Case Report

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The Implementation of "McGill's Big 3" in an Individual with an Acquired Brain Injury who Ambulates Independently: A Case Report

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Abstract:

Background: Improved function, through balance and mobility, has been demonstrated in individuals with an acquired brain injury (ABI) following various exercise interventions; however, the feasibility of implementing "McGill's Big 3" exercises, typically prescribed for people with back pain, to improve function in people with ABI requires investigation.

Objective: The aim of this case report was to determine the feasibility of implementing "McGill's Big 3" exercises on balance and mobility when prescribed to an individual with an ABI who ambulates independently.

Methods and Materials: A 40-year-old female with an ABI completed an 8-week exercise intervention consisting of "McGill's Big 3" exercises. Balance and mobility testing were completed pre and post intervention, including, heel-to-toe standing; the foot tap test; forward reach test; pick-up test; stand-to-floor test; and three-meter timed up-and-go.

Results: The results demonstrated improvement across all tests.

Conclusions: These findings support the use of "McGill's Big 3" exercises in a rehabilitation program, for individuals with neurological impairments such as an ABI.

Key Words:

Acquired brain injury, exercise training, function, "McGill's Big 3"

Key Messages:

"McGill's Big 3" exercises can improve balance and mobility in an individual with an ABI, which suggests it warrants consideration for inclusion into rehabilitation programs for physical therapy.

An acquired brain injury (ABI) results from a direct, or indirect blow to the head and is not related to a congenital disorder or a degenerative disease.[1] The neuropathological changes that occur as the result of an ABI, often lead to long-term physical disability due to suppressed visual and vestibular system functioning, inefficient integration of vestibular information, and impaired neuromuscular control and trunk muscle recruitment.[2] Previous research has associated trunk muscle control with fall occurrences and diminished functionality in individuals with neuropathological conditions resulting from an ABI.[2] Such impairments can greatly influence the ability to carry out common activates of daily living and lead to dependency issues and an overall reduced quality of life.[1]

The trunk musculature is considered pivotal to almost all kinetic chains in the human body.[3] Controlling the trunk musculature, maximizes the function of the upper and lower extremities, provides a solid platform to exert or resist force, and stabilizes the body and spine.[3] As a result, trunk strengthening exercise interventions have become popular in rehabilitation and therapeutic settings.[2]

Various trunk strengthening exercise interventions have been developed to improve the control of the trunk musculature, including Yoga, Tai Chi, and Pilates.[3] Ustinova[4] demonstrated significant improvements in trunk muscle control, in participants with an ABI following therapeutic exercises requiring whole body

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coordination in lying, sitting, or standing positions. McGill,[5] proposed a novel intervention, involving three exercises to promote strengthening the muscles of the trunk. These specific combined exercises termed the "McGill Big 3", are suggested to produce strengthening patterns for flexion dominant challenges using a version of a curl-up; frontal plane challenges using a side bridge; and extensor dominant challenges using the bird-dog exercise.

Evidence has identified the role of the "McGill's Big 3" exercises at enhancing trunk muscle control and improving function through correct muscle activation in people with back pain.[5] It is not clear if similar improvements in trunk control or function are possible following "McGill's Big 3" in people with ABI or whether a modification to these exercises is required in this population. Consequently, the aim of this case report was to determine the feasibility of implementing "McGill's Big 3" exercises on balance and mobility when prescribed to an individual with an ABI who ambulates independently.

Case History

The present case report adheres to the CAse REporting (CARE) structure and reporting Guidelines. Before commencing the intervention, the participant received an explanation of the purpose, methods, risks, and benefits and provided written, informed consent. The protocol was approved by the University's Institutional Ethics Review Committee.

The participant of this case report was a 40-year-old female who sustained an ABI in early childhood and was considered otherwise apparently healthy with no known cardiovascular, respiratory, or metabolic conditions. Sensory-motor and functional impairments included (but were not limited to) unsteadiness, with difficulty maintaining balance during unassisted bilateral stance (>30 s) and difficulty preventing sway as well as an inability to walk unassisted for long distances (>20 m) and difficulty picking up objects from the floor.

Outcome measures

The participant was required to attend two testing sessions, pre-and post-exercise intervention. The pre and post assessment were comprised of a combination of balance and mobility tests including, heel-to-toe standing; the foot tap test; forward reach test; pick-up test; stand-to-floor test; and three-meter timed up-and-go (TUG) test. Test procedures are valid and reliable indicators of function.[6,7] The participant was required to perform three trials of each test with a 30-s rest between each trial, with the mean outcome reported.

