not ready for clinical use. Results of imaging studies (e.g., functional MRI and arterial spin labeling) may remain abnormal for months after signs and symptoms have resolved and are presently used as research tools only.[47] A buffer zone of a gradual increase in activity before an unrestricted return to sport is therefore recommended (Table 4).[46] This approach includes physical activity (e.g., walking) and controlled aerobic exercise (e.g., stationary cycling or jogging outdoors) as early therapeutic stages to prepare athletes for sport-specific drills and contact. In a recent prospective observational study[48] involving 1751 collegiate athletes with concussion (mean age, 19.2 years; 63% of whom were male), participants began the return-to-play protocol within a median of 6.4 days (interquartile range, 3.7 to 11.8) after the concussion and spent a median of 12.8 days (interquartile range, 8.7 to 20.1) in the protocol, yet it was not until 1 month after injury that most participants (85%) were cleared for unrestricted sport participation.

AREAS OF UNCERTAINTY

The establishment of objective biomarkers to diagnose concussion and establish recovery is important given that the signs and symptoms of concussion can be subtle and nonspecific and that most conventional diagnostic tools have limited sensitivity.[49] Large prospective cohort studies are needed to investigate persisting symptoms of concussion with the use of a common set of tests and measures and to determine the incidence of long-term cardiovascular and neurodegenerative diseases such as chronic traumatic encephalopathy (CTE). Some studies involving former professional athletes suggest an increased risk of dementia, not necessarily from concussions but from the cumulative burden of repetitive impacts to the head.[50] This observation needs to be confirmed in higher-quality prospective cohort studies that better control for confounding factors. Evidence-based strategies to facilitate return to school and validation of the SCOAT tools await prospective trials.

GUIDELINES

Table 5 compares various current guidelines about concussion and mild TBI occurring in nonmilitary contexts. The assessment and management of concussion and mild TBI is generally consistent among them. The recommendations in this article are concordant with the guidelines from

Table 4. Return-to-Sport Strategy.*

Step No. and Exercise Strategy	Activity	Goal
1. Symptom-limited activity	Daily activities that do not more than mildly and briefly exacerbate concussion symptoms (e.g., walking)	Gradual reintroduction to work or school
2. Aerobic exercise	Stationary cycling or walking at a slow-to-medium pace; may start light resistance training that does not result in more than mild and brief exacerbation of concussion symptoms	Increased heart rate
3. Individual sport-specific exercise	Sport-specific training away from the team environment (e.g., running or change-of-direction or individual training drills away from the team environment); no activities that risk impact to the head	Addition of movement and change of direction
4. Noncontact training drills	Exercise to high intensity, including more-challenging drills (e.g., passing drills and multiplayer training) that can integrate the athlete into a team environment	Resumption of usual intensity of exercise and coordination and increased thinking
5. Full-contact practice	Participate in normal training activities	Restoration of confidence and assessment of functional skills by coaching staff
6. Return to sport	Normal game play	

* Mild and brief exacerbation of concussion symptoms is defined as an increase of no more than 2 points on a scale ranging from 0 points (no symptoms) to 10 points (worst symptoms imaginable) for less than 1 hour as compared with the baseline value reported. Athletes may begin step 1 (symptom-limited activity) within 24 hours after the injury, with progression through each subsequent step typically taking a minimum of 24 hours. If more than mild exacerbation of concussion symptoms (>2 points) occurs during steps 1, 2, and 3, the athlete should stop and attempt to exercise the next day. Steps 4, 5, and 6 should begin after the resolution of any symptoms or abnormalities in cognitive function, including with and after physical exertion. Athletes who have concussion-related symptoms during step 4, 5, or 6 should return to step 3 to establish full resolution of symptoms with exertion before engaging in an at-risk activity. Written determination of readiness to return to sport should be provided by a health care provider before unrestricted return to sport, as directed by local laws and sporting regulations.
Aerobic exercise in step 2 has two stages: light exercise (defined as approximately ≤55% of the maximum heart rate) and moderate exercise (approximately ≤70% of the maximum heart rate). The predicted maximal heart rate (in beats per minute) according to age is used (i.e., 220 minus patient age).
If sport-specific training involves any risk of inadvertent impact to the head, medical clearance should occur before step 3.

the Sixth International Conference on Concussion in Sport.[2]

CONCLUSIONS AND RECOMMENDATIONS

The soccer player in the case vignette fulfills diagnostic criteria for concussion or mild TBI on the basis of a plausible mechanism of injury, immediate signs (wobbly gait), current symptoms, and clinical signs (oculomotor and vestibular impairments). Her 5P score of 10 (on a scale from 0 to 12)[19] and her cervical injury[22] raise her risk of persisting symptoms. I would treat the cervical injury immediately with physical therapy to reduce the risk of delayed recovery.[22] Oculomotor and vestibular impairments can cause or contribute to many of her symptoms (cognitive intolerance, headache, nausea, and dizziness) and, combined with her poor sleep and physical inactivity, raise her risk of delayed recovery.

