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Physical Therapy Management of a 16 Year Old Female with Vestibular Symptoms Following Suspected Concussion: A Case Report

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PHYSICAL THERAPY MANAGEMENT OF A 16 YEAR OLD FEMALE WITH VESTIBULAR SYMPTOMS FOLLOWING SUSPECTED CONCUSSION: A CASE REPORT

By

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M.S. Benedictine University, 2010

Capstone Project

Submitted in partial fulfillment of the requirements
For the Degree of Doctor of Physical Therapy

Governors State University
University Park, IL 60484

2015
ABSTRACT

Background: Post concussion syndrome has become more common in adolescents involved in school related sports. Management of dizziness and imbalance is challenging after concussion; vestibular rehabilitation has been shown to reduce symptoms and improve balance.

Purpose: The purpose of this study was to describe and implement appropriate interventions for a patient with suspected post concussion syndrome. A combined approach using targeted physical therapeutic exercise as well as functional tasks were evaluated and assessed.

Case description: The patient was a 16 year old Caucasian female who presented to the clinic with a physician order to evaluate and treat vestibular symptoms congruent with concussion. She presented with impairments in balance, vision, coordination and proprioception. She had sustained a head injury six months prior to evaluation.

Outcomes: This case report found that interventions addressing balance and gait were effective in the rehabilitation for a patient with vestibular symptoms.

Discussion: The physical therapy interventions designed for this patient to address balance and coordination were effective. Additional studies would be beneficial to further refine intervention procedures for other individual cases.
INTRODUCTION

Recently there has been an increase in the number of athletes seeking treatment for post concussion syndrome (PCS).\textsuperscript{1} PCS is a non-specific cluster of symptoms resulting from a mild traumatic brain injury (mTBI) or concussion.\textsuperscript{2} The International Classification of Diseases (ICD-1) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) differ on diagnostic criteria, therefore there is no standard or universal definition.\textsuperscript{3}

Vestibular complaints are the most frequently reported symptom after a mild TBI\textsuperscript{4} with less frequent reports of cognitive deficits, depression, anxiety, sleep disturbances and post traumatic stress disorder.\textsuperscript{3} Dizziness, a very non-specific term that encompasses varying sensations, is present in almost 80% of those with concussion.\textsuperscript{5}

A systematic review by Hansson in 2007 analyzed 71 studies to describe vestibular research as a feasible treatment for vestibular hypofunction, multi-sensory dizziness and Meniere’s Disease. While the strongest evidence supported the use of vestibular therapy in the above mentioned conditions, with less research being done on other disorders (benign paroxysmal positional vertigo [BPPV], and migraine) the evidence is promising that vestibular rehabilitation is effective in treating the symptoms of these disorders as well.
In mTBIs, vestibular physical therapy has been established as the most imperative modality for this population.\textsuperscript{4} Eye-head movement coordination exercises, ambulation exercises and static standing balance exercises are the most frequently used interventions in vestibular rehabilitation for dizziness and imbalance.\textsuperscript{7} Vestibular physical therapy may be able to decrease dizziness and improve gait quality in both adults and children.\textsuperscript{8}

The purpose of this study was to examine the effectiveness of interventions used to treat vestibular symptoms regardless of the medical diagnosis.

**SUBJECT DESCRIPTION**

The patient was a 16 year old Caucasian female who was referred by her physician to outpatient physical therapy to evaluate and treat. She had been experiencing dizziness, nausea, tinnitus and fatigue for six months preceding the visit to her physician.

The patient had a history of intermittent tinnitus which would resolve in past episodes and wore hearing aids. Her relevant history included strabismus, which had been surgically corrected, and she continued to wear corrective lenses post surgery. The patient had not had any diagnostic imaging performed and denied any history of concussion. Her physician had prescribed antibiotic ear drops that did not change her symptoms.
The patient was a high school junior and was actively involved in sports including martial arts, wrestling, distance running and mixed martial arts (MMA) fighting as well as extracurricular participation in Key Club. She was an honor student and her curriculum consisted of college preparatory accelerated classes.

