



The Effectiveness of Prescribed Rest Depends on Initial Presentation After Concussion

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Objective To evaluate if patients with signs of injury respond differently to prescribed rest after concussion compared with patients with symptoms only.

Study design Secondary analysis was completed of a prospective randomized controlled trial (NCT01101724) of pediatric concussion patients aged 11-18 years. Patients completed computerized neurocognitive testing and standardized balance assessment at the emergency department within 24 hours of injury and on follow-up (3 and 10 days). Patients were randomized to rest or usual care and completed activity and symptom diaries for 10 days after injury. A series of 2×2 ANOVAs with grouping factors of patient group (symptoms, signs) and treatment arm (prescribed rest, standard of care) were used to examine differences on clinical measures. Univariate nonparametric test (ie, χ^2 with ORs and 95% CIs) was used to examine the association between treatment arm and symptom status 1-9 days after injury.

Results A 2×2 factorial ANOVA revealed a significant patient group \times treatment arm interaction for symptom score at 3 days after injury ($F = 6.31$, $P = .01$, $\eta^2 = 0.07$). Prescribed rest increased the likelihood of still being symptomatic at days 1-6 and 8 ($P < .05$) for the symptoms group. Rest was beneficial for patients in the signs group on verbal memory performance ($t = -2.28$, $P = .029$), but not for the symptoms group.

Conclusion Compared with patients with signs of injury, patients with predominantly symptoms were more likely to remain symptomatic after injury if prescribed rest, whereas patients with signs of injury benefited from rest after a concussion. Individualized treatment planning after concussion should start in the emergency department. (*J Pediatr* 2017;185:167-72).

Trial registration ClinicalTrials.gov: NCT01101724.

Evidence-based treatment for concussion is limited and clinical management relies on consensus-based guidelines, which recommend cognitive and physical rest to prevent re-injury and reduce postconcussion symptoms.¹ This practice is derived from the assumption that rest may promote neurometabolic recovery of the injured brain.² However, results of research studies examining rest after a concussion are inconclusive.

Although guidelines have not clearly defined the duration of rest, research suggests that extreme rest modalities, such as bed rest or “cocoon therapy,”³ may hinder concussion recovery. De Kruijk et al⁴ reported no benefit to 6 days of bed rest in a randomized, controlled trial (RCT) of concussed adult patients. Recently, our research collaborators published a RCT wherein pediatric concussion patients were assigned to strict cognitive and physical rest, defined as “no school, work, or physical activity,” for the first 5 days after injury. Patients prescribed rest reported more symptoms 10 days after injury than those treated with the standard of care.⁵ Similar findings for symptom outcomes have been reported by other investigators.^{6,7} Other studies have found that some degree of cognitive and/or physical activity after concussion is beneficial for recovery.⁸⁻¹⁰ Yet, not all researchers have found rest to be detrimental to concussion recovery, because strict rest applied up to 1 month after injury¹¹ led to improvements in outcomes,¹² whereas excess postinjury activity has been associated with worse outcomes.^{8,13}

Methodologic differences, related to the definition of rest or activity, and duration of rest may account for some discrepancies in findings.¹² Additionally, despite the heterogeneous nature of concussion, patient risk factors, injury characteristics, and clinical profiles have not been considered.¹⁴ It is feasible that concussed patients respond differentially to rest depending on clinical presentation. Immediate

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| BESS | Balance Error Scoring System |
| ED | Emergency department |
| ImPACT | Immediate Post-Concussion Assessment and Cognitive Testing |
| LOC | Loss of consciousness |
| PCSS | Post-Concussion Symptom Scale |
| PTA | Post-traumatic amnesia |
| RCT | Randomized, controlled trial |

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signs of injury (eg, loss of consciousness [LOC], post-traumatic amnesia [PTA], confusion/disorientation) have been linked to longer recovery¹⁵⁻¹⁷ and determine which patients are at risk for more significant intracranial injury and, therefore, warrant emergent imaging in the emergency department (ED) setting.^{18,19} Patients presenting to the ED with isolated symptoms may have physiologic or psychological differences from patients who are seen with signs of a concussion.

Although signs are generally external findings thought to reflect underlying neurologic dysfunction,¹⁹ concussion symptoms represent internal subjective experience, shaped by a patient's past perception of illness (eg, preinjury somatization).²⁰ The objective of the current study was to determine if there was an interaction between these different clinical presentations and efficacy of prescribed rest on clinical outcomes after a concussion. We hypothesized that patients with multiple signs of injury would benefit from prescribed rest on neurocognitive and balance measures, and symptom report throughout the first 10 days after injury. We expected that patients with predominantly symptoms would not benefit from rest.

