Traumatic Brain Injury: A Case Study of an Atypical Rehabilitation Progression Due to Unmodifiable Circumstances

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Traumatic Brain Injury: A Case Study of an Atypical Rehabilitation Progression Due to Unmodifiable Circumstances

By

Brianna Gustafson

A Scholarly Project Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

Grand Forks, North Dakota
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This Scholarly Project, submitted by Brianna Gustafson in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Michelle Labrecque
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Title Traumatic Brain Injury: A Case Study of an Atypical Rehabilitation Progression Due to Unmodifiable Circumstances

Department Physical Therapy

Degree Doctor of Physical Therapy

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Date 9-8-10
# TABLE OF CONTENTS

LIST OF TABLES .......................................................................................................... v

ACKNOWLEDGEMENTS ............................................................................................ vi

ABSTRACT ................................................................................................................ vii

CHAPTER

I. BACKGROUND AND PURPOSE ........................................................................... 1

II. CASE DESCRIPTION ............................................................................................ 4
   - Review of Systems ........................................................................................ 6
   - Examination ................................................................................................ 7
   - Evaluation .................................................................................................... 10
   - Diagnosis, Prognosis, and Plan of Care ....................................................... 11

III. INTERVENTIONS .............................................................................................. 14

IV. OUTCOMES ...................................................................................................... 20

V. DISCUSSION ...................................................................................................... 24
   - Reflective Practice ..................................................................................... 27

APPENDIX A ........................................................................................................... 30

APPENDIX B ........................................................................................................... 32

APPENDIX C ........................................................................................................... 34

REFERENCES .......................................................................................................... 35
LIST OF TABLES

1. Table 1: Initial Examination Scores............................................................... 10
2. Table 2: Treatment Interventions from the Initial Examination
Through the Tenth Treatment................................................................. 15
3. Table 3: Treatment Interventions from the Eleventh
Treatment until Discharge................................................................. 16
4. Table 4: Initial and Discharge Examination Scores................................. 20
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ABSTRACT

**Background and Purpose** Traumatic brain injuries (TBI) are very prevalent throughout the US. They are often caused by a head injury leading to alterations in brain functioning and often result in lifelong disabilities. Current literature is limited on the aspects of rehabilitation following a TBI because of the many factors that differ within each case. This study will explore an atypical pathway for rehabilitation following a TBI.

**Case Description** The patient was a 32-year-old male who sustained a TBI following a motor vehicle accident (MVA). The Glasgow Coma Scale (GCS) and Rancho Los Amigo Scale (RLAS) were assessed initially and scored at 11/15 and III respectively. A modified version of the Berg Balance Scale (BBS) was only administered once and scored 41/48. The patient scored grossly a 1/5 for Manual Muscle Testing (MMT) of bilateral lower extremities and left upper extremity. An abnormal treatment progression occurred due to unmodifiable factors that included the patient’s uninsured status, an increased census in the acute care hospital, and limited familial support.

**Outcomes and Discussion** The patient was treated for a total of 39 sessions over a 44 day period. The GCS score improved to 13/15 and the RLAS improved to IV. The patient also had improvements to 5/5 MMT for all lower extremity motions except right knee extension and dorsiflexion which were both 2/5 MMT. The patient progressed with the treatment provided, however he may have progressed to a greater extent if he had been transferred to a rehabilitation center sooner. Further research needs to be done to determine the ideal path for rehabilitation following a TBI.
CHAPTER I

Background and Purpose

Traumatic brain injury (TBI) can be defined as an alteration in brain functioning, or evidence of pathology within the brain, caused by an external force such as a jolt or blow to the head.\textsuperscript{1} An injury to the head can result in a TBI with the primary causes of TBIs including falls, motor vehicle crashes, struck by or against objects, and assaults. Other common sources of injury include sporting events and recreational activity accidents. In 2010, there were approximately 2.5 million TBIs reported in the United States. Men between the ages of 15 to 44 are most commonly the sufferers of TBIs sustained in a motor vehicle accident.\textsuperscript{2} TBIs can vary in severity from mild to severe. Mild TBIs are often referred to as concussions whereas severe TBIs are diagnosed with extended periods of unconsciousness and memory loss.\textsuperscript{3} Severe TBIs result in greater damage and impairments than mild TBIs. TBIs are a noteworthy source of disability within the United States, often affecting numerous body systems and aspects of life, and can also leave lifelong consequences. About 30\% of all injury deaths result from TBI contributions and approximately 5.3 million citizens in the US live with lasting disabilities from a previous TBI.\textsuperscript{4}

Following a TBI, an extensive range of impairments may be present depending on the location and severity of the injury to the brain. Areas of impairments associated with TBIs include neuromuscular, cognitive, neurobehavioral, communication and swallowing. Neuromuscular impairments typically present with impaired motor function.
Examples of the neuromuscular deficiencies can include upper extremity and lower extremity paresis, diminished postural control, impaired coordination, abnormal tone and ataxic gait. These neuromuscular deficiencies may present as lifelong impairments. Impairments associated with cognition can affect consciousness, attention, memory, learning and many others. Patients who have sustained a TBI can also suffer from neurobehavioral changes visible in areas of personality such as agitation, aggression and impulsivity. Communication can be affected as patients may have trouble with expressing and understanding information. There can be other secondary complications following a TBI such as depression, decreased cardiovascular capacity, swallowing difficulties, and changes in family dynamics and relationships.5

Following acute care hospitalization for a severe TBI, the patient often is transferred to a long term acute care hospital (LTACH) if further complex medical care is required or the patient may be transitioned to an inpatient rehabilitation center for greater focus on rehabilitative therapies. After completing inpatient rehabilitation, community integrated rehabilitation begins with outpatient rehabilitation services. This may involve neurobehavioral rehabilitation, vocational rehabilitation or other areas where the patient needs additional therapy. Some patients have enduring effects following a TBI. These individuals may require continuous, lifelong therapy services to maintain optimal level of functional performance in daily life. The continuum of rehabilitation post TBI may be different for each patient, depending on the services and needs of the individual.6

Goals of rehabilitation after a TBI consist of assisting the patient to achieve the highest level of functioning possible considering the patient’s capabilities. The rehabilitative treatment consists of not only physical rehabilitation but also includes
cognitive, neurobehavioral and communication pieces. It is important to note that there is not a specific rehabilitation protocol that is guaranteed to be successful for all patients. Often rehabilitation teams consist of the physician, speech language pathologist, occupational therapist, physical therapist, nursing, dietetics and others. Therapists need to focus on the individual patient’s specific needs and disabilities and tailor a program that is personalized and effective.

