OUTPATIENT REHABILITATION OF A PATIENT WITH A NONDISPLACED PELVIC RING FRACTURE FOLLOWING A HIGH-ENERGY TRAUMA

A Doctoral Project
A Comprehensive Case Analysis

Presented to the faculty of the Department of Physical Therapy

California State University, Sacramento

Submitted in partial satisfaction of
the requirements for the degree of

DOCTOR OF PHYSICAL THERAPY

by

Sara Osborne

SUMMER
2018

OUTPATIENT REHABILITATION OF A PATIENT WITH A NONDISPLACED PELVIC RING FRACTURE FOLLOWING A HIGH-ENERGY TRAUMA

A Doctoral Project

by

Sara Osborne

Approved by:

_____, Committee Chair
Brad Stockert, PT, PhD

_____, Second Reader
Rolando Lazaro, PT, PhD, DPT, GCS

_____, Third Reader
Rafael Escamilla, PT, PhD

_____
Date

Student: Sara Osborne

I certify that this student has met the requirements for format contained in the University format manual, and that this project is suitable for shelving in the Library and credit is to be awarded for the project.

_____, Department Chair _____
Michael McKeough, PT, EdD Date

Department of Physical Therapy

Abstract

of

OUTPATIENT REHABILITATION OF A PATIENT WITH A NONDISPLACED PELVIC RING FRACTURE FOLLOWING A HIGH-ENERGY TRAUMA

by

Sara Osborne

A patient with nondisplaced fractures at the base of the right superior pubic ramus, right inferior pubic ramus and right sacral ala was seen in outpatient physical therapy for 15 sessions over the course of 8 weeks. A student physical therapist provided treatment under the direct supervision of a licensed physical therapist.

The patient was evaluated with goniometry, manual muscle testing, the numeric pain rating scale, the lower extremity functional scale, and the fear avoidance belief questionnaire. The patient's goals were to improve range of motion, improve strength, restore ambulation without the use of an assistive device, and to return to work without restrictions. Primary interventions used to accomplish these goals were progressive therapeutic exercises focusing on functional and task-specific training, as well as joint mobilizations to restore range of motion.

After 8 weeks of skilled therapeutic interventions the patient demonstrated improved range of motion, strength and resumed ambulation without the use of an assistive device. The patient was able to return to work full time without restrictions. The patient was discharged from outpatient physical therapy to continued independent community living with a home exercise program.

_____, Committee Chair
Brad Stockert, PT, PhD

_____
Date

ACKNOWLEDGEMENTS

I would like to thank my clinical instructor, Mark Eddy, for affording me the opportunity to learn about and treat patients with orthopedic conditions. The contribution this experience has made to my education has been invaluable.

I would like to thank my committee members, Dr. Bradley Stockert, Dr. Rolando Lazaro, and Dr. Rafael Escamilla, for their guidance through this process. I'd like to thank each faculty and staff member for playing an integral role in helping me build a strong foundation of knowledge and skills. Each of these individuals strived cultivate unique learning opportunities in an encouraging and family oriented environment. I feel fortunate to have had thirty-one amazing and incredibly talented classmates. A special thanks to Chelsea, Nic and Paul, it was a privilege to go through this process with you three.

Thank you to my family and friends for your support and encouragement. Amy, your support, guidance and frequent reminders to maintain perspective throughout this journey have meant more to me than words can express.

To my husband, you are my rock and there are not enough words to express my gratitude for all you have done for me. I would not be the person I am today without your love and support. Thank you from the depths of my heart for helping me to realize this dream.

TABLE OF CONTENTS

Page

LIST OF TABLES

Tables Page

Chapter 1

General Background

Pelvic ring fractures are disruptions of the ilium, ischium or pubic bones; commonly occurring as simultaneous fractures of the anterior and posterior arches.[1] Fractures of the pelvic ring are uncommon, occurring in less than 10% of patients with skeletal injuries in Northern America.[2] The incidence of individuals who sustain pelvic fractures has been reported as 34 per 100,000 persons per year.[3] High forces generations greater than 2,000 N are necessary to cause pelvic ring disruptions, for this reason these fractures rarely occur in isolation.[4] Nearly 90% of patients diagnosed with a pelvic fracture have associated orthopedic, abdominal, head or thoracic injuries.[5]