Intervention program

For 8-weeks, the participant completed an exercise intervention, consisting of two training sessions per week incorporating "McGill's Big 3" exercises, with no modifications required. After completing a standardized warm-up, the participant performed the exercises in the order of (1) modified curl-up, (2) bird-dog, and (3) side bridge. Table 1 describes the specific exercise prescription and the mode of progress.

Results

The participant appeared to tolerate all 16 training sessions when self-assessed using a ten-point BORG rating of perceived exertion (RPE) scale. Results for all pre and post assessments are reported in Table 2. All outcomes, excluding the tap test (left foot) demonstrated improvements following the 8-week intervention. Improved static and dynamic balance were observed through the tap test (right foot), forward reach test, and heel-to-toe standing. Improved mobility was observed through the pick-up test, stand-to-floor test, and the three-meter TUG test.

Discussion

The present case report demonstrates for the first time that an 8-week exercise intervention incorporating the "McGill's Big 3" exercises is feasible and has the potential to improve balance and mobility in people with an ABI. Improved balance and mobility will improve the ability to carry out common activities of daily living as well as increase independence and overall quality of life.

The results from this case report concur with previous literature, that assessed the effects of short-term exercise interventions ($\leq$ 6-weeks), incorporating trunk strengthening protocols, on static and dynamic sitting and standing balance, gait, and agility in both apparently healthy and stroke patient populations.[8,9] Furthermore, a recent case report demonstrated improvements in the dynamic balance, muscle strength, and gait patterns of an individual with an ABI following their participation in an intervention consisting of trunk strengthening and balance exercises.[10]

The proposed mechanisms that underly the improvements in balance and mobility observed in the present report include increasing the sensitivity of feedback pathways and shortening of the onset times of the selected muscles by improving proprioception of both agonistic and antagonistic muscles. Furthermore, improvements in trunk strength might have resulted in increased trunk stability and balance allowing greater confidence during functional tasks.[10]

Despite the novel information provided, the present investigation has several limitations. Firstly, a case report is insufficient to provide clear evidence for the efficacy of a specific exercise intervention. Second, assessing changes to the motor impairment of the trunk muscles, via the Trunk Impairment Scale might have provided valuable additional information. Finally, the mechanisms behind the improvements noted in this report are unknown. Longitudinal randomized controlled trials, with large cohorts of participants, assessing changes in the strength of the trunk musculature, and comparing various exercise interventions are needed in the future to confirm these preliminary findings.

Conclusions

"McGill's Big 3" exercises can improve balance and mobility in an individual with an ABI, which suggests it warrants consideration for inclusion into rehabilitation programs for physical therapy. However, further longitudinal studies are needed to address the previously mentioned limitations.

Table 1: Eight-week exercise intervention protocol

Exercise	Sets × Reps	Rest	Intensity/duration	Progression
Modified curl-up	2×10	1 min between sets	3 second hold in trunk flexed position	Week 3-4 increase to 3 sets. Week 4-6 increase reps to 12. Week 6-8 in crease reps to 14.
Side bridge	2×5 each side	1 min between sets	The highest level that can be tolerated without inducing a fall or near fall with the aim to progress to 7-8 second holds.	Week 3-4 increase reps to 7. Week 4-6 increase reps to 8 and hold for 5-6 seconds Week 6-8 increase reps to 10 and hold for 7-8 seconds.
Bird-dog	2×5 each side	1 min between sets	The highest level that can be tolerated without inducing a fall or near fall with the aim to progress to 7-8 second holds.	Week 3-4 increase reps to 7. Week 4-6 increase reps to 8 and hold for 5-6 seconds. Weeks 6-8 increase reps to 10 and hold for 7-8 seconds.

Table 2: Results for functional outcome assessments following the eight-week exercise intervention

Test	Preintervention	Postintervention	% change
Heel-to-toe stand, left foot in front (seconds)	0	7.5	-
Heel-to-toe stand, right foot in front (seconds)	0	6.0	-
Tap test left foot (taps in 15 seconds)	9.0	9.0	0.0
Tap test right foot (taps in 15 seconds)	8.0	9.0	12.5
Forward reach test (centimeters)	11.2	12.3	9.8
Pick-up test (seconds)	3.5	2.1	40.0
Stand-to-floor (seconds)	23.8	20.1	15.5
Three-meter timed up-and-go (seconds)	18.2	17.5	3.8

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understand that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Author Queries???
AQ1: Kindly provide department.
AQ2: Kindly check for correctness, It would be part of sentence or not?