Common assessments used to evaluate a patient’s function following a TBI are the Ranchos Los Amigos Scale (RLAS) (see Appendix A) and the Glasgow Coma Scale (GCS) (see Appendix B). The RLAS and the GCS are used initially to assess the patient’s responsiveness. Following the acute stage of the injury, the RLAS and GCS are used to evaluate changes in the patient’s responsiveness and consciousness along with assisting healthcare providers in understanding the patient’s cognitive status.

Current literature is limited on the aspects of physical therapy rehabilitation following a TBI, due to the inordinate degree of impairments that can be sustained with a TBI. The purpose of this case study is to describe the physical therapy intervention of a 32-year-old male who sustained and survived a severe TBI. The case will explore the atypical rehabilitative pathway that was required due to unmodifiable factors that included the patient’s uninsured status, an increased census in the acute care hospital, and limited familial support.
CHAPTER II

Case Description

The patient was a 32-year-old Caucasian male being seen following a motor vehicle accident (MVA) resulting in severe TBI and right hemiplegia. Treatment took place in an acute care hospital in a metropolitan city. The patient was intubated and screened upon arrival to the critical care unit. The GCS initially was found to be 6/15 with eye = 1 (none), verbal = 1 (none), and motor = 4 (flexion responses). Following screening it was reported that the patient had sustained many injuries including a closed TBI, a C7 non-displaced left facet fracture, a commuted right clavicle fracture and scapular body fracture, a right non-displaced 3rd-5th rib fracture posteriorly and anteriorly, a right lobe hepatic laceration, and a right lung contusion leading to a small hemopneumothorax. The patient’s blood and lab reports revealed that the patient had a blood alcohol level of .245 mg/dL upon arrival to the hospital.

Prior to the MVA the patient was independent in all aspects of life and in good health. He was working full time in a physically demanding job and had no restrictions of his physical functioning. The patient was right hand dominant for all activities and the highest level of education completed was a high school diploma. He was a father of three but only cared for the children occasionally as he lived alone. The patient grew up in a small town with his sibling and divorced parents. He did not have familial support because his mother lived far from his home and his father was deceased.
The patient enjoyed playing with his children, watching/playing football and driving his motorcycle. In his spare time, he worked as a hobby mechanic on cars and enjoyed going to the racetrack. It is unknown if the patient used smokeless tobacco but he did not use cigarettes/cigars or illicit drugs. There was a question about his alcohol intake as he was under the influence when the MVA occurred.

There was no pertinent family history on record. The only major previous medical history for the patient was discovered during initial screening and was found to be chronic bilateral spondylolysis at L5, which was not affected by the MVA. There were no other previous hospitalizations, surgeries, or medical conditions. The patient was not taking any medications prior to the MVA. The patient was intubated and sedated upon arrival to the hospital on 08/14/15 until 09/02/15. Surgeons determined that the TBI took priority and postponed surgery to the clavicle and scapula fractures.

The patient was on an extensive list of medications following the MVA. The two that were most pertinent to physical therapy were precedex and fentanyl. These medications are significant to physical therapy because they affect consciousness. The patient was receiving precedex (dexmedetomidine) for sedation and comfort purposes. The dosage was decreased once physical therapy was ordered. Fentanyl (Duragesic) may affect arousal as it is used partially as a narcotic and for sedation.

The patient was followed by neurosurgery, a general surgery team, case management, physical therapy, occupational therapy, dietetics, speech language pathology and others throughout his hospital stay. The hospital employed an individual known as a mobility aid on the critical care unit (CCU) floor. The mobility aid ensured
that the patient received position changes for weight bearing and received passive range of motion (PROM) to all extremities while the patient was unable to actively participate.

**Review of Systems**

Therapy services were initiated following a decrease in sedation. Physical therapy’s initial evaluation was on 09/02/15, nineteen days after the patient’s MVA and TBI. The patient had a tracheostomy with a Passy-Muir Valve (PMV) and was receiving humidified air. His vitals were assessed and had Sp02 of 100%, pulse of 70 beats per minute, 13 respirations per minute and blood pressure of 115/75 mmHg. Weight was recorded at 158 pounds, height was 6 feet, and body mass index was calculated to be 21.4 kg/m². Integumentary assessment found patient to be pale and observed healing abrasions to his face, bilateral elbows, and the right clavicle had sutures closing a wound. Posture was assessed in supine and found to be within normal limits. When the patient was sitting at the edge of the bed it was difficult to assess posture due to the patient’s inability to sit or stand without maximal assistance.

A cervical spine brace was in place and the patient was required to wear the brace for 24 hours per day for 8 weeks. The patient continued to hold his head and neck to the left and he would not track with his eyes past midline. He was not fully conscious and was unable to consistently follow commands as directed by the physical therapist. Communication was attempted but he was not able to respond despite the Passy-Muir Valve placement. Because of absent communicative abilities, an orientation assessment consisting of month, date, year, place, and situation was deferred.

The physical therapy examination plan involved assessment of mobility, range of motion (ROM), strength, balance, orientation and cognition. Since TBIs affect the whole
body, it is important to remember that many systems may be impacted and require assessment prior to treatment. Prognosis is often difficult to predict due to the large amount of disabilities that can stem from sustaining a TBI. Findings of the initial examination determined the appropriateness of initiating physical therapy with this patient.

**Examination**

Tests and measures were administered at the initial session, throughout treatment, and at discharge. Examinations were performed to assess diagnosis, prognosis, monitor progression and to observe outcomes. The initial examination began with the Glasgow Coma Scale (GCS) due to its significance for physical therapist’s comprehension of patient status, level of active participation and knowledge of appropriate goal setting. The GCS assesses level of consciousness and assesses the bodily function domain.