While large forces are needed to disrupt the pelvic ring, the mechanism of injury varies between age groups.[4] Younger patients often sustain pelvic fracture injuries via high-energy traumas, such as: motor vehicle accidents (60%), falls from a height (30%), and crush injuries (10%).[1-4] Older patients are more likely to sustain pelvic injury through low-energy trauma, such as a fall from a height of less than one meter.[1,4] In younger patients, males are more likely than females to sustain a pelvic fracture with severe trauma.[6] In adults who are older than 55 years of age, females are more at risk of pelvic fractures than males, due to an increased incidence of osteoporosis, however both genders have increased risk.[2]

In general, most fractures heal without complications.[7] Risk factors hypothesized to contribute to complications and adverse events include: age; being female; diabetes, poorly controlled type-I or II diabetes; osteoporosis; use of

medications, such as corticosteroids, estrogen-containing hormone therapy, or the use of nonsteroidal anti-inflammatory for greater than four weeks; history of smoking; excessive alcohol use; and poor nutrition.[7,8]

Conceptually the pelvic ring is divided into an anterior and a posterior arch.[1] The anterior arch contains the structures anterior to the acetabulum, including the pubic rami and pubic symphysis.[1] The anterior arch has been reported to contribute as much as 40% to stability and stiffness during double leg stance.[3] The posterior arch includes the structures posterior to the acetabulum, namely the sacrum, sacroiliac (SI) joints and posterior ilium.[1] Disruption of the posterior arch has been reported to lead to higher incidences of pelvic instability.[3] Structural integrity at the unions of these bones is provided through ligamentous attachments.[1,3]

The Tile classification system is a commonly utilized system for determining the need for surgical intervention following a pelvic fracture.[3] Tile's system places pelvic ring fractures into three categories: Type A – stable, non-surgical fractures; Type B – fractures that maintain vertical stability with loss of rotational instability; and Type C – fractures resulting in the loss of vertical and rotational stability that require surgery. Six months following a type A pelvic fracture 30% were able to return to work.[9]

The estimated mortality rate related to pelvic ring fractures is 10%.[10] Historically, mortality and the severity of the fracture were thought to be inversely related. Recent research has demonstrated the degree of associated injuries plays a more important role in the cause of mortality than the degree of instability.[10,11]

Chapter 2

Case Background Data

Examination – History

The patient was a 65-year-old female who presented to the outpatient orthopedic pro bono clinic seven weeks after a motor vehicle accident that resulted in multiple fractures and contusions. The patient reported she was treated and released from the emergency department on the day of the incident. The patient sustained nondisplaced fractures at the base of the right superior pubic ramus, the right inferior pubic ramus and the sacral ala. The patient reported a clinical diagnosis of left rib fractures.

Acutely the patient reported hematomas, edema, pain and tenderness along the medial aspect of her right knee, lateral aspect of her left elbow, left lower extremity and the lateral aspect of her left rib cage. The patient complained of persistent right groin and hip pain that increased with weight-bearing (right > left), right hip flexion, and right hip external rotation. The patient was initially prescribed a front wheel walker for ambulation, however the patient reported she was unable to ambulate with the device due to an exacerbation of left rib pain with weight-bearing through the left upper extremity. Consequently, the patient transitioned to the use of single point cane in the right hand.

At the time of the initial evaluation the patient reported that her pain levels, hematomas and edema had decreased since the original injury. The patient reported improved ability to ambulate with decreasing need for an assistive device. The patient reported persistent “tiredness and achiness” in the right groin region. Her symptoms

were worse in the morning and her sleep was limited to approximately six hours due the therapeutic window of the pain medications elapsing during the night. The patient reported she continued to experience fear and anxiety associated with driving long distances, specifically past the site of the accident on her route to work. The patient reported intermittent muscle spasms across the posterior aspect of her left scapula and sensations of numbness over the dorsal aspect of her left hand.