The onset of her recent symptoms was unclear; the patient believed she may have “blacked out” during a wrestling move approximately six months prior when she struck her head on the head of her opponent, but she was not certain. She believed the symptoms may have started at that time and had gotten progressively worse.

Her symptom reproduction was random and for the most part she reported a constant issue with movement and activity, however there were times when symptoms would present with no movement. Symptoms were worse with reading activities and computer work. She was unable to concentrate and visually focus on objects, and had difficulty riding in a moving vehicle due to exacerbation of symptoms. She reported she had to sleep on her back at night to alleviate dizziness.

The patient consulted her medical doctor after symptoms had persisted over her summer recess and she was very concerned that they would affect her performance in the upcoming school year.
CLINICAL IMPRESSION 1

After the subjective narrative from the patient regarding her history and symptoms, balance and proprioception presented most impaired. The physical therapist determined that vestibular rehabilitation was the appropriate choice at this point. Tests and measures to address these issues were then implemented during the initial evaluation to confirm the course of action.

TESTS AND MEASURES

The patient initially presented to the clinic symptomatic. On observation, she had rounded shoulders with a forward head posture and wore her corrective lenses. All cervical range of motion was within normal limits and presented no problems.

Symptoms of dizziness and nausea were positive upon movement of her head while simultaneously ambulating 20 feet.

The patient’s balance was tested using the following parameters:

- Standing with a narrow base of support (feet together) she was able to maintain balance for 30 seconds with her eyes open, 13 seconds with her eyes closed.
- With feet together and standing on the Air Ex (An AirEx pad is a square piece of high density foam 5 inches high that simulates
standing on unstable surfaces). She was able to maintain balance with her eyes open for 22 seconds, with eyes closed for 3 seconds.

- She was able to maintain a tandem stance for 15 seconds without loss of balance.
- During tandem ambulation of 20 feet she lost balance once.

To further assess, special tests (Activities-Specific Balance Confidence Scale [ABC scale], Vestibulo-ocular Suppression Reflex [VOR], saccade testing, convergence testing, smooth pursuit testing, Dix Hallpike, Eye chart testing, and Star Excursion Balance Test [SEBT]) were conducted.

**Activities-specific Balance Confidence test (ABC)**

This test is a subjective measure of confidence in performing various ambulatory activities without falling or experiencing a sense of unsteadiness. Through a 16 item self-report measure, patients rate their confidence for performing specific activities. Items are rated on a scale from 0-100; 0 represents no confidence, 100 represents complete confidence. Overall score is calculated by adding scores and dividing the total number of items. Research on older adults shows an ICC of 0.879 with internal consistency of 0.973, 95% CI.

**VOR Suppression test**

The patient sits on a swivel chair with arms outstretched and hands held together and is asked to remain visually focused on their hands as the
chair rotates. Assesses the ability of the vestibulocerebellar system to suppress a vestibular signal.\textsuperscript{11}

**Saccade Test**

The examiner holds two widely spaced targets in front of the patient and asks the patient to look back and forth between the targets. Assesses the ability to rapidly fixate from one object to the other.\textsuperscript{11}

**Convergence Testing**

Patient fixates on an object as it is slowly moved to a point that is directly between the eyes.\textsuperscript{11}

**Smooth Pursuit Testing**

The patient follows an object moved across their full range of horizontal and vertical eye movements\textsuperscript{11}

**Dix Hallpike**

The patient long sits on the exam table, examiner turns patient head 30 to 45 degrees to one side and helps patient quickly lie back so head hangs over the end of the table. The examiner watches for nystagmus which will indicate the cause of vertigo as inner ear or brainstem.\textsuperscript{12}

**Eye Chart Testing**

Patient looks at a chart of 11 rows of capital letters starting with one large letter (usually “E”) and progressively smaller letters as rows descend. Assesses visual acuity.\textsuperscript{11}
The Star Excursion Balance Test

This test was introduced halfway through the treatment and was performed twice – once to get a baseline measurement of the patients balance and at discharge to gauge outcome. 8 lines are made on the floor using tape at 45 degrees from the center of a circle; the subject performs a single leg squat in all directions. ICC values range from 0.88 to 0.96 in all directions, SEM values 2.41 to 3.30 and SDD values 6.68 to 9.15.\textsuperscript{13}

On the sixth visit to the clinic the patient scored 73\% on the right (R) lower extremity (LE) and a 75\% on the left (L) lower extremity. On the thirteenth visit her score was 85\% on the (R) LE and 89\% on the (L) LE. Test results were recorded as a (+) if they reproduced patient’s symptoms. The patient at no time exhibited nystagmus. A summary of the results is shown in Table 1.

