By Jessica Heath and Neal Goulet

Tommy Roe had a pop hit in 1969 called “Dizzy.” “I’m so dizzy, my head is spinnin’/Like a whirlpool, it never ends,” went the song. It dealt with affairs of the heart, a boy singing about a girl, but today it also applies to a more serious matter of the mind: sports concussions and their after-effects. Another line from the song: “I need to call a doctor for some help.”

Each year, according to the Obama administration, youths make nearly 250,000 emergency room visits with sports or recreation-related brain injuries. More than 3.8 million concussions occur each year owing to sports, according to the Centers for Disease Control and Prevention. Though rarely fatal, concussions are an injury to the brain — it is shaken inside the skull — that can cause significant and even lasting problems. Some 50 percent of concussions go unreported.

Among the post-concussion symptoms for which physical therapy can provide considerable relief are those involving dizziness and imbalance.

SOCCER NOW CITED

Concussions are particularly common in collision and contact sports such as football, ice hockey, rugby and basketball. Concussion risk is highest in football: male participants have a 75 percent chance of suffering one, according to the Sports Concussion Institute. The National Football League and the National Hockey League have each been sued by former players over concussions. For its part, the NFL Foundation has donated $45 million to USA Football, the sport’s national governing body, to teach safer tackling to youth players to avoid head injuries.

Drayer Physical Therapy Institute and the University of South Carolina are partnering on a three-year youth football safety study in conjunction with USA Football to assess potential risk factors and to help create policies to make youth football safer. These efforts include research studies on head injury and concussion assessment.

Soccer traditionally has been thought to be safer than other sports; after all, soccer players don’t even wear helmets. However, a New York Times article titled, “Brain trauma extends to the soccer field,” challenged that assumption by recounting the story of Patrick Grange.

At only 3 years of age, Grange could “head” a soccer ball into a net. It was an act he no doubt performed thousands of times as his passion and skill allowed him to play soccer in college and as a semi-professional. That repetition and the damage it may have caused to the front of his brain is at the heart of Grange’s tragic story, which came to national prominence in 2014. Grange, who died at age 29 in 2012, became the first soccer player to be diagnosed with the degenerative brain disease known as chronic traumatic encephalopathy, or CTE.

But concussions account for 6 to 9 percent of all soccer injuries, according to an article on Scientific American’s website. “One [study] shows some 63 percent of all varsity soccer players have sustained concussions — yet only 19 percent realized it.”

Traumatic brain injuries such as a concussion can contribute to CTE. Researchers believe that Grange’s brain damage was “the precipitating factor” in his diagnosis, at age 27, of ALS, also known as Lou Gehrig’s disease, a degenerative disease of the nervous system.

A soccer player might head the ball a dozen times in a game but many more times in practices. Impact speeds can reach 50 to 70 mph. Grange’s case suggests some of the longer-term implications of concussions; the Times article cited one concussion during a high school game in which he was knocked unconscious. This raises the issue of what can be done to mitigate the complications that result from concussions — and how concussions can be prevented in the first place.

SAFETY AND PREVENTION

It might not be possible to prevent all concussions. Two athletes playing fairly but aggressively might accidentally butt heads, causing injury. But there are ways to reduce the incidence,

Continued on Page 2
Concussions

By Jeremy Ansbach

WHAT IS A CONCUSSION AND HOW CAN IT OCCUR?

Common within the United States, concussions are a disturbance in brain function caused by high-impact trauma to the head or neck in which the brain often "bounces" within the skull. Concussions result from motor vehicle accidents, contact sports, falls, and other activities.

WHAT ROLE DOES THE VESTIBULAR SYSTEM PLAY?

Concussions often affect the inner ear, or vestibular system, which assists with balance. The vestibulo-ocular reflex (it assists with the ability to focus on moving objects) and gaze stability of the eyes, specifically, are disrupted, making it challenging to focus. If the cerebellum of the brain (controls coordination) is involved, balance can be affected. Vertigo or dizziness can occur when structures within the inner ear are damaged as a result of trauma.

