Vestibular & Aerobic Interventions for Concussion Rehab

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Introduction

Symptoms after concussion, a type of traumatic brain injury (TBI), are detrimental to the social, emotional, and functional aspects of an individual's life. Those affected by concussions may demonstrate a plethora of symptoms, including but not limited to, mood changes, autonomic nervous system disturbances, cardiovascular abnormalities, balance deficits, headaches/migraines, eye strain, light sensitivity, and decreased exercise tolerance. Appropriate decision-making regarding the best rehabilitation methods to promote optimal recovery post-concussion is an area in which current research is lacking. Clinicians speculate that vestibular and/or aerobic interventions may play a pivotal role in concussion recovery, but there is a shortage of studies that examine the relationship between various interventions and concussion rehabilitation. This case report details the rehabilitation program of a 30-year-old female who experienced a direct impact injury during a fall, resulting in the diagnosis of a concussion, who is currently participating in outpatient physical therapy to improve symptoms.

Research Question: Does vestibular training followed by targeted HR aerobic training improve reported concussions symptoms? **Purposes: 1)** To open up a conversation about appropriate concussion-based interventions and to bridge a gap in the literature; **2)** to understand if vestibular and aerobic activity with submaximal target HR ranges are beneficial in reducing symptoms 2/2 concussion; **3)** to explore various outcome measures and tests for better understanding of appropriate methods for assessing progress of patients who are diagnosed with concussions.

Methods

Participant: 30-year-old female who presented to outpatient physical therapy with a dx of concussion sustained 3 weeks prior to initial evaluation.

Month	Exercises (Aerobic)
1: 25%-35% Age-Related HR max	• Recumbent bike • Treadmill • Agility ladder • Step ups
2: 65%-75% Age-Related HR max	• Recumbent bike • Treadmill • Agility ladder • Step ups • Jumping jacks • Lunges • Suttle runs

Month	Exercises (Cognitive)
1	• Word search w/ letter finding • Printable maze game • Memory game with cards • Search and find game • Hart Chart
2	• Word search w/ letter finding • Search and find game • Hart Chart • Verbal category listing w/o repeating • Connect the dots • Memorization of poem w/ randomized recall throughout session • Number finding on wall

Month	Exercises (Vestibular)
1	• VOR and VORc activity • SLS, tandem stance, narrow stance on/off foam • Straw & stirrer activity • Tandem walking forward and backward • Ball toss, in/out of BOS
2	• Tandem walking forward and backward (w/ eyes closed) • Cone taps in star pattern • Narrow stance on BOSU w/ eyes closed • Ring toss on foam w/ hop turns • SLS on bosu w/ ball tosses • Jumping turns in agility ladder

Initial Measurements

Outcome Measures				
DHI	Total score: 60 (severe handicap)	Total functional score: 28	Total emotional score: 14	Total physical score: 18
CTSIB-M	Rhomberg solid surface w/ eyes open: 30sec	Rhomberg solid surface w/ eyes closed: 30sec	Rhomberg foam surface w/ eyes open: 30 sec w/ significant postural sway and instability	Rhomberg foam surface w/ eyes closed: 30sec w/ significant postural sway and instability
SLS	SLS solid surface w/ eyes open: R side 30sec	SLS solid surface w/ eyes open: L side 30sec	SLS solid surface w/ eyes closed: R side unable	SLS solid surface w/ eyes closed: L side unable
Oculomotor Exam	Smooth pursuit: (-) Saccades: (-) Spontaneous nystagmus: (-)	VOR slow movement: (+) VOR fast movement: (+)	Convergence: (+)	FTN, eyes open: (-) FTN, eyes closed: (+)
Buffalo Concussion Treadmill Test	Resting HR: 68bpm	Testing stopped at 3:12	Pt's HR 128bpm and symptomatic	Test terminated due to safety concerns