GCS was performed by observing the patient and assessing eye opening, verbal responses, and motor responses to a stimuli or commands. The scores for each of the three categories are totaled and taken out of possible 15 points. A study by Fischer et al assessed reliability of the GCS within an ICU. The results concluded that the exact inter-rater agreement within clinicians was 71% and the inter-rater reliability within ± 1 point was 90% reliable. These statistics concur that the GCS has high inter-rater reliability within the ICU. The GCS validity in relation to Glasgow Outcome Scores for predictability of prognosis was adequate to poor, according to a study by Balestreri et al in 2004. The Glasgow Outcome Scores were not used in this study, since the purpose of the GCS was not to assess outcome scores, but to assess current patient status, which the GCS is valid for. Upon admission to the CCU, the GCS was scored at a 6/15 and at initial
physical therapy examination 19 days later, the GCS score was 11/15. The following sub scores were given: eye opening = 4, with patient continuously looking to the left, tracking to midline then quickly reverting back to left, verbal response = 1 none, and motor response = 6, as the patient was able to follow commands to squeeze his left hand one time. The patient scored a 15/15 at discharge on the GCS, reflecting no deficits in consciousness.

The Rancho Los Amigos Scale (RLAS) was also examined to identify the patient’s current status as well as classify patterns of recovery with regards to behavior and cognition. There are eight levels of recovery within the RLAS. Within each level there are different characteristics of behavior and cognitive functioning that are assessed as present or absent. The inter-rater reliability of the RLAS was assessed in a study by Beauchamp in 2001. Beauchamp reported an adequate to excellent inter-rater reliability of 91% overall for the RLAS. Gouvier performed a study to evaluate the validity of the RLAS compared to other commonly used evidence based tests. The conclusions validated that the RLAS had excellent concurrent validity of 92% with the Levels of Cognitive Functioning Assessment Scale. The Levels of Cognitive Functioning Assessment Scale is a behavioral assessment commonly used for patients who are recovering from a TBI.

With initial testing the patient’s RLAS was calculated to be Level 3 – Localized Response. This level requires total assistance for all cares and mobility. The patient was able to move his eyes and inconsistently track individuals on the left side, as well as inconsistently follow simple one-step commands such as squeezing with his left hand. On 9/30/15, the RLAS was administered again and the patient had progressed to Level 6 – Confused Appropriate.

He remained at Level 6 throughout his stay at the facility. The
The patient was confused because of cognitive deficits affecting orientation, memory, and lack of task carry over. He could participate in therapy for up to 30 minutes, but required supervision and assistance for the majority of tasks. The RLAS was essential for physical therapist’s comprehension of the patient’s state of mind and attitude, as well as understanding his learning and comprehension levels.

The patient was also examined for muscle strength by completing a manual muscle test (MMT) assessment. At the initial evaluation the patient’s strength was assessed grossly due to impaired cognitive functioning. He had a 1/5 MMT for the left upper extremity and bilateral lower extremities throughout the larger muscle groups. The fractures and inability to comprehend commands resulted in deferring MMT and ROM testing to the trunk, neck, and right upper extremity. Passive range of motion (PROM) was recorded as within normal limits (WNL) for all assessed extremities except for left knee extension, which was measured to be -15 degrees from neutral. Active ROM and Active Assistive ROM were deferred because of patient’s decreased cognitive level.

The Berg Balance Scale (BBS)(See Appendix C) was administered on 9/30/2015, as the patient progressed and the measure was more appropriate for his level of motor functioning. The BBS assessed balance, functional mobility and risk of falls. The measure consisted of 14 activities with varying difficulty with static and dynamic components. The BBS has limited research regarding reliability and validity specifically for TBI diagnosis. However, a study by Newstead concluded that the BBS has an excellent test-retest reliability of 98.6%. La Porta conducted a study searching internal validity of the BBS for neurorehabilitation patients. The results concluded that the BBS needed to be modified to reach a high level of internal validity. The static sitting and
standing balances were eliminated resulting in a 12 task BBS. With this modified version, the internal validity score was high at 95.7%. Considering the evidence reported by La Porta, the BBS for this TBI patient was assessed out of the reported 12 tasks. The patient scored a 41/48. The patient was not assessed on the BBS again as there was an unexpected and limited notice for time/day of discharge. Table 1 shows the initial scores on all of the above listed areas of physical therapy examination.

**Table 1. Initial Examination Scores 9/2/2015**

| Glasgow Coma Scale | 6/15 upon admission to ICU  
<table>
<thead>
<tr>
<th></th>
<th>11/15 at initial PT evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranchos Los Amigos Level</td>
<td>III</td>
</tr>
<tr>
<td>Manual Muscle Testing</td>
<td>Grossly 1/5 throughout bilateral lower extremities and left upper extremity</td>
</tr>
<tr>
<td>Passive Range of Motion</td>
<td>WNL throughout except right knee extension = -15 degrees from 0</td>
</tr>
<tr>
<td>Berg Balance Scale</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**Evaluation**

During the initial physical therapy examination, the patient was very dependent with mobility. He required maximal assistance of two for bed mobility and sitting at the edge of bed required moderate to maximal assistance of one. He was not verbally responding which lowered his GCS score to 11/15. RLAS was determined to be Level 3, Localized Response, indicating that he was able to follow some commands and visualize inconsistently but required maximal assistance for self and daily cares. MMT and PROM were performed to assess available ROM and muscular strength. The results demonstrated mostly full PROM but very limited strength with a 1/5 MMT on the left lower extremity and a 0/5 MMT on the right lower extremity. The GCS and RLAS scores indicated decreased cognitive functioning. His decreased understanding and
consciousness could have led to patient misinterpretation of physical therapist’s commands. The examination findings were reviewed as a whole and concluded that his impaired cognitive functioning and decreased physical status were consistent with the presentation of a TBI.

The major areas of impact from the TBI and MVA on the patient were evaluated and determined to be right hemiplegia resulting in weakness, right clavicular, scapular, and rib fractures, fracture of C7 cervical vertebrae, tracheostomy placement, inability to verbally communicate, inhibited cognition, and decreased consciousness. The physical impairments led to complete reliance for assistance in all aspects of life. Fractures complicated the hemiplegia and made it more difficult for caregivers to provide treatments. His impaired cognition and inability to communicate limited the patient’s social interaction with caregivers and visitors.

This patient’s TBI was caused by a MVA as well as the physical trauma with resultant fractures decreasing the patient’s movement abilities. The trauma to the patient’s brain sustained during the MVA also led to impaired motor functioning and right hemiplegia. By reviewing the causative information, applying it to the examination findings and to current literature, it was established that the movement dysfunctions were the result of the TBI.

