

Movement Medicine: A Systematic Review on the Effect of Early Aerobic Exercise Initiation on Symptom Recovery Following Concussion

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Context

- Complete physical and cognitive rest until symptom resolution was historically the mainstay of concussion management
- Current guidelines still recommend a brief period (24-48 hours) of physical and cognitive rest acutely, followed by gradual and progressive return to activity⁶
 - Weak evidence – based on animal studies and expert consensus rather than human clinical trial data^{8,9}
- Mounting evidence suggests that aerobic exercise is an effective therapeutic modality for individuals experiencing persistent post-concussion symptoms beyond four weeks^{10,11}
- Few studies have examined the effect of exercise in the early phase following concussion, but emerging observational research indicates that it may be protective^{12,13}

Evolution of Concepts in Post-Concussion Therapy:



Objective

Research Question:

- Does initiating structured aerobic exercise soon after concussion (within the first two weeks) affect symptom recovery or risk of developing persistent post-concussion symptoms compared to standard care or minimally active control?

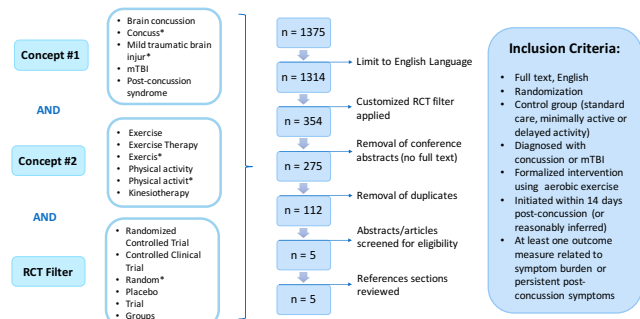
PICO Framework:

Population	Individuals recovering from concussion
Intervention	Formalized aerobic exercise intervention initiated within the first two weeks following concussion
Comparison	Standard care or minimally active control (no formal aerobic exercise intervention within two weeks)
Outcome	Residual symptom recovery or risk of developing persistent post-concussion symptoms

Methods

Literature Search Strategy:

- MEDLINE, EMBASE, PsycINFO, CENTRAL databases searched for Randomized Clinical Trials
- Two concepts translated into MeSH terms and keywords, combined with custom RCT filter



Results

Table 1: Results Summary

Source	Population (n)	Intervention	Control	Key Outcome Measures	Results
Leddy et al. (2018) ¹	• Adolescents (14-19 years) with SRC • Presenting 1-10 days post-injury • n = 54	• Single Buffalo Concussion Treadmill Test (BCTT) – graded exercise test to symptom exacerbation/voluntary exhaustion • Beginning 1-10 days post-injury	• No BCTT • Standard care – gradual return to play advice based on current guidelines	• Days to recovery (Normalization of PCS5, exercise tolerance on BCTT, physician examination) • Typical (<21d) vs. prolonged (>21d) recovery	• No significant difference in days to recovery (p=0.706) or typical vs. prolonged recovery (p=0.1195) between groups • Lower HR threshold at symptom exacerbation was strongly associated with prolonged recovery time (p=0.0032)
Micay et al. (2018) ²	• Adolescents (14-18 years) with SRC • Symptomatic at 5 days post-injury • n = 16* (*15 males included in analysis)	• 8 sessions of cycle ergometer exercise with progressive increase in intensity and duration (10 min @ 50% age-pred maxHR to 20 min @ 70% age-pred maxHR) • Beginning on day 6 post-injury	• Standard care – gradual return to play advice based on current six-stage progression	• Days to medical clearance for return to play • Symptom resolution across the recovery timeline (PCS5 scores weekly for 4 weeks post-injury)	• No significant difference in mean time to medical clearance between groups (p=0.87) • Exercise group had significant within-group decrease in symptom severity between weeks 1 to 3, versus usual care had no significant resolution of symptoms until week 4
Dobney et al. (2018) ³	• Youth (9-17 years) • Symptoms persisting 2 weeks post-injury • n = 20	• Daily aerobic exercise (treadmill/stationary bike) 15 min @ 60% age-pred maxHR (+ coordination/skill practice, visualization and education) • Beginning at 2 weeks post-injury (Early AR)	• Standard active rehabilitation (AR) – same intervention initiated at 4 weeks post-injury	• Symptom burden on PCSI at 2, 4, 6 + 8 weeks	• Both groups achieved comparable levels of post-concussion symptoms by week 8* • Patients in early AR group reached a "normal" symptom severity by 4 weeks post-concussion, versus 6 weeks in standard AR* (*based on visual inspection; no between-group statistical comparison available)
Maerlender et al. (2015) ⁴	• College athletes • "Recently concussed" • n = 28	• Daily mild-mod stationary bike riding (Borg RPE) x 20 min • Beginning as early as day of concussion diagnosis	• Standard care – No systematic exertion, gradual return based on guidelines	• Days to symptom recovery • Proportion with prolonged recovery (> 2 weeks)	• No significant difference in median time to symptom recovery (p=0.705) or proportion with prolonged recovery (p=0.464)
Leddy et al. (2019) ⁵	• Adolescents (13-18 years) with SRC • Presenting within 10 days post-injury • n = 103	• Daily aerobic exercise 20 min @ 80% HR achieved at symptom exacerbation on weekly BCTT • Beginning 48 hours to 10 days post-injury	• Daily gentle, progressive, whole body stretching program • 20 minutes per day	• Days to recovery (Normalization of PCS5, exercise tolerance on BCTT, physician examination) • Proportion with delayed recovery (>30 days)	• Aerobic exercise group recovered significantly faster than control (p=0.005) after adjusting for age, sex, time from injury, concussion history • Non-significant lower incidence of delayed recovery in the aerobic exercise group compared to control (p=0.08)