I would encourage a return to school, even while symptoms are present, and would provide a letter outlining supportive measures, including more time for assignments, rest breaks, and a recommendation that tests be postponed until her recovery. I would recommend good sleep hygiene and a return to light physical activities (e.g., walking and activities of daily living) and cognitive activities (e.g., reading with scheduled breaks) while avoiding activities that more than mildly increase symptoms (e.g., video games). For exercise, I would prescribe daily walking or stationary cycling at 50% of her age-predicted

Table 5. Practice Guidelines for Concussion or Mild Traumatic Brain Injury in Civilians.*

Variable	Guideline Reference (Level or Strength of Evidence)		
	Ontario Neurotrauma Foundation	CDC	Sixth International Conference on Concussion in Sport
Prompt diagnostic evaluation	Section 1.4 (B)	Consistent	Page 699
No routine neuroimaging	Section 2.1c (A)	Sections 1A, 1B, and 2 (B)	Consistent
No clinical use of serum biomarkers	Consistent	Section 6 (R)	Page 702
Use validated symptom scales for initial assessment and to track recovery	Section 2.1a (B)	Sections 5A and 10B (B)	Page 702
Perform a comprehensive physical examination	Section 2.1b (B)	Consistent	Pages 700 701
Note common modifiers that may delay recovery and use a clinical risk score to predict risk of prolonged symptoms	Section 2.2 (A)	Section 9B (C)	Pages 701 702; modifiers but no risk score
Early education for patient and family members	Sections 2.2 and 2.10 (B)	Sections 7A and 7B (B) and 12 (A)	Consistent
Recommendation for an initial 24 48 hr of rest	Section 2.3a (A); relative rest	Section 13A (B); strict rest	Page 701; relative rest
Guidance on gradual stepwise return to preinjury activities	Section 2.3b (A: physical activity; B: cognitive activity)	Sections 13B, 13C, 13D (B)	Pages 703 704
Prescribe physical activity and aerobic exercise early after injury to facilitate recovery and reduce the incidence of symptoms persisting for >4 wk	Section 2.3b (A)	Section 13C (B)	Page 701
Return-to-school protocols should be customized based on the severity of postconcussion symptoms.	Section 12.1 (B)	Section 15B (B)	Consistent
Referral to specialists or higher level of care for patients with symptoms persisting for >4 wk	Section 2.3d (A)	Sections 11B and 15F (B)	Page 701

* Information that is consistent with but not explicitly recommended in the guideline or statement is noted as such. Definitions for levels of evidence or strength of the recommendations are provided below for the various guideline references.
Adapted from the Ontario Neurotrauma Foundation.[51] Levels of evidence are defined as follows: A indicates consistent, good-quality evidence (e.g., from a randomized, controlled trial; meta-analysis; or large, high-quality, multicenter cohort study), B lower-quality evidence (e.g., from small cohort studies, case studies, or controlled trials with limitations), and C consensus or opinion.
Adapted from the Centers for Disease Control and Prevention (CDC).[52] The strength of the recommendations is defined as follows: A indicates that the recommendation should almost always be followed, B that it should usually be followed, C that it may sometimes be followed, and R that the intervention generally should not be done outside a research setting.
Adapted from the Sixth International Conference on Concussion in Sport.[2] Information about levels of evidence or the strength of the recommendations is not applicable.

maximum heart rate, with each session continued until her symptoms increase more than mildly. I would endorse a return to gym class to perform aerobic exercise with an avoidance of team or contact sports. I would have her follow up with me weekly until her concussion symptoms resolve. I would endorse a return to unrestricted contact sport only after she completed the Amsterdam return-to-sport strategy program (i.e., graduated symptom-limited activity until resolution of symptoms at high exercise intensity, with tailoring to the relative contact nature of the sport) without a return of concussion symptoms.[46] Finally, I would educate the patient and her parent that current evidence does not support a greater risk of neurologic diseases (e.g., CTE) among former amateur athletes after exposure to a single concussion or repetitive impacts to the head.[50]

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