**Diagnosis, Prognosis and Plan of Care**

Adapted practice pattern 5D from the Guide to Physical Therapy Practice is associated with impaired motor functioning, as it relates to disorders of the central nervous system (CNS). Many areas of the practice pattern 5D issued by the Guide to Physical Therapy Practice coincide with the patient evaluation presented in this case.
including impaired motor function, compromised communication, loss of balance, and many others. The expected prognosis for this patient was difficult to assess due to the excessive degree of his injuries. The patient’s potential to regain full independence was limited. This prognosis was determined because of the extent of his injuries, his limited familial support and the extended physical therapy treatment in an acute care facility instead of an inpatient rehabilitation facility.

Goals were set initially to coincide with patient discharge, however, the prolonged acute care treatment disrupted the course of goal progression. Once goals were met they were advanced in a functional progression. Goals addressed bed mobility, transfers, ability to use an assistive device, sitting balance, and ability to follow one step commands. Treatment sessions were comprised of interventions that aimed at development of the goals. Due to the immense acute care hospital census, the patient was seen 1-2 times per day as the physical therapist’s schedule allowed. Re-examination and evaluation was completed periodically throughout each month, although the physical therapists observed and recorded the patient’s behavior, cognition and physical progression at daily treatments.

The patient was an excellent candidate for physical therapy intervention due to his decreased cardiovascular function, right hemiplegia, fractures of clavicle and scapula and reduced cognitive status. The patient was treated by physical therapy with the focus on mobility, therapeutic activities, gait training, and lower extremity strengthening. Other therapy services such as occupational therapy and speech language therapy were also initiated to assist the patient in returning to optimal function.
Initial Physical Therapy Goals set on 9/2/2015

- Ability to independently manage bed mobility
- Transferring from supine to sitting with moderate assistance of one
- Transferring from sitting to standing with moderate assistance of two
- Transferring with moderate assistance of two from bed to wheelchair
- Ability to sit at the edge of the bed for ten minutes with minimal assistance of one
- Follow simple, one step commands 100% of the time to assist with ease of transfers

Progressed Physical Therapy Goals set on 10/14/2015

- Ability to transfer from sitting to standing independently and without an assistive device
- Ability to complete all transfers independently with the use of a quad cane
- Ambulate 500 feet with a quad cane and stand by assistance along with consistent clearance of right foot without cues from the physical therapist
- Ascend and descend four stairs with a rail, independently, using a reciprocal pattern
- Achieve 3/5 MMT for right quadriceps strength
- Achieve 40/56 on the Berg Balance scale
- Attain neutral right ankle dorsiflexion and 0 degrees of right knee extension
CHAPTER III

Interventions

Physical therapy worked closely with occupational therapy and speech therapy to take a holistic view when treating the patient. Physical therapy focused on the lower extremities, functional tasks, gait training and neuromuscular proprioception. Occupational therapy worked with the upper extremities, activities of daily living, and cognitive status progression. Speech language pathology also worked with cognitive status, memory, organization, speech and swallowing. Other members of the healthcare team included the nurses, aides, and physicians who also worked with the patient daily.

Initially the patient was at a lower consciousness level. Therefore, during the early stages of recovery, the hospital's mobility aid performed PROM for all large joints two times per day and assisted with changes in position for weight bearing approximately every two hours. Following increased consciousness, physical therapy interventions were initiated and tailored to the patient. The therapists also took into account the major bodily injuries that the patient had sustained in the MVA along with consideration of 19 days of inactivity. The extended immobilization led to decreased cardiovascular conditioning as well as diminished muscle mass and bone mineral density. The right upper extremity and cervical spine were not included in the physical therapy treatment due to fractures and bracing placement.

Considering the effects of bed rest, decreased consciousness and the RLAS levels the initial treatments were focused on functional tasks with maximal assistance. The
patient was prompted to assist with movements and therapists encouraged incorporating the right lower extremity due to hemiparesis. As the patient began to offer increased assistance, the physical therapy treatment progressed however he was not able to incorporate the right lower extremity.

The first ten treatments were focused on functionality per the patient’s abilities. Progression of functional tasks were advanced in the following order: bed mobility, transferring to sitting at edge of bed (EOB), sitting balance, transferring from sitting to standing, standing balance, and transferring from sitting EOB to sitting in a chair. During these treatments therapeutic exercises were also initiated. The specific exercises included hamstring and gastrocnemius stretches, long arc quads while sitting at EOB, ankle pumps, bridging in hooklying, hip abduction/adduction in supine, and following simple one step commands such as wiggling toes, raising left arm into the air and squeezing left hand. Table 2 depicts specifics on the treatment interventions for the first ten treatments.

Table 2. Treatment Interventions from the Initial Examination Through the Tenth Treatment

<table>
<thead>
<tr>
<th>Treatment Interventions</th>
<th>First 3 Treatments 9/2/2015-9/4/2015</th>
<th>10th Treatment 9/13/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supine to Sitting Edge of Bed</strong></td>
<td>Maximal assistance x 3</td>
<td>Minimal assistance x 1</td>
</tr>
<tr>
<td><strong>Sitting Balance</strong></td>
<td>Maximal assistance x 1 patient sat EOB for 3 minutes</td>
<td>Sat EOB independently for 10 minutes</td>
</tr>
<tr>
<td><strong>Sitting to Standing Transfer</strong></td>
<td>N/A</td>
<td>Moderate/Maximal assistance x 1</td>
</tr>
<tr>
<td><strong>Standing Balance</strong></td>
<td>N/A</td>
<td>Stood 20 seconds x 2 with Moderate assistance x 1</td>
</tr>
<tr>
<td><strong>Transferring to Chair</strong></td>
<td>N/A</td>
<td>MOA x 2 with small steps to chair</td>
</tr>
<tr>
<td><strong>Hamstring and Gastrocnemius</strong></td>
<td>Stretches were completed 3 x 15-30 seconds due to pain</td>
<td>3 x 30 – 60 seconds for each stretch</td>
</tr>
<tr>
<td><strong>Stretch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Following Commands</strong></td>
<td>Attempted many commands, patient able to wiggle toes and squeeze hand x 1</td>
<td>Patient able to follow commands and assists with transfers often</td>
</tr>
<tr>
<td><strong>Therapeutic Exercises:</strong></td>
<td>Exercises were to failure, 2-4 reps (bridges, ankle pumps, IAQ, hip add/abd)</td>
<td>All exercises were continued to failure, Approximately 5-10 reps</td>
</tr>
</tbody>
</table>
Following the first ten sessions, the treatment progressed to more advanced therapeutic exercises, starting with stepping exercises and eventually gait training and stair climbing with assistive devices. With increased independence, the patient was transitioned into difficult functional interventions such as putting on his own shoes. Neuromuscular activities were also incorporated following improvement of functional status. The neuromuscular activities included independent standing with narrow base of support, tandem stance, and single leg stance on the left lower extremity. Stretching of the left lower extremity continued for the hamstrings and gastrocnemius throughout treatment. Table 3 depicts progression from the eleventh treatment session to discharge.