The patient reported increased fatigue since the injury, as well as episodes of nausea and vomiting, which she attributed to the pain medication. The patient indicated she had discussed these conditions with her primary care physician. The patient denied any changes in bowel/bladder function or in sensation of the perianal region. The patient reported chronic hypertension, seasonal allergies and asthma; each treated with medications (see Table 1). The patient also reported visual impairments with the use of corrective reading glasses and contacts. Outside of the conditions mentioned above, the patient denied the presence of any other red flag screening conditions or past medical history findings.

The patient had been on medical leave from her position as an occupational therapist since the time of the injury. The patient lived alone in a two-story home, although she reported minimal use of the second floor of her home. The patient denied use of any adaptive equipment aside from the single point cane. The patient reported she had family members nearby who expressed emotional and physical support.

Prior to the motor vehicle accident, the patient reported she was fully independent, ambulated without the use of an assistive device and worked full-time as

an occupational therapist. The patient denied any impairments, limitations or restrictions prior to injury. The patient's goals were to decrease pain, improve right hip range of motion, improve right lower extremity strength, return to walking without an assistive device and to return to work without duty modifications or restrictions.

Systems Review

The patient's cardiovascular system was impaired based on a self-reported history of hypertension. At the time of the initial evaluation the patient's vitals were as follows: heart rate – 100 bpm with normal rhythmicity and pulse pressure; blood pressure – 123/74 mmHg; oxygen saturation – 97%. The patient's pulmonary system was impaired based on patient report of asthma. At the time of the initial evaluation her respiration was normal and non-distressed. The patient's musculoskeletal system was impaired based on gross assessment of range of motion and strength, as well as patient report of pelvic ring fractures confirmed by diagnostic magnetic resonance imaging. The patient demonstrated decreased weight-bearing through the right lower extremity during ambulation, standing and sitting. The patient reported her height as 4 feet 10¼ inches and her weight as 146 pounds. Her BMI was 30.5 which classified her with Class I obesity.[12] The patient's neuromuscular system was impaired based on observations of aberrant gait patterns and use of an assistive walking device. The patient's integumentary system was impaired based on visual evidence of hematomas and swelling; no integumentary disruptions were visualized or reported. Based on patient report the urogenital system was not impaired. Based on observation and

communication with the patient her communication, affect, cognition, and learning were not impaired.

Examination - Medications

Table 1

Medications[13]

MEDICATION	DOSAGE	REASON	SIDE EFFECTS
Amlodipine (Calcium Channel Blocker)	5 mg (1 tablet, 1x/day)	Hypertension	Common side effects may include: dizziness, feeling tired, stomach pain nausea, flushing
Qvar (inhaled corticosteroid)	80 mcg (1 actuation, 2x/day)	Asthma	Common side effects may include: headache, nasal congestion, throat irritation
Fluticasone (steroid)	50 mcg (1x/nostril, 1x/day)	Asthma	Common side effects may include: cold symptoms, low fever, cough, wheezes, chest tightness, hoarseness, white patches or sores inside the mouth or on the lips, headache, nausea, vomiting, upset stomach
Diclofenac (Nonsteroidal Anti-inflammatory)	50 mg (1 tablet, 3x/day)	Pain and inflammation	Common side effects may include: indigestion, gas, stomach pain, nausea, vomiting, diarrhea, constipation, headache, dizziness, drowsiness, itching, increased sweating, increased blood pressure, swelling or pain in arms or legs

Hydrocodone acetaminophen 10-325 (opioid with analgesic)	10 mg opioid with 325 mg of analgesic (1 tablet, 4x/day, as needed)	Pain	Common side effects may include: constipation, stomach pain, nausea, vomiting, dry mouth, itching, swelling in the hands or feet, muscle pain, back pain, cold symptoms, mild drowsiness, tired feeling, headache, dizziness; medication may lead to habit formation
Loratadine (antihistamine)	10 mg (1x/day)	Seasonal Allergies	Common side effects may include: headache, somnolence nervousness, fatigue, dry mouth
Abbreviations: milligrams (mg), micrograms (mcg), time (x), per (/)			

Chapter 3

Examination – Tests and Measures

Classification of the patient's impairments was done using the International Classification of Functioning, Disability and Health (ICF) Model.[14] At the body structure or function (BSF) level the patient's lower extremity range of motion (ROM) and strength was examined with goniometry and manual muscle testing (MMT) respectively. The patient's pain level was assessed via the numeric pain rating scale (NPRS). At the activity level the patient's ability to perform activities of daily living (ADL) was assessed using the Lower Extremity Functional Scale (LEFS). The Fear Avoidance Belief Questionnaire (FABQ) was used to evaluate the patient's social and participation restrictions. The Wells Criteria was used to monitor for the presence of a deep vein thrombosis (DVT).