Table 1: Initial Evaluation Special Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>ABC test</td>
<td>28.75</td>
</tr>
<tr>
<td>VOR suppression test</td>
<td>(+)</td>
</tr>
<tr>
<td>Saccade test</td>
<td>(+)</td>
</tr>
<tr>
<td>Smooth pursuit test</td>
<td>(+)</td>
</tr>
<tr>
<td>Convergence test</td>
<td>(+)</td>
</tr>
<tr>
<td>Dix Hallpike</td>
<td>(+) with unrelenting symptoms</td>
</tr>
<tr>
<td>Eye chart testing</td>
<td>(+)</td>
</tr>
</tbody>
</table>
**Star Excursion Balance Test (session 6)**

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<table>
<thead>
<tr>
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<td>73% (R LE) 75% (L LE)</td>
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</table>

**CLINICAL IMPRESSION 2**

During the initial evaluation it was determined that her balance was most notably impaired. The interventions used during the patients 13 sessions of physical therapy were focused on diminishing symptoms to improve balance and proprioception to return to prior level of functioning.

**DIAGNOSIS AND PROGNOSIS**

Although the patient had denied history of concussion, her report of possibly “blacking out” when receiving a blow to the head suggested concussion. The fact that she was not able to remember further strengthened suspected diagnosis of concussion. Her symptoms were congruent with post-concussion syndrome.

The patient’s young age and motivated attitude suggested that she was a good candidate for physical therapy. She was very active and driven in school and demonstrated ambition to succeed.

**Goals**

The patient’s short term goals for physical therapy initially centered on a time frame between 1 to 3 weeks from start of treatment.
1. To perform narrow base of support exercises on the Airex balance
   pad for at least 30 seconds
2. To perform single leg stance for at least 30 seconds
3. to tolerate at least 30 minutes of computer work with a 50%
   reduction in symptoms
4. to roll in bed without symptoms

The patient’s long term functional goals ranged from 4 to 8 weeks

5. to resume running symptom free
6. to participate in all school activities symptom free
7. to perform driving activities symptom free
8. to perform martial arts activities symptom free

The plan of care was to treat the patient 3 times a week for 4 to 8 weeks.
She was covered under her parent’s private insurance plan.

**INTERVENTIONS**

The patient attended physical therapy for 14 sessions over six and a
half weeks. Her appointments were scheduled either early in the morning
(7:00 am) before school or later in the afternoon (4:00 pm or later) after
school as both her schedule and the clinic’s schedule allowed. She did not
miss any scheduled appointments.

Three evaluations were made during the course of her therapy: the
initial evaluation done at the first session, a re-evaluation of the taken three
weeks later and a final evaluation taken at the end of the 6 and a half weeks. Interventions were not performed at the initial evaluation or at the re-evaluation at discharge.

The interventions were chosen to address the patient’s deficits in balance. The interventions were divided between tasks that required ambulation (Table 2) and tasks that were executed standing upright (Table 3). Interventions were adjusted during the six and a half week timeframe to accommodate the patient’s progress. As she improved in one task (increased steadiness, decreased loss of balance) other tasks were added or subtracted from the treatment plan.

Improvements and increases in function were noted by both the increase in time the patient was able to maintain the exercise and observance of the patient’s ability to maintain proper form without loss of balance during the intervention.