Methods

We conducted a secondary analysis of a prospective RCT of patients presenting to an ED.⁵ The study was approved by the Children's Hospital of Wisconsin Institutional Review Board and registered with [ClinicalTrials.gov](https://clinicaltrials.gov) (NCT01101724). Children were eligible if they were 11-22 years of age and presented to the ED within 24 hours (median, 3) of a concussion. Patients were excluded for the following reasons: non-English speaking, no legal guardian present, intracranial injury, admission to the hospital, or unable to complete clinical assessments.

Definitions and Measures

Concussion. Patients were diagnosed with a concussion if they sustained direct force or transmitted force to the head that resulted in a constellation of signs (eg, LOC, confusion/disorientation, PTA) and/or symptoms (eg, physical, cognitive, emotional, sleep).

Signs of Injury. During initial screening, patients were asked if signs of injury were present immediately after the injury, including LOC, confusion/disorientation, and PTA. Signs were self-reported, but verified by informants (eg, parents, health-care professional on the sideline, emergency medical services, ED clinical treatment team). We used the Acute Concussion Evaluation tool, a validated tool for pediatric patients and parents, to assess immediate injury findings in a structured format. LOC was assessed and the duration recorded. Patients were coded as positive LOC if it was longer than 30 seconds verified by an observer. In contrast, reported LOC of "a few seconds" was not coded as positive LOC. The presence of PTA was coded as a sign of injury, regardless of duration. Further PTA and LOC were also assessed independently, consistent with the format of the Acute Concussion Evaluation. For analysis purposes, they were combined as PTA.

For the purpose of this study, patients were grouped as follows: (1) symptoms (ie, symptoms of injury and 0-1 signs of injury), or (2) signs of injury (ie, 2 or more of the following: LOC > 30 seconds, confusion/disorientation, or PTA) group.

Symptom Report. The Post-Concussion Symptom Scale (PCSS) is a computerized self-report symptom inventory that includes 22 items representing the most commonly reported concussion symptoms, including somatic, cognitive, affective, and sleep-related symptoms of concussion. Patients rate each symptom on a 7-point Likert scale from 0 (none) to 6 (severe), and the scale has adequate reliability and validity.²¹ The full PCSS (administered as a component of Immediate Post-Concussion Assessment and Cognitive Testing [ImPACT]) was completed at the ED, day 3, and day 10 after injury. A 19-item PCSS, adapted from Aubry et al,²² was included as a daily diary entry for days 2-9. For the purpose of this study, we defined "asymptomatic" as a PCSS of less than 5, based on previously published scores in healthy adolescents,²¹ and considering the fewer number of items.

Balance. The Balance Error Scoring System (BESS) is a clinical balance assessment developed to evaluate static and dynamic postural stability after concussion.²³ A trained observer assesses 6 balance conditions with eyes closed. A total BESS score is determined by counting the number of errors across all conditions, with higher scores representing worse balance. Although all research staff were trained in administering the BESS, different scorers assessed patients in the ED and at follow-up. A comprehensive description and detailed properties for the BESS are described elsewhere,²⁴ although intrarater reliability is higher than inter-rater reliability.²⁵ In the ED, only the 3 conditions with feet on the floor were administered, although at the 3-day follow-up, all 6 balance conditions were administered.

Neurocognitive Testing. The ImPACT is a computer-based neurocognitive test battery comprised of 6 subtests designed to evaluate neurocognitive impairment in individuals with concussion. The test yields 4 composite scores for verbal and visual memory, processing speed, and reaction time, and takes approximately 20-25 minutes to administer. ImPACT has adequate reliability, validity, and sensitivity,^{26,27} and moderate test-retest stability.^{28,29} ImPACT was administered at the ED (<24 hours after injury), 3 days, and 10 days after injury.

Procedures

Patients underwent an initial screening to gather demographic information and injury details. Computerized neurocognitive testing and a standardized balance assessment were administered by a research assistant in the ED. Patients were then randomized to rest (advice to restrict school/extracurricular work and physical exertion for 5 days) or to usual care, in which ED physicians were free to recommend activity restrictions as they saw fit. Activity and symptom diaries were completed for the first 10 days after injury and had follow-up appointments during which neurocognitive tests and balance assessments were readministered.

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