Goniometry is routinely used to determine ROM impairments at the BSF level.[15] Goniometry protocols described by Norkin and White[15] were implemented in this case. While goniometry is common practice, no research has been conducted on the psychometrics of goniometry in patients with pelvic fractures. General research on goniometry and hip ROM has shown a high degree of variability with intratester and intertester reliability; intraclass correlation coefficients (ICC) for various populations range from 0.72-0.99 and 0.76-0.99, respectively.[15] Pau et al.[16] conducted a research study on individuals with hip osteoarthritis who had a mean age of 62 ± 8.9 years and complaints of hip or groin pain. They reported good to excellent reliability with ICC of 0.86 to 0.97, standard error of measurement (SEM) ranges of 3.1 – 4.7 degrees, and a

range for minimal detectable change at a 90% confidence level (MDC_{90}) of 7.1 – 11.0 degrees.[16]

Strength evaluation is often done using MMT in the clinic as a way to quantify, diagnose and assess movement impairments at the BSF level.[17] Standard MMT protocols described by Hislop et al.[17] were followed in this case study. MMT has been shown to be reliable and valid.[17] Wadsworth et al.[18] found high reliability with test-retest reliability coefficients (r_s) ranging from 0.63 to 0.98. No specific MDC or minimal clinically important difference (MCID) has been reported for MMT. Cuthbert and Goodheart[19] state a MMT score must change by more than one full grade to be confident of a true change in strength.

Evaluation of pain is often performed in the clinic via the NPRS.[20] This tool provides a quick and simple means of assessing the patients perceived level of pain, by asking them to rate their pain on a scale of 0 to 10, where 0 signifies no pain and 10 represents worst possible pain.[20] Due to the inherent subjectivity associated with quantifying pain meaningful psychometric data is difficult to established.[20] Farrar et al.[20] established a clinically important improvement as a change of -1.74 and a percent change of -27.9% on the NPRS.

The LEFS is a patient-reported subjective outcome measure used to assess activity limitations.[21,22] The LEFS survey is comprised of 20 questions.[21,22] Each question is scored on a numeric scale of 0 to 4 points, where 0 represents inability to complete the task and 4 represents ability to perform the task without limitation.[21,22] The highest possible score of 80 points corresponds to a low impairment level.[21,22] The

LEFS has demonstrated good test-retest reliability with ICC values ranging from 0.75 to 0.998 and *r* values > 0.85; good absolute reliability with standard error of measurement (SEM) values ranging between 0.88 to 6.5; and good internal consistency with Cronbach alpha values > 0.92.[21] Content validity of the LEFS has been demonstrated through small floor effects of 11.7% and 11%.[21,22] Construct validity has been established against the Medical Outcomes Study 36-Item Short-Form (SF-36) through moderate correlations with components of the physical subscale ($r = 0.61 - 0.67$).[21,22] Responsiveness of this outcome measure has shown large effect sizes of 1.92, in patients with general LE musculoskeletal disorders.[21] For patients with LE musculoskeletal disorders the MDC at 90% confidence ranged between 2.05 to 9.6, whereas the MCID was found to be 9.[21,22]

The FABQ is a self-reported outcome measure designed to assess a psychosocial construct contributing to avoidance of movement due to an inappropriate fear of pain or creating tissue damage.[23] This questionnaire contains 16-items divided into two subscales for assessing work (FABQ-W) and physical activity (FABQ-PA) related fear avoidance beliefs.[23] These two subscales allow the questionnaire to be used for either the activity or participation domain of the ICF classification system. Questions are formatted using a 7-point Likert scale, where 0 represents complete disagreement and 6 represents complete agreement.[23] The FABQ-PA subscale score is the sum of 4 items with a maximum score of 24 points, whereas the FABQ-W subscale is the sum of 7 items with a maximum score of 42 points.[24,25] Higher scores indicate greater fear-avoidance beliefs.[23,24] This scale was designed for patients with low back pain (LBP). In