Table 3. Treatment Interventions from the Eleventh Treatment until Discharge from Physical Therapy

<table>
<thead>
<tr>
<th>Hamstring and Gastrocnemius</th>
<th>Eleventh Treatment 9/14/15</th>
<th>Discharge 10/15/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stretches</strong></td>
<td>3 x 30-60 seconds</td>
<td>3 x 30-60 seconds x 2 per day</td>
</tr>
<tr>
<td><strong>Gait Training</strong></td>
<td>4 steps forward and 3 steps backward with moderate assistance x 1 on right and maximal assistance for forward progression of right lower extremity</td>
<td>Ambulates 580 feet with quad cane and minimal assistance</td>
</tr>
<tr>
<td><strong>Stair Climbing</strong></td>
<td>N/A</td>
<td>Patient ascended/descended 4 stairs x 2 per day using a step-to-step pattern</td>
</tr>
<tr>
<td><strong>Neuromuscular: Standing Weight</strong></td>
<td>All exercises were continued to failure, approximately 5-10 reps a rest was allowed if needed</td>
<td>All exercises were completed following gait training, 5-10 reps x 2 sets were completed</td>
</tr>
<tr>
<td><strong>Therapeutic Exercises: Straight Leg Raise, Long Arc Quad, Bridging, ankle pumps</strong></td>
<td>Standing balance was the focus during this phase of treatment, minimal to moderate assistance was used to assist standing along with quad cane</td>
<td>Standing balance with wide stance, eyes closed, weight shifting with tandem stance and marching were performed for 30-60 seconds</td>
</tr>
</tbody>
</table>
Gait training began with stepping forward and backward with assistance as the patient tolerated and progressed to walking further distances. A hemi walker was used initially, although the patient continued to place the hemi walker in front of his body rather than at the side. A quad cane was substituted for standing balance and gait training and this proved to be a much better option as the patient better understood the use of the quad cane. Each day the patient was encouraged to ambulate as far as able with two therapists assisting initially, one to assist standing and the other to assist forward progression of the right lower extremity. An assistant followed behind with a wheelchair to allow for continuance of ambulation. A referral for Orthotics was made as the patient presented with foot drop on the right and an ankle foot orthosis was developed. However, the orthosis was delayed due to the patient’s uninsured status. The patient received the orthosis in the beginning of October and he made great improvements in his ambulation and stability.

Ambulation on the stairs was initiated following increased independence with level surface ambulation. Only four stairs were utilized for ascending, with a platform at the top to be able to turn around and descend. There was a railing on each side of the stairs to allow for upper extremity assistance. Verbal cues were given for step-to-step gait pattern up the stairs leading with the left lower extremity for ascending and right lower extremity for descending. Moderate to minimal assistance of two therapists was given to the patient for support with ambulating the stairs.

Neuromuscular training began when the patient increased independence with standing balance. Standing weight shifting, marching, and wide stance with eyes closed were performed one time per day. The therapists began with offering moderate assistance
initially then advanced to stand by assist. The patient used a quad cane in the left upper extremity initially and progressed to performing exercises without the quad cane.

Hamstring and gastrocnemius stretching were continued on the left lower extremity throughout treatment due to the initial findings of decreased knee extension and dorsiflexion. The aim of increased stretching was to assist with more efficient ambulation. Therapeutic exercises were progressed to straight leg raises, long arc quad in sitting, bridging, ankle pumps and dorsiflexion.

As the patient continued to require a cervical spine brace and a sling on the right arm because of fractures, interventions requiring head motions or right upper extremity were excluded. Also due to the patient's decreased cognitive level, many higher level activities needed to be avoided for patient safety.

Patient education was attempted by using simple commands, directions, and timing with feedback based on patient performance. Due to his decreased cognitive level and diminished memory, continuous education occurred with every treatment session. Limited familial education occurred because the patient's family was not often present. An exercise program was developed for the patient and the nurses and aides were educated and asked to complete the exercise program with the patient as they were able. The home exercise program included all of the therapeutic exercises that were performed in the physical therapy treatment sessions. It is believed that the patient did not perform the home exercise program as frequently as the therapists would have recommended.

As the hospitalization for this case was prolonged, the therapists were searching for ways to offer more frequent gait training sessions. Current research has been investigating the potential benefits of partial weight bearing gait training against
traditional physical therapy gait training. A study by Wilson\textsuperscript{22} examined two gait training techniques and which had a greater extent of increasing functional ambulation with patients who sustained a severe TBI. The researchers determined that partial weight bearing was not superior to traditional gait training following a severe TBI.

A study performed by Sveen\textsuperscript{23} reviewed pathways for rehabilitation following a severe TBI and which of the pathways led to increased functional independence. The pathways observed were transferring from acute care to specialized or non-specialized rehabilitation, home, or nursing home settings. The results concluded that transferring directly from acute care to a specialized rehabilitation setting most likely contributed to superior functional independence. This study is relevant to the case presented due to the patient’s prolonged treatment in an acute care setting and delayed transfer to a specialized rehabilitation center. The patient had remained in the acute care hospital throughout the entirety of his treatment with physical therapy, totaling 62 days in the hospital. The patient received 39 physical therapy sessions during his 62 day hospital stay.
CHAPTER IV

Outcomes

Due to the lengthy treatment in an acute care setting, the outcomes for this patient may be less significant than if he would have been transferred to a specialized rehabilitation facility earlier in his recovery process. At discharge, the patient was assessed for consciousness using the GCS, the RLAS as it offered insight to his cognitive functioning, the BBS evaluated fall risk, and MMT along with PROM were utilized to measure changes in the musculoskeletal system. See Table 4 for initial and discharge examination outcome scores.