HOW CAN PHYSICAL THERAPISTS PLAY A ROLE IN REHABILITATION?

The first step in recovery is rest. If symptoms continue, re habilitation should be considered.

Q&A

Because no two concussions are identical, a physical therapist will develop an individualized treatment program based upon the needs of the patient as identified during an evaluation of the vestibular system. Treatment may include eye training, balance and gait, as well as address secondary complaints of the musculoskeletal system, including deficits in range of motion, joint mobility and strength that may have resulted from trauma. Graded exposure to aerobic activity will be designed by a PT to promote blood and oxygen flow for healing and will be closely monitored for symptoms.

WHAT IS SECOND IMPACT SYNDROME AND HOW CAN RISKS BE DECREASED?

Second Impact Syndrome is swelling of the brain caused by a second concussion when symptoms from the first concussion have not yet subsided. Approximately 50 percent of concussions are undiscovered. Once a concussion occurs, it is important to recognize the signs in order to protect the brain against further damage. Common complaints associated with concussions include nausea, vomiting, dizziness, concentration and cognitive difficulties, headaches, fatigue, sensitivity to light, double vision and uncoordinated balance. Rapid changes in emotions are common. It is important to treat the concussion with rest and other therapies prior to the return to activities such as sports.

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**Post-Concussion Syndrome**

By Rob Volstad

**PATIENT HISTORY**

While driving, a 52-year-old technology saleswoman was struck on the driver’s side by another vehicle. She struck her head against the window and lost consciousness. She was taken to the hospital, where all testing, including MRI and X-ray, was normal.

She complained of vertigo with bed mobility. Vestibular positional testing found that she suffered from benign paroxysmal positional vertigo (BPPV). Repeated repositioning maneuvers were unsuccessful in correcting this.

She was released from the hospital with continued vertigo, dizziness, headaches and neck pain, but with no further instructions for follow up, being told she only had a concussion. She returned to work immediately but found that concentrating and driving triggered stronger headaches, dizziness, and word-finding difficulties. She felt constantly exhausted and could no longer perform her work responsibilities.

Approximately two weeks after the accident, she noticed some loss of her visual field. She was referred to a neuro-ophthalmologist, who diagnosed her with a left optic nerve stroke. This physician then referred her to vestibular physical therapy for her complaints of vertigo and symptoms consistent with post-concussion syndrome.

**ASSESSMENT**

At initial evaluation, the patient’s primary complaint was vertigo with positional changes. Dix-Hallpike testing was positive for BPPV on the left posterior canal. All other oculomotor testing was within normal limits, though several of the test movements did provoke dizziness or nausea. The presentation of busy visual stimulation and patterned backgrounds also provoked strong symptoms, indicating high space and motion discomfort. Dizziness Handicap Inventory score was 50/100. Functional Gait Assessment score was 25/30, with imbalance most noted with quick head turns and nods. She had poor head-shoulder dissociation when turning. Motion Sensitivity Quotient was moderate at 18.75.

Because of the patient’s neck pain, dizziness and vertigo, a full cervical spine examination was completed, finding significant trigger points activity and upper cervical range of motion (ROM) restrictions, mostly on the left and with movements to the left. Original verbal pain score was 7/10.

**TREATMENT**

The patient was seen for eight weeks, primarily for vestibular PT to address the imbalance, space and motion discomfort, abnormal gait stabilization, and poor visual preference. The BPPV identified on the initial visit was successfully treated at that time. Initially, vestibular exercises included basic head and eye coordination maneuvers until they could be performed against plain backgrounds and busy backgrounds without any symptoms. Her balance exercises progressed as she improved, to include walking with changes in motion, with eyes closed, and with narrowing of her base of support.

At the onset, manual therapy was initiated to decrease cervical and upper thoracic pain and strain. Soft-tissue massage and upper cervical mobilization were the primary focuses.

During the coming weeks, as the patient reported improving, symptoms, vestibular exercises were advanced to include dynamic visual adaptations. She moved her head with increasing speed while maintaining visual contact on near and distant targets, first while standing and then while walking. To address her space sensitivity, she was placed in a dark room with a disco ball rotating colored lights across the walls of the room until triggering her symptoms.