Note: SRC = Sport-Related Concussion; BCTT = Buffalo Concussion Treadmill Test; PCS5 = Post-Concussion Symptom Scale; PCSI = Post-Concussion Symptom Inventory; Age-pred maxHR = age-predicted maximal heart rate

Results Summary:

- Studies examined youthful populations (children to young adults), with sample sizes ranging from 16 to 103 participants
- Four studies examined only athletes with sport-related concussions
- All studies were randomized trials with diverse intervention and control groups
- Aerobic exercise interventions were initiated as soon as the day of concussion diagnosis
- Of the four studies that were able to analyze between-group differences, one showed significantly faster recovery in the early aerobic exercise group compared to control, while three showed no significant difference
- Two studies demonstrated a trend toward faster initial symptom resolution in the early exercise group compared to control

Results

Table 2: Quality Assessment – PEDro Scale

PEDro Criteria	Leddy et al. (2018)	Micay et al. (2018)	Dobney et al. (2018)	Maerlender et al. (2015)	Leddy et al. (2019)
Eligibility criteria were specified (*does not contribute to overall score)					
Subjects randomly allocated to groups					
Allocation was concealed					
Groups were similar at baseline regarding most important prognostic indicators					
Blinding of subjects					
Blinding of therapists					
Blinding of assessors					
Measures were obtained from more than 85% of the subjects initially allocated to groups					
Analyzed by "intention to treat"					
The results of between-group statistical comparisons are reported for at least one key outcome					
The study provides both point measures and measures of variability for at least one key outcome					
TOTAL SCORE (/10)	6	7	4	3	6

Conclusions

- There is preliminary RCT evidence to suggest that aerobic exercise initiated in the early post-concussion period does not exacerbate symptoms or prolong recovery time, and may potentially hasten recovery.

Limitations:

- Small sample sizes
- Paucity of evidence in non-sport related and adult populations
- Heterogeneous interventions – difficult to isolate the effect of early aerobic training alone

Implications:

- Shifting practice guidelines – is initial period of rest necessary?
- Can aerobic exercise not only treat but also prevent persistent post-concussion symptoms?

Future Directions:

- Larger RCTs are required to better characterize the optimal timing, type, frequency, intensity and duration of aerobic exercise programs
- Seek to better elucidate individual prognostic factors predicting who is at greatest risk of prolonged recovery time and may benefit most from early intervention

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