Table 4. Initial and Discharge Examination Scores

<table>
<thead>
<tr>
<th></th>
<th>Initial 9/2/2015</th>
<th>Discharge 10/15/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glasgow Coma Scale</strong></td>
<td>6/15 upon admission to ICU</td>
<td>15/15</td>
</tr>
<tr>
<td></td>
<td>11/15 at initial PT evaluation</td>
<td></td>
</tr>
<tr>
<td><strong>Ranchos Los Amigos Level</strong></td>
<td>III</td>
<td>VI</td>
</tr>
<tr>
<td><strong>Manual Muscle Testing</strong></td>
<td>Grossly 1/5 throughout bilateral lower extremities and left upper extremity</td>
<td>5/5 throughout except Right knee extension = 2/5 Right dorsiflexion = 2/5</td>
</tr>
<tr>
<td><strong>Passive Range of Motion</strong></td>
<td>WNL throughout except right knee extension = -15 degrees from 0</td>
<td>WNL throughout except Right knee extension = -5 degrees from 0 Right dorsiflexion = -10 degrees from 0</td>
</tr>
<tr>
<td><strong>Berg Balance Scale</strong></td>
<td>Not applicable</td>
<td>41/48</td>
</tr>
</tbody>
</table>
Upon discharge on day 62, the patient’s GCS score was 15/15 indicating that he did not exhibit any deficits in consciousness level. This was an improvement from the 6/15 when he was admitted to the CCU and 11/15 at the initial physical therapy evaluation on day 18. The increase in verbal communication improved for the patient with removal of the tracheostomy and PMV. Speech therapy had also been working with the patient throughout treatment to improve verbal communication.

The RLAS was administered on 9/30/2015 and the patient’s score had improved to level VI, Confused Appropriate. At discharge the patient had improved but had not progressed to reach the level VII, Automatic Appropriate. The patient was motivated to participate in therapy sessions but continued to require supervision and direction for previously learned tasks. Throughout his physical therapy sessions, the patient was able to follow simple commands and impulsive reactions began to diminish as he started to recognize the physical therapists working with him. According to family, long term memory had improved. However, physical therapists observed that he continued to lack memory of recent events as he struggled with task carry over.

The BBS was only administered to the patient once, on 9/30/2015, due to the limited notice of discharge. The patient’s BBS score was a 41/48 using the modified BBS version with the sitting and standing balance tasks removed to create greater internal validity. This score indicated a low fall risk. Since the BBS is used to assess balance, fall risk and functional mobility, the physical therapists agreed with the resulting score. However, since the patient was near the ceiling of the BBS and was working towards higher level functioning with ambulation, the patient could have also been assessed by using the Community Balance and Mobility Scale (CB&M). The CB&M differs from the
BBS by offering tasks that are more difficult to complete. A few examples of tasks from the CB&M are tandem walking and hopping forward. A study performed by Innes\textsuperscript{24} compared the BBS to the CB&M for higher level functioning TBI patients and examined the construct validity of the CB&M. The results concluded that the CB&M may be a more valid tool to detect change in higher level functioning TBI patients and the construct validity of the CB&M was supported by a significant relationship of measures collected from the study.

At discharge the patient’s strength had greatly improved; the MMT scores were 5/5 MMT throughout bilateral lower extremities except for right knee extension and right dorsiflexion scored at 2/5 MMT. This was a great improvement considering the patient’s initial evaluation scores were 1/5 MMT throughout bilateral lower extremities. The patient continued to demonstrate a slight foot drop on the right with ambulation but he was able dorsiflex within his available ROM in a gravity eliminated position. Although the patient had improvements in strength, the patient continued to demonstrate significant weakness with right knee extension and dorsiflexion despite continuous strengthening intervention.

PROM was assessed at discharge and found the lower extremities were within normal limits for all joints except right knee extension and right dorsiflexion with PROM of -5 degrees from neutral and -10 degrees from neutral respectively. The limited ROM could be due to prolonged inactivity as well as noncompliance to the HEP.

The patient responded well to the physical therapy treatment interventions provided. All of the functional assessments as well as MMT had improved throughout the physical therapy course of treatment. The patient’s satisfaction was difficult to assess
because of deficits in short term memory, although near the end of treatment the patient demonstrated increased motivation and energy during physical therapy sessions. One limitation to improvement was the patient’s noncompliance to the HEP. The noncompliance was non-intentional by the patient but it was mostly due to the cognitive deficits and lack of familial support for assistance with the HEP.
CHAPTER V

Discussion

In total the patient was hospitalized for 62 days and treated for physical therapy for 39 visits over a 44 day period. The initial physical therapy treatments were delayed due to the severity of the MVA, causing the patient to be medically unstable. The patient had been medically stable and awaiting discharge to a rehabilitation facility for continued therapy care 37 days prior to discharge. The prolonged discharge status was due to the patient’s lack of medical insurance at the time of the MVA, and delayed application for medical assistance programs. The acute care hospital had a very high patient census during the patient’s stay and the physical therapists were unable to treat the patient as often as recommended. The patient’s progress may have suffered because of the lack of physical therapy sessions and treatment time that he required.

Functional assessments such as GCS, RLAS, BBS, along with measurements of strength and ROM assisted in the identification of the patient’s deficits and guided the treatment interventions and planning of therapy sessions. The GCS and the RLAS helped determine the patient’s cognitive level and ability to participate in therapy sessions. The RLAS also aided in determination of the patient’s level of cognitive functioning including memory, task carry over, orientation, and behavioral issues. BBS assisted in the physical therapist’s understanding of the patient’s functional balance abilities regarding tasks such as transferring. It was important for the physical therapists to collect the information from the functional assessments to direct therapy sessions and to guarantee
that relevant interventions would be implemented.