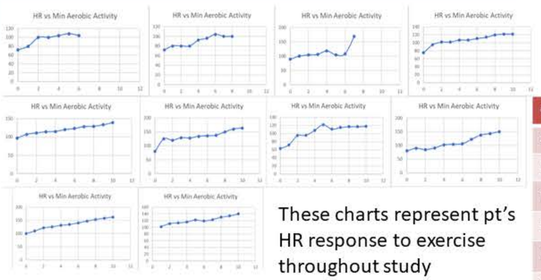
Cervical AROM (Norms)	Initial	Comments
Flexion (80-90)	50˚	Pain
Extension (70-80)	50˚	Pain
R Rotation (70-90)	55˚	Pain
L Rotation (70-90)	55˚	Pain
R side bending (20-45)	25˚	
L side bending (20-45)	25˚	

Outcomes

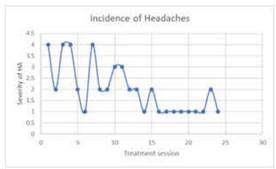
DHI Score: Improved from 60 (severe handicap) to 38 (moderate handicap)
Buffalo Concussion Treadmill Test: Week 4 resulted in a negative test (no s/s & steady HR response)

	Rhomberg, solid surface, eyes open	Rhomberg, solid surface, eyes closed	Rhomberg, foam surface, eyes open	Rhomberg, foam surface, eyes closed
Week 1	30sec	30sec	30sec w/ moderate postural sway	30sec w/ moderate postural sway
Week 4	30sec	30sec	30sec w/ mild postural sway	30sec w/ mild postural sway
Week 8	30sec	30sec	30sec	30sec w/ mild instability

	SLS, R side, eyes open	SLS, L side, eyes open	SLS, R side, eyes closed	SLS, L side, eyes closed
Week 1	30sec	30sec	0sec	0sec
Week 4	30sec	30sec	4sec	6sec
Week 8	30sec	30sec	2sec	2sec



These charts represent pt's HR response to exercise throughout study



Cervical AROM	Week 1	Week 4	Week 8
Flexion (80-90)	50˚ c/o pain	70˚	61˚
Extension (70-80)	50˚ c/o pain	35˚	48˚
R rotation (70-90)	55˚ c/o pain	62˚	80˚
L rotation (70-90)	55˚ c/o pain	68˚	75˚
R side bending (20-45)	25˚	35˚	40˚
L side bending (20-45)	25˚	35˚	52˚

Results & Discussion

Improvements: Increased exercise tolerance, decreased eye strain, decrease HA incidence, improved AROM of cervical spine, improved cardiovascular response to exercise, decrease in DHI score from baseline, self-reported improvements in ability to perform functional tasks, improvements in concentration and memory.

Limitations: 1) Patient's DHI score plateaued b/w week 4 and 8 (however, post-study it was reported that by week 11, the patient's DHI score was at 18 indicative of mild handicap); **2)** pt's balance made slight improvements but continued to be a main area of concern for the patient; **3)** pt was also attending acupuncture and massage appointments outside of physical therapy; **4)** there was difficulty isolating time with the pt due to a busy clinic case-load; **5)** pt was aware of participating in this case-study; **6)** pt's symptoms were inconsistent each session, affecting ability to participate in certain tasks and requiring frequent use of clinical judgement to determine appropriate progression/regression based on patient symptoms.

Conclusions

Vestibular & aerobic exercises may be advantageous to concussion rehab, but more research is required.

Recommendations for future research: 1) Use a large sample size with a randomized control design; **2)** administer in a controlled environment with decreased stimuli during sessions; **3)** assign 1 group of participants to a vestibular exercise group, 1 group of participants to an aerobic exercise group, and 1 group to a combination of vestibular and aerobic exercises to compare how each intervention affects recovery.

Future plans for the patient: Sessions began to target the vestibular system more specifically. The patient experienced a fall at home while using a step stool, which made vestibular and balance training the main focus after week 8. The patient began to show improvements in balance following this. Patient was discharged at week 15 (post-study) with improved overall symptoms.

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