**Terms and equipment:**

Terms and equipment employed during the interventions at this facility are as follows:

A lap was defined as ambulating the distance from one wall of the clinic to the far wall and then back to the original start position, a total distance of 50 feet. (1 lap = 50 feet)
All standing interventions and start positions were performed at a ballet bar placed 3.5 feet from the ground so that the patient was able to hold on if needed to maintain her balance at any time.

An Airex pad was used to increase the difficulty of the exercises as the patient progressed. An AirEx pad is a square piece of high density foam 5 inches high that simulates standing on unstable surfaces.

**Exercises**

**Bike** – the patient warmed up at the beginning of every session on a stationary bike for 10 minutes.

**Tandem gait** - The patient walked heel-to-toe

**Ambulation with head movement laterally** – the patient walked at self directed speed and gait while moving her head from side to side

**Ambulation with head movement vertically** – the patient walked at self directed speed and gait while moving her head up and down

**Narrow base of support eyes open/eyes closed** – the patient stood with her feet together in a narrow base of support with eyes open and again with eyes closed

**Balance board medial/lateral and anterior/posterior balance and rock** - the patient stood on a balance board for four different exercises: the board was first set up in a medial-lateral (ML) position
so the patient would rock back and forth for a specified amount of time followed by balancing the board evenly for a specified amount of time. The board was then re-configured in an anterior-posterior (AP) position so the patient would rock forward and backward for a specified amount of time followed by balancing the board evenly for a specified amount of time.

**Narrow base of support with Airex** – the patient stood feet together on the Airex pad for a range between 30 seconds and two minutes.

**Single leg stance** – the patient stood on one leg between ten seconds and 30 seconds.

**Ambulating in a straight line with eyes closed** – the patient walked with her normal gait with her eyes closed

**Single leg stance grid** – An 8 point star grid was constructed on the floor using white tape. The patient stood at the center of the grid on one leg and toe tap to each direction on the grid with the other foot.

**Spin focus** – the patient quickly made a 360 degree turn while “spotting” – fixating her focus on an object of her choice on the far wall and keeping her head still for as long as she could while turning the rest of her body.
Narrow base of support on Airex with eyes closed – the patient stood on the Airex with feet together and eyes closed for a specified amount of time.

Single leg stance deadlifts – the patient balanced on one leg while leaning over in a dead lift position and then returning upright.

Table 2: Ambulation interventions

<table>
<thead>
<tr>
<th>Session</th>
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</table>

Key:
TG – Tandem gait
Amb HM LM – Ambulation with head movement medial lateral
Amb HM UD – Ambulation with head movement up down
AMB EC – Ambulation eyes closed
SF – Spin focus
Table 3: Standing interventions

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<th>Session</th>
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<tr>
<td>SLS grid ea LE</td>
<td>5x</td>
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<td>NBOS Ax EC</td>
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<tr>
<td>SLS DL ea LE</td>
<td>10x</td>
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</table>

**Key:**
NBOS EO – Narrow base of support eyes open
BB – Balance Board
NBOS Ax EO – Narrow base of support eyes open
SLS ea LE – Single leg stance each lower extremity
SLS grid ea LE – Single leg stance grid each lower extremity
NBOS Ax EC – Narrow base of support eyes closed
SLS DL ea LE – Single leg stance deadlift each lower extremity

**OUTCOMES**

The patient filled out the ABC questionnaire a total of three times during the course of treatment: at initial evaluation, at re-evaluation three weeks later and then at discharge at the end of the six and a half week treatment. From initial evaluation to the re-evaluation there was no
significant change noted; however from re-evaluation until discharge there was a substantial improvement. (Figure 1)

Figure 1: ABC outcomes

The SEBT was given twice, once at three weeks into treatment and again at discharge. The patient showed improvement in scores over the three week period. (Figure 2).
During the entire course of treatment, the patient stated that with every session she felt a minor decrease in symptoms. During all interventions, the therapist observed that the patient steadily showed an increase in balance by displaying less wobbling and increased time of performance of the specific intervention. At re-evaluation, the patients ABC score had not changed from the baseline score of 28.75, but she had completed one short term goal of performing NBOS exercises on the Airex pad for 30 seconds. The initial tests and measures were repeated at discharge to measure improvement, and the results are summarized in Table 4.
Table 4: Tests and measures at discharge