Increases in the RLAS can be related to increased daily planning and organization with the patient throughout all healthcare disciplines, as well as persistence with similar exercises to encourage carry over of task memory. Slowly increasing multiple step tasks as well as continued simple step tasks allowed for retention and improvement of direction following. Incorporating neuromuscular training was key for increasing the BBS score. Encouraging increased independence with transferring and practicing balancing exercises along with decreasing assistance during stance were seen as the greatest activities for improvement in neuromuscular tasks. Continuous strength training and stretching supported increases in lower extremity strength and ROM. The increases in strength and PROM did not improve greatly compared to the extended length of this treatment.

The physical therapy interventions addressed the primary deficits of the patient that had resulted from the TBI. By focusing on functional mobility/tasks along with strengthening and stretching of the lower extremities, the patient made great improvements over the treatment period. Due to limited familial support and increased census in the acute care facility, the patient was unable to complete a HEP independently and did not receive the amount of treatment desired.

Prognosis is very hard to determine for TBI patients due to the diverse location of the injury within the brain, as well as other body systems that can be affected in the injury. It is difficult to determine if this patient would have had better outcomes if he would have been transferred to an inpatient rehabilitation center earlier. A systematic review of literature by Brasure et al.25 found that the current available evidence is inadequate to develop conclusions of outcomes for severe or moderate TBIs and were
unable to identify one method of treatment that was superior to another. Therefore, conclusion of treatment outcomes cannot be assessed accurately from this case to another.

A major limitation of this case study was the minimal amount of time that the patient was treated in physical therapy compared to if he would have been able to transfer to a specialized facility immediately following medical stabilization. Due to the high patient census in the acute care facility, the patient’s treatment sessions were only about thirty minutes in length. A patient who sustained a TBI would likely receive at least three hours of therapies each day for five to seven days per week at a typical inpatient rehabilitation facility. The physical therapists and occupational therapists worked closely together with this patient but a drawback to comprehending the whole patient is that the physical therapists focused mostly on the lower extremities while the occupational therapists focused mostly on the upper extremities. This led to limited information and assessment that was available to each discipline. The hospital was also not equipped to work with such an advanced TBI patient. The acute care facility did not possess the more advanced equipment such as parallel bars or a treadmill to progress the patient. The patient also was in need of an ankle foot orthosis (AFO) early in his treatment. The physical therapists had been recommending and referred the patient to orthotics within the facility but the delivery of an AFO was delayed due to expense, no insurance, and limited knowledge of when the patient would be discharged to a rehabilitation facility.

Another limitation to the patient’s success was the limited familial support offered to him. The patient’s family visited only about twice per week throughout the entire
duration of treatment at the acute care facility. If the family members were to have been more involved in the patient’s recovery the patient may have been able to be more compliant with the HEP which could have led to greater improvements. Familial support often offers great amounts of emotional recovery.

For increasing effectiveness of future studies, it may be helpful to have one discipline treat both upper and lower extremities to create a holistic treatment of care. Further research should be done on the effectiveness of familial support and the changes in outcomes, as well as if higher level equipment would be beneficial for improvements.

**Reflective Practice**

The history portion of the examination could have been more thorough in the aspects of relevant medical history and detailed living situations. Additional questions that would have been beneficial to physical therapy treatment would have addressed previous lower extremity muscular tightness and strength as well as physical activity. Other specific history questions that would have been asked would be the specific patient goals and accomplishments that he wanted to complete. This was not done due to the cognitive deficits the patient sustained.

The patient could have been examined later in treatment by using the CB&M instead of the BBS because of the increased validity in detecting change in higher level functioning TBI patients. This would have allowed for continued evaluation and assessment of change in patient progression. Other examination procedures that would have improved the process would have been to standardize the time of day the interventions would have been completed throughout the duration of the treatment progression.
Standardizing the treatment plan and interventions would have been beneficial for concluding exact treatments and exercises that were most valuable to the patient’s improvement. Organizing specific patient treatment times with other therapies to create a structured schedule would have also been beneficial to observing outcomes and patient’s cognitive progression over the treatments. Other changes that the physical therapists would have liked was to have increased treatment frequency and time spent working with the patient to potentially improve the patient’s wellbeing and overall function.

No additional referrals were deemed necessary to improve the patient’s plan of care or treatment, although the referrals that had been made should have been done so sooner in the duration of treatment. The referral to orthotics for implementation of an AFO to address the patient’s foot drop during gait was one of the consultations that may have been beneficial to the patient had it been earlier. Another referral that should have been made much earlier was the referral to medical assistance. This was not made immediately and would have been necessary for earlier discharge to a rehabilitation facility.

Increased evidence would be valuable for seeking patient prognosis for different severity of TBIs. This would assist with increased comprehension of what the outcomes may have been for this patient, along with assessment of the treatment and progression. Other evidence that should be further explored is comprehensive treatment progressions for patients with severe TBIs as this will improve the knowledge base of prognosis and outcome analysis.
**Rancho Los Amigos Levels of Cognitive Functioning**

- **Level 1:** No response, person appears to be in deep sleep
- **Level 2:** Generalized response, person reacts inconsistently, not directly in response to stimuli
- **Level 3:** Localized response, reacts inconsistently, directly to stimuli
- **Level 4:** Confused/Agitated, person is extremely confused, agitated
- **Level 5:** Confused-Inappropriate/Non-Agitated, person is confused and responds inaccurately to commands
- **Level 6:** Confused-Appropriate, Person is confused, responds accurately to commands
- **Level 7:** Automatic-Appropriate, person goes through daily routine with minimal confusion
- **Level 8:** Purposeful-Appropriate, person has functioning memory, responsive to environment, may display depression
- **Level 9:** Purposeful-Appropriate, goes through daily routine aware of need for stand-by assistance, depression may continue
- **Level 10:** Purposeful-Appropriate/Modified Independent, goes through daily routine but may require more time or compensatory strategies, periodic depression may occur.

