



Getting a jump on recovery from sports-related concussion

Early subthreshold aerobic exercise safely improved recovery time over a stretching regimen among adolescents in this clinical trial.

PRACTICE CHANGER

Recommend subsymptom threshold exercise in adolescents with a sports-related concussion. Early return to light aerobic activity not only seems safe but may help speed recovery compared with stretching alone in this patient population.

STRENGTH OF RECOMMENDATION

B: Based on a single multicenter, prospective, randomized clinical trial¹

Leddy JJ, Haider MN, Ellis MJ, et al. Early subthreshold aerobic exercise for sport-related concussion: a randomized clinical trial. *JAMA Pediatr.* 2019;173:319-325. doi: 10.1001/jamapediatrics.2018.4397

ILLUSTRATIVE CASE

A 16-year-old girl with no chronic medical illness presents to your office with her parents after sustaining a head injury at a soccer game over the weekend. She collided with another player while attempting to head the ball. Immediately afterward, she was taken off the field and assessed. She was confused but had a normal level of consciousness and denied vision changes, weakness or tingling in her arms or legs, severe headache, or neck pain. Further testing revealed dizziness and abnormal balance. Her confusion and abnormal balance resolved after 1 day. She has had a mild headache and light sensitivity since the event. She otherwise feels well at rest in the office. She wants to recover quickly but safely and has heard conflicting statements about whether she should completely rest or start back to light activity now.

Sports-related concussions (SRCs) are highly prevalent in the United States, with as many as 3.8 million cases annually. Of those, 1.1 to 1.9 million cases are in children 18 years old or younger.^{2,3} SRCs are defined by the Concussion in Sport Group (CISG) 2017 consensus statement as involving the following criteria: (1) direct or indirect trauma anywhere on the body with force transmitted to the head; (2) rapid or delayed symptom presentation, typically with spontaneous resolution; (3) functional rather than structural injury; and (4) occurrence with or without loss of consciousness with stepwise symptom resolution.⁴

SRCs do not have a proven, effective treatment and can have short- or long-term consequences. Initial treatment includes removing athletes from play immediately after an event. The American Academy of Neurology recommends that athletes not return to play until the concussion is resolved, as judged by a health care provider, and the athlete is asymptomatic when off medication.²

The CISG recommends a 6-step approach, with each step taking at least 24 hours.⁴ The final step is a return to normal activity.⁴ This working group recommended extensive study of rehabilitation programs involving subsymptom threshold exercise (ie, exercise performed at a level that does not exacerbate symptoms) before implementation as routine practice. Evidence from a 2015 study suggests that following strict rest for 5 days until complete symptom resolution

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may prolong recovery compared with rest for only 1 to 2 days.⁵ Additionally, strict rest did not show a difference in neurocognitive or balance outcomes in that study, and the authors noted it may also negatively impact academic, sports, and social function in adolescents.⁵ This study looked at the potential benefit of subsymptom threshold exercise during recovery from SRC.¹

STUDY SUMMARY

Light aerobic exercise may help speed recovery

This multicenter, prospective, parallel, randomized clinical trial compared subsymptom threshold aerobic exercise to placebo-like stretching. Patients were included if they were ages 13 to 18 years and presented within 10 days of an SRC, as diagnosed using the CISG criteria. Exclusion criteria included focal neurologic deficits; history of moderate or severe traumatic brain injury; inability to exercise due to orthopedic injury, cervical spine injury, diabetes, or heart disease; increased cardiac risk; or low postconcussion symptom severity. Patients with a diagnosis of and treatment with medication for attention-deficit/hyperactivity disorder (ADHD), depression, anxiety, or learning disorder were excluded, as were patients with a history of more than 3 previous concussions.

Patients in the aerobic exercise group were instructed to use a stationary bike or treadmill (or equivalent walking or jogging if they did not have access to this equipment) at a prescribed heart rate. The target heart rate was 80% of the heart rate achieved during initial assessment with the Buffalo Concussion Treadmill Test (BCTT).⁶ Patients in this group were instructed to exercise for 20 minutes or to the point at which their symptoms increased by 2 points (on a 10-point scale) from pre-exercise levels, whichever came first, with rest prescribed at all other times.