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
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<tbody>
<tr>
<td>ABC test</td>
<td>83.75</td>
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<tr>
<td>VOR suppression test</td>
<td>(-)</td>
</tr>
<tr>
<td>Saccade test</td>
<td>(-)</td>
</tr>
<tr>
<td>Smooth pursuit test</td>
<td>(-)</td>
</tr>
<tr>
<td>Convergence test</td>
<td>(-)</td>
</tr>
<tr>
<td>Dix Hallpike</td>
<td>(-)</td>
</tr>
<tr>
<td>Eye chart testing</td>
<td>(+)</td>
</tr>
<tr>
<td>Star Excursion Balance Test</td>
<td>85% (R LE) 89% (L LE)</td>
</tr>
</tbody>
</table>

The eye chart testing was the only tenant that rendered a positive response at this time; possibly due to the patient’s history of strabismus and the use of corrective lenses.

**DISCUSSION**

The purpose of this case report was to follow a 16 year old patient with vestibular symptoms through a course of physical therapy to determine the effectiveness of treatment focused on balance and gait for reduction of vestibular signs and symptoms post suspected concussion.
All of her short term goals had been met at discharge. She was able to roll in bed without symptoms, perform a single leg stance for 30 seconds on each leg, and able to tolerate 30 minutes of computer work without symptoms.

Her long term goals had not been, however. She was not able to drive, participate in all school activities, run, or perform martial arts. The patient disclosed that she did not meet these goals due to a hesitance in actually trying to perform these tasks. She stated that because she was feeling so much better she feared that “pushing too hard” might once again bring on symptoms of vertigo and she was not comfortable trying at this time.

Initially long term goals were set for eight weeks; formal physical therapy sessions only lasted a little over six weeks. It stands to reason that if given another two weeks of formal therapy long term goals may have been met.

She was given a home exercise program consisting of several of the same interventions that she performed during her physical therapy sessions with the objective of completing long term goals on her own.

Asalaleen et al states that eye-head movement coordination exercises, ambulation exercises and static standing balance exercises are the most frequently used interventions in vestibular rehabilitation for dizziness and imbalance.
Another study by Asalaleen et al states that vestibular therapy may decrease dizziness and improve gait quality in both children and adults.°

Hoffer et al states that vestibular therapy has been shown to be an imperative modality for patients with mild traumatic brain injury.°

According to the data obtained, the interventions used were effective in diminishing symptoms and improving the patient’s quality of life. The patient reported her symptoms had subsided, she was more confident in her daily activities. These results reflect the evidence in the literature.

An interesting thing to note is that research on concussion and vestibular rehab focuses on acute treatment. The patient in this case report had been experiencing symptoms for over six months without a diagnosis. This data seems to suggest that weeks or even months after the initial onset of symptoms, vestibular rehabilitation may be effective.

Limitations

The data acquired in this study was from a single subject; the results may not be generalized.

Functional outcomes for vestibular rehabilitation are measured in self reported scales and clinician observation.° The patient’s main complaint was dizziness, which by nature is purely subjective and therefore difficult to assess.°
Observational changes noted by the therapist are also subjective and may not be accurate.

Measureable outcomes such as the Berg Balance scale or the Tinetti may have provided more strength to this report.

While the Star Excursion Balance Test did present quantifiable data, the nature of the improvements was based on patient reports, which may be inaccurate. The improvements shown were unable to be quantified by the therapist and rather were reported based on the administrator observation of enhanced steadiness of the patient’s movements. Administrator observation is also subjective and time consuming and thus is not always accurate.

**Implications**

The interventions performed with this patient yielded positive results. A combination of ambulation exercises and standing balance exercise was effective in treating a patient with vestibular symptoms. This course of treatment would be appropriate in other patients with similar issues to improve balance, coordination, proprioception and consequently quality of life. Future studies may find it beneficial to further break down the interventions, focusing on ambulation and gait versus static standing balance separately rather than using both in tandem.
REFERENCES