Available at: [http://www.burke.org/docs/RLCF.jpg](http://www.burke.org/docs/RLCF.jpg)
Glasgow Coma Scale

Eye Opening Response
- Spontaneous—open with blinking at baseline 4 points
- To verbal stimuli, command, speech 3 points
- To pain only (not applied to face) 2 points
- No response 1 point

Verbal Response
- Oriented 5 points
- Confused conversation, but able to answer questions 4 points
- Inappropriate words 3 points
- Incomprehensible speech 2 points
- No response 1 point

Motor Response
- Obeys commands for movement 6 points
- Purposeful movement to painful stimulus 5 points
- Withdraws in response to pain 4 points
- Flexion response to pain (decorticate posturing) 3 points
- Extension response in response to pain (decerebrate posturing) 2 points
- No response 1 point

Available at: http://www.cdc.gov/masstrauma/resources/gcs.pdf
**BERG BALANCE SCALE**
14-item Long Form Original Version

| Name: __________________________ | Date: ___________ |
| Rate: __________________________ |

1. **SITTING TO STANDING**

**INSTRUCTIONS:** Please stand up. Try not to use your hands for support.
(1) able to stand without using hands and maintain independently
(2) able to stand independently using hands
(3) able to stand using hands after several trials
(4) unable to stand 10 seconds unsupported
(5) unable to stand 30 seconds unsupported
(0) unable to stand 30 seconds unsupported, score full points for sitting unsupported. Proceed to item #4.

2. **STANDING UNSUPPORTED**

**INSTRUCTIONS:** Please stand for two minutes without holding.
(1) able to stand safely 2 minutes
(2) able to stand 2 minutes with supervision
(3) able to stand 30 seconds unsupported
(4) unable to stand 30 seconds unsupported, score full points for standing unsupported. Proceed to item #4.

3. **SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED**

**INSTRUCTIONS:** Please sit with arms folded for 2 minutes.
(1) able to sit safely 2 minutes
(2) able to sit 2 minutes under supervision
(3) unable to sit 10 seconds
(4) unable to sit without support 10 seconds

4. **STANDING TO SITTING**

**INSTRUCTIONS:** Please sit down.
(1) able to sit safely 2 minutes
(2) able to sit 2 minutes with supervision
(3) unable to sit independently but use hands
(4) needs assistance to sit

5. **TRANSFERS**

**INSTRUCTIONS:** Arrange chairs (a) for a pivot transfer. Ask subject to transfer one way in a convenient armrest and one way in vest without assistance. You may use less chairs (one with and one without armrest) or a bed and a chair.
(1) able to transfer safely with assistance of hands
(2) able to transfer safely with verbal assistance
(3) able to transfer safely independently but needs hand
(4) unable to transfer safely independently
(5) unable to move independently, but needs hand

6. **STANDING UNSUPPORTED WITH EYES CLOSED**

**INSTRUCTIONS:** Please close your eyes and stand until 10 seconds.
(1) able to stand 10 seconds
(2) able to stand 10 seconds with supervision
(3) unable to stand 30 seconds
(4) unable to keep eyes closed 30 seconds but stays steady
(5) needs help to keep from falling

7. **STANDING UNSUPPORTED WITH FEET TOGETHER**

**INSTRUCTIONS:** Place your feet together and stand without holding.
(1) able to place feet together independently and stand 1 minute safely
(2) able to place feet together independently and stand 1 minute with supervision
(3) able to place feet together independently but unable to hold for 30 seconds
(4) unable to keep position but able to stand 30 seconds
(5) unable to keep position and unable to hold for 15 seconds

| TOTAL SCORE (Maximum = 56) | a person scoring below 45 is considered to be at risk for falling. |

8. **REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING**

**INSTRUCTIONS:** Left arm to 90 degrees. Strenck out your fingers and reach forward as far as you can. (Ensure you place a ruler at end of fingers when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The maximum score is the distance forward that the finger reaches while the subject is in the mean forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)
(1) can reach forward completely >25 cm (10 inches)
(2) can reach forward >12 cm safety (5 inches)
(3) can reach forward >5 cm safely (3 inches)
(4) unable to reach forward independently
(5) loses balance while reaching/requires external support

9. **PICK UP OBJECT FROM FLOOR FROM A STANDING POSITION**

**INSTRUCTIONS:** Pick up a paper which is placed in front of your feet.
(1) able to pick up slipper safety and easily
(2) able to pick up slipper but needs supervision
(3) unable to pick up but reaches 2-5cm (1-2 inches) from slipper and keeps balance independently
(4) unable to pick up and needs supervision while trying
(5) unable to try/needs assistance to keep from losing balance or falling

10. **TURN 360 DEGREES**

**INSTRUCTIONS:** Turn completely around in a full circle, purse. Then turn a full circle in the other direction.
(1) able to turn 360 degrees safely in 4 seconds or less
(2) able to turn 360 degrees safely in 6-4 seconds or less
(3) able to turn 360 degrees safely in 8-6 seconds or less
(4) unable to turn 360 degrees safely in 10 seconds or less
(5) unable to turn 360 degrees independently

11. **PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED**

**INSTRUCTIONS:** Place each foot alternately on the step. Continue until each foot has touched the stipulated four times.
(1) able to stand independently and safely and complete 8 steps in 20 seconds
(2) able to stand independently and complete 8 steps in 20 seconds
(3) able to complete 8 steps without aid with supervision
(4) able to complete 8 steps independently
(5) unable to do any steps and needs assistance
(6) needs assistance to keep from falling/able to try

12. **STANDING UNSUPPORTED ONE FOOT IN FRONT (DEMONSTRATE TO SUBJECT)**

**INSTRUCTIONS:** Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try in step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width).
(1) able to place foot forward independently and hold 30 seconds
(2) able to place foot forward independently and hold 30 seconds
(3) able to take small step independently and hold 30 seconds
(4) able to take small step independently and hold 30 seconds
(5) unable to step or unable to hold 15 seconds
(6) loses balance while stepping or standing

13. **STANDING ON ONE LEG**

**INSTRUCTIONS:** Stand on one leg as long as you can without holding.
(1) able to lift leg independently and hold >10 seconds
(2) able to lift leg independently and hold >2-10 seconds
(3) able to lift leg independently and hold <2-10 seconds
(4) unable to lift leg
(5) unable to stand independently
(6) unable to lift leg independently and hold >2-10 seconds
(7) unable to lift leg independently and hold <2-10 seconds
(8) unable to lift leg independently and hold <2-10 seconds
(9) unable to lift leg independently and hold <2-10 seconds
(10) unable to lift leg independently and hold <2-10 seconds
(11) unable to try or needs assist to prevent fall

Available at: [http://img.docstoccdn.com/thumb/orig/68360229.png](http://img.docstoccdn.com/thumb/orig/68360229.png)
REFERENCES