patients with pelvic girdle pain the FABQ-PA has demonstrated moderate reliability, ICC (95% CI) of 0.88 (0.77 - 0.93), with a SEM of 2.20 and a MDC 6.1.[26] A Norwegian study of patients with LBP found ICCs of 0.82 (0.64 - 0.92) and an MDC of 12.1 for the FABQ-W.[25] In a study examining the predictive validity of the FABQ-P and FABQ-W, Cleland et al looked at patients with LBP covered by private health insurance versus those covered by worker's compensation and their probability of returning to work.[27] On the FABQ-W these authors found a sensitivity (95% CI) of 0.07 (0.0028 - 0.17) and 0.75 (0.53 - 0.89), and a specificity of 0.92 (0.86 - 0.95) and 0.83 (0.70 - 0.91) for private insurance and workers' compensation, respectively.[27] They reported positive likelihood ratios (LR+) (95% CI) of 0.86 (0.28 - 2.57) and 4.33 (2.27 - 8.27) for private insurance and workers' compensation, respectively, on the FABQ-W.[27] They reported negative likelihood ratios (LR-) (95% CI) of 1.01 (0.93 - 1.11) and 0.30 (0.14 - 0.65) for private insurance and workers' compensation, respectively, on the FABQ-W.[27]

Deep Vein Thrombosis is a serious and potentially life threatening condition that commonly occurs after trauma.[28] The Wells Clinical Prediction Rule for DVT is a well-validated tool with diagnostic value.[28] The Wells score is based on ten criteria related to the patient's history and signs/symptoms.[28] Each existing criterion is given a score of one point, except the alternative diagnosis criteria which receives a score of negative two points.[28] The total score is a summation of the points.[28] To inform the low probability (-2 to 0 points), moderate probability (1 to 2 points), or high probability (3 to 8 points).[28] Modi et al.[28] determined the relative risk of having a DVT increased as the score increased in patients in the Emergency Department; scores of ≤ 1 had a

relative risk ratio (RR) of 0.075 (95% CI: 0.03 - 0.19), whereas scores of 2, 3 and 4 had RR of 13.3 (95% CI: 5.5 - 33.3), 13.9 (95% CI: 6.5 - 29.8) and 18.5 (95% CI: 11.5 - 29.8), respectively. The Wells score was found to have a high sensitivity of 100% and a high negative predictive value (NPV) of 100% with scores of 1 point.[28] When the Wells score was greater than the cutoff score of 2 specificity was 90% (95% CI: 87 - 94%), sensitivity was 67% (95% CI: 45 - 88%), positive predictive value was 31% (95% CI: 16 - 45%) and the NPV was 98% (95% CI: 96 - 99%).[28]

Table 2

Examination Data

BODY FUNCTION OR STRUCTURE				
Measurement Category	**Test/Measure Used**	**Test/Measure Results**		
Hip AROM	Goniometry		R	L
		Flex	0 - 95º	0 - 110º
		Ext	0 - 20º	0 - 30º
		Abd	0 - 25º	0 - 30º
		Add	0 - 15º	0 - 20º
		ER	0 - 35º	0 - 45º
		IR	0 - 20º	0 - 20º
Hip Strength	MMT		R	L
		Flex	3+/5	4/5
		Ext	3+/5	4/5
		Abd	3+/5	5/5
		Add	3/5*	4/5
		ER	4/5	5/5
		IR	4/5	5/5
R groin pain	NPRS	Worst Pain: 6/10 Best Pain: 1/10		

FUNCTIONAL ACTIVITY		
Measurement Category	**Test/Measure Used**	**Test/Measure Results**
Activity Limitation	LEFS	Score: 24/80 (70% impaired)
PARTICIPATION RESTRICTIONS		
Measurement Category	**Test/Measure Used**	**Test/Measure Results**
Ability to perform normal social roles	FABQ	Total score: 59/96 FABQ-P score: 16/24 FABQ-W score: 23/42
Abbreviations: ROM – range of motion, AROM – active range of motion, R – right, L – left, Flex – Flexion, Ext – Extension, Abd – Abduction, Add – Adduction, ER – external rotation, IR – internal rotation, NPRS - numeric pain rating scale, LEFS – lower extremity functional scale, FABQ – fear avoidance belief questionnaire, FABQ-P – fear avoidance belief questionnaire physical activity subscale, FABQ-W – fear avoidance belief questionnaire work subscale		
* patient at least a 3 (able to complete full ROM against gravity; deferred application of resistance due to patient irritability)		

