

## Rehabilitation and returning to activity after prolonged moderate traumatic brain injury

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*To the Editor:* Traumatic brain injury (TBI) indicates the disruption of normal function after a head or body blow or a concussion. In accordance with the criteria of the Glasgow Coma Scale, the severity of a TBI is classified into mild, moderate, and severe, based on patients' motor and verbal responses and eye opening.<sup>[1]</sup> Recently, studies have shown that 10% to 30% of individuals who tolerate head injuries may experience delayed symptoms and impairments from months to years later.<sup>[2]</sup>

According to the World Health Organization, TBI is predicted to become the third leading cause of global mortality and disability by 2024. On average, 2.8 million people suffer from TBI.<sup>[2]</sup> TBI is estimated to occur at rates of 1.5 million cases per year in the US and in 116 persons per 100,000 in Saudi Arabia.<sup>[1]</sup>

Few studies on rehabilitative strategies, particularly physical therapy interventions, are available for affected patients to recover from moderate TBIs (mTBIs). An evidence-based physical therapy intervention protocol is unavailable for such patients.<sup>[3]</sup> This case report aims to describe the intervention that is used to treat a patient with prolonged post-mTBI symptoms to ensure return to activity.

The patient was a 24-year-old Saudi woman who presented to the Physical Therapy Clinic at Qassim University Hospital. She walked into the clinic with imbalance, deviated when walking straight and when rising from the chair, and was holding walls while changing direction. She had a history of road traffic accident 10 months prior and reported loss of balance due to a fractured skull and internal hemorrhage. Surgery was performed to address the skull fracture, and she was admitted to the intensive care unit for 10 days. She was complaining of headache, dizziness, diplopia, and foggy sensation and had no history of other health disorders.

Magnetic resonance imaging findings showed the presence of surgical cranial bony defects, which were noted in the occipital bone associated with the extracranial herniation. The post craniectomy follow-up computed tomography scans showed a complete resolution of previously seen hemorrhagic areas with only remnant multiple hypodense areas in the frontal lobes and the right cerebellum. A physical examination was performed to determine the severity of symptoms. During palpation of the bilateral neck muscles and the vertebral cervical regions, the patient reported tenderness on the suboccipital muscles and upper three cervical joints, dizziness, and headache. Active and passive ranges of motion were measured with a cervical range-of-motion device and were within normal limits. The neck and lower extremity muscle strengths were assessed using manual resistance through multiple test positions.

The heart rate and the rating of perceived exertion changes were evaluated during a graded exercise on the Buffalo Concussion Treadmill Test, which is a validated safe test to measure the amount of aerobic exercise. The results of the test were recorded using a chart to measure the patient's aerobic ability. The Balance Error Scale System<sup>[5]</sup> was used to evaluate the balance and the postural control. The patient's score reached 24, indicating a clear imbalance.<sup>[5]</sup>

The patient's balance was evaluated using a dynamic stability test (Y Balance). The patient's composite score for the right and the left lower limbs were low (47% and 47.5%, respectively), indicating neuromuscular control deficits and a high chance of lower limb injury. The demographic data which were extracted from the patient using the post-concussion symptom scale (PCSS) were obtained through self-reporting of symptoms, such as headache, dizziness, and foggy sensation on the Likert scale of 0 to 6.<sup>[4]</sup> The patient's PCSS score was 33 (moderate).

Initially, we explained the patient's level of limitations and weakness and how the intervention program that she

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would undergo could help to enhance her balance level and activity performance and reduce the risk of prolonged post-TBI. After completing each of the six sessions, regular reassessments were performed to note the improvement and the performance levels and help the intervention level progression. The patient underwent in-clinical sessions, consisting of cardiovascular, musculoskeletal, postural control, and vestibular tests, based upon her personal needs which were identified during the examination [Supplementary Table 1, <http://links.lww.com/CM9/A537>]. The PCSS checklist and vital assessments were performed before and immediately following the aerobic activity.<sup>[4]</sup>

In this report, the patient underwent the first physical therapy intervention 10 months after the injury. The intervention was performed by focusing on four major aspects, namely education, rehabilitation, prevention, and preparation to return to activity. The patient received >30 sessions of physical therapy and instructions to follow the same exercise program per session as the home program [Supplementary Table 1, <http://links.lww.com/CM9/A537>]. General postural control, balance, and motor control exercises were incorporated for the patient. These exercises targeted balance, proprioception, and general lower extremity neuromuscular function. Balance rehabilitation was implemented into the patient's treatment until she was able to perform the exercises for at least 30 s while maintaining the same position. The last 3 weeks involved progression to Nordic walking exercises (a form of physical activity during which regular walking is supported by poles)<sup>[4]</sup> for actively engaging the upper extremities and the trunk.

The vestibular rehabilitation and gaze stability exercises reduced the patient's dizziness. The prevention was performed in parallel with the rehabilitation process to ensure a maximum recovery level and the normalization of imbalance. The preventive program included proper warm-up protocol, return to activity guidelines of prevention, lumbo-pelvic hip stability exercises, educating the patient about possible causes, and prevention of TBI. The guidelines of returning to activities consisted of six stages. Stages 1 to 3 are aimed at helping a patient progress to stage 4, which is focused on the performance of specific activities without contacting others.<sup>[3]</sup>

The patient reported no symptom at the end of the program whether at rest or during activity. She retained the ability to perform double-leg, single-leg, and tandem standing with open and closed eyes, and the patient's composite Y Balance scores for right and left lower limbs were 71.2% and 67.5%, respectively.

Following >2 months of physical therapy for a prolonged mTBI, the patient demonstrated improvements in her lower limb muscle, core, and trunk strengths; functional performance; balance; and level of confidence. In addition, the patient was able to jump up with high balance and showed improvement in her overall condition. Discussions with the patient about the importance of following the home exercise program and performance of each session helped to decrease the recovery time. Combined with a rehabilitation program, prevention protocols were implemented to improve her balance. A holistic approach of intervention and regular reassessments with follow-up after discharge demonstrated an improvement in her condition and level of confidence, thus enabling her to return to activity without any symptom.

#### Declaration of patient consent

The author certifies that she has 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 understands that her name and initials will not be published and due efforts will be made to conceal her identity, although anonymity cannot be guaranteed.

#### Conflicts of interest

None.

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