Her tolerance without symptoms increased from just seconds at the initial trial to several minutes by the time of her discharge—indicating when she moved around.

Cervical and upper thoracic strengthening exercises were added several weeks into her therapy to assist with good posture and cervical stability.

Balance and vestibular exercises continued to advance as the patient reported improved function with less pain and dizziness. By week four, she was able to drive in all traffic without dizziness.

**OUTCOME**

After eight weeks of physical therapy, education and behavior modification, the patient had met each of her goals and returned to her demanding job. She was able to drive, tolerate busy visual environments such as a grocery store or mall, and walk with quick head and body turns without dizziness or imbalance. She had full cervical pain-free ROM and no longer complained of vertigo with positional changes.

Her Dizziness Handicap Inventory score improved to 2/100. Functional Gait Assessment score improved to 30/36. Motion Sensitivity Quotient score improved to 0.4, mild. She reported 0/10 pain at worst.
RESEARCH ABSTRACT

**Vestibular Rehab After Concussion**

By Branden Fleishman

**INTRODUCTION**
A concussion is one of the most common neurological conditions among children and young adults. The growing rate of concussions in contact and collision sports has made for a major public health concern worldwide.

A concussion, also referred to as a mild traumatic brain injury, disrupts brain function, resulting in physical, cognitive, emotional and/or sleep-related symptoms and may involve a loss of consciousness. Symptom duration can vary from minutes to months or even longer.

Dizziness, causing poor balance and postural instability, is a frequent symptom in the first days after injury, occurring in 23 to 81 percent of cases.

The purpose of this paper was to examine the effect of vestibular rehabilitation on reducing dizziness and improving gait and balance function after concussion.

**METHODS**
The authors conducted a retrospective study reviewing charts of 114 patients referred for vestibular rehabilitation after concussion. Duration of time between the concussion and referral for evaluation was a median 61 days. Vestibular rehabilitation interventions were customized based on each patient’s impairments and functional limitations that related to dizziness, ocular-motor function, and gait and balance function. Clinical and home exercises included gaze stabilization, standing balance, walking with balance challenge, and, in a few cases, canalith repositioning maneuvers, or techniques used to assist in the correct placement of crystals in the ear canals.

Self-reported and performance measures were taken at the initial evaluation and at discharge. Self-reported measures included dizziness severity, the Activities-specific Balance Confidence (ABC) scale, and the Dizziness Handicap Inventory (DHI). Gait and balance performance were measured using the Dynamic Gait Index (DGI), Functional Gait Assessment (FGA), gait speed, Timed Up and Go, Five Times Sit To Stand (FTSTS) test, and Sensory Organization Test (SOT). A mixed-factor, repeated-measures analysis of variance was used to test whether there was an effect of vestibular rehabilitation therapy and age on the outcome measures.

**RESULTS**
Of the 114 patients referred, 84 returned for at least one visit. Median number of visits was four and median duration was 33 days. Among these patients, improvements were observed in all self-reported gait and balance performance measures at time of discharge. Children (ages 18 and younger) demonstrated significant improvement in dizziness severity and on the SOT compared with adults.

**DISCUSSION**
The primary finding of this study is that people who had persistent dizziness and gait and balance dysfunction after having a concussion improved after vestibular rehabilitation. For most outcome measures, improvement in post-concussion symptoms did not depend on age, indicating that vestibular rehabilitation may equally benefit children and adults. While many symptoms may resolve within the first few weeks after the injury, this study indicates that skilled intervention may be beneficial in improving symptoms that persist in the sub-acute and chronic phases and do not resolve with rest.

Future research evaluating patients from time of injury to return to full activity or function can assist health care professionals in providing appropriate care. Concussion severity markers such as loss of consciousness, amnesia and confusion should be included for determining prognosis and appropriate interventions. A multidisciplinary approach incorporating a vestibular rehabilitation program should be implemented after concussion.

**REFERENCE**