For the placebo-like group, a stretching instruction booklet was provided, with the goal of achieving a heart rate that was not significantly elevated. Participants in this group were told to perform the stretches for 20 minutes daily. Of note, researchers ensured the level of physician and research staff attention was similar for each patient, regardless of

treatment group, to prevent intervention bias. Additionally, interventions were not initiated prior to 48 hours from the time of injury.

The primary outcome was number of days to recovery since the date of injury. This was defined as symptom resolution to normal (as evaluated by a physician blinded to the study group) and by the patient's ability to exercise to exhaustion without symptom exacerbation on the BCTT. Secondary outcomes measured the proportion of patients with delayed recovery (defined as recovery requiring > 30 days) and daily symptom scores.

Of 165 patients meeting the inclusion criteria, 52 patients were excluded prior to randomization (12 patients chose not to participate, 39 were excluded for lack of symptoms, and 1 withdrew due to severe symptoms on the BCTT). A total of 113 were randomized to either group, and 103 patients completed the study (10 patients did not complete the study or had another illness during the intervention). The study analysis included 52 patients in the aerobic exercise group and 51 in the placebo-like stretching group. The study was powered to detect a significant difference in recovery time.

Patients were about equally divided by sex, with a mean age of 15 years. Patients who had no previous concussion made up 50% of the aerobic group and 57% of the stretching group. The average time since injury was similar in the aerobic and stretching groups (4.9 days and 4.8 days, respectively). The aerobic exercise group recovered in a median of 13 days (interquartile range [IQR] = 10-18.5 days) compared with a median of 17 days (IQR = 13-23 days) for the stretching group ($P = .009$). The incidence of delayed recovery (> 30 days) was higher in the stretching group ($n = 7$) compared with the aerobic exercise group ($n = 2$) but was not statistically significant. Daily symptom reporting occurred at a high rate in both groups, with patients stating that they performed their prescribed exercise 89% of the time. No adverse events were reported.

WHAT'S NEW

First high-quality study to support evidence for early light activity

This is the first high-quality study of subsymptom threshold exercise for SRC. Its findings add

to the growing body of evidence that early engagement in light aerobic activity that does not provoke symptoms (but not fully returning to sports activity) can aid in recovery from an SRC.

CAVEATS

Narrow study population limits application of findings

It is unclear if subsymptom threshold exercise is safe and effective in adolescents with a history of multiple concussions, as those with more than 3 concussions were excluded from this study. Additionally, patients with comorbidities such as ADHD, depression, anxiety, or learning disorders were not included in this study, which limits the application of these findings. The generalizability of this study is limited in younger children, adults, those with increased cardiovascular risk, and in patients with concussions that are not sports related.

CHALLENGES TO IMPLEMENTATION

More real-world studies needed to confirm benefit

The majority of adolescent athletes in this study completed the subsymptom threshold exercise in a monitored environment with

trainers, heart rate monitors, and access to equipment, limiting the study's generalizability. Additionally, physicians need to be familiar with the BCTT to assign heart rate goals and assess improvement. The study environment may be feasible for some but not others. Studies evaluating real-world settings with athletes self-monitoring for symptom threshold with stepwise evaluations are needed and may be more broadly applicable. **JFP**

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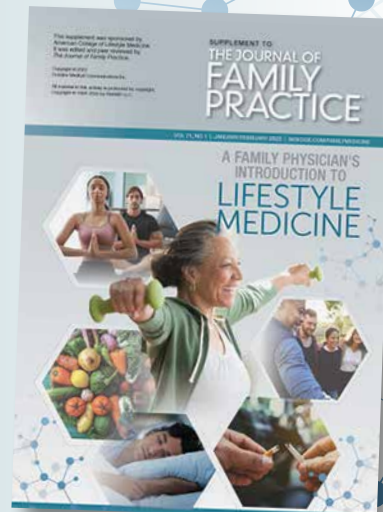
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