Chapter 4

Evaluation

Evaluation Summary

The patient was a 65-year-old female who was diagnosed with nondisplaced fractures of the right superior pubic ramus, right inferior pubic ramus and right sacral ala following a high-energy motor vehicle accident 7 weeks prior to the initial evaluation. The patient also sustained multiple contusions on the lateral aspect of the left elbow, the lateral aspect of the left lower extremity and the medial aspect of the right knee, and a clinical diagnosis of left rib fractures. Persistent pain made worse with weight-bearing led the patient to utilize an assistive device for ambulation. A single point cane was used in the right hand due to aggravation of left rib pain and left scapular muscle spasms during left upper extremity cane usage. Since the initial injury, the patient reported improved ability to ambulate with decreased need for the assistive device. The patient had not been able to return to her prior level of function and continued to complain of decreased right lower extremity ROM, strength and ability to perform many of her normal ADLs or to return to work as an occupational therapist. The patient presented with impaired active right hip ROM and strength, as assessed by goniometry and MMT, respectively. The patient reported moderate pain in the right groin and hip on the NRPS. At the time of the initial evaluation, the patient was at low risk of having a DVT per the Wells Clinical Prediction Rule for DVT. Patient report and the LEFS provided evidence the patient was moderate to highly limited in her ability to perform her normal ADLs. Based on the patient's FABQ-W subscale score the patient

had an increased likelihood of returning to work and supported a possible contribution of psychological factors impacting her readiness to return to work. The patient's impairments and activity limitations contributed to her restricted ability to return to work.

Diagnostic Impression

The patient presented with signs and symptoms consistent with nondisplaced pelvic ring fractures. All domains of the ICF model were impacted. At the BSF level the patient presented with impaired right hip ROM, strength and pain, which contributed to her limitations with most weight-bearing activities. The patient had a low probability of having a DVT. These impairments and limitations contributed to the patient's employment restrictions and all findings were consistent with her diagnosis of pelvic fracture.

Prognostic Statement

While Papasotiriou et al.[9] reported after six months only 30% of patients who sustained a type A pelvic fracture had returned to work, the totality of the patient's prognostic factors indicated she had good rehabilitation potential to return to prior level of function, including return to work. The patient's positive prognostic factors included: higher socioeconomic status, higher education, high motivation, good social support, few comorbidities, few associated injuries, no hospitalization, type of injury, and having an injury acquired outside of work that was covered by private health insurance coverage.[9,29] The patient's hypertension and asthma were regulated with medications. Negative prognostic factors with the potential to impede the patient's recovery were her

age, greater than 55 years of age, being of the female gender, and use of NSAIDs greater than four weeks.[7,8]

G-Codes

Current with modifier: G8978 – CL 70% impairment based on LEFS

Goal with modifier: G8979 – CI 14% impairment based on LEFS

Discharge Plan

The patient was expected to be discharged to continued independent community living with a comprehensive home exercise plan for maintenance of strength and ROM. After 8 weeks of treatment the patient was expected to resume ambulation without the use of an assistive device and to return to work without restrictions.

Chapter 5

Plan of Care-Goals and Interventions

Table 3

Evaluation and Plan of Care

PROBLEM	PLAN OF CARE **Short Term Goals (Anticipated Goals) (4 weeks)**	**Long Term Goals (Expected Outcomes) (8 weeks)**	**Planned Interventions Interventions are Direct or Procedural unless they are marked: (C) = Coordination of care intervention (E) = Educational intervention**
BODY FUNCTION OR STRUCTURE IMPAIRMENTS			
Impaired R hip AROM: • Flex 0-95º • Ext 0-20º • Abd 0-25º • Add 0-15º • IR 0-20º • ER 0-35º (MDC_{90}: 7.1-11.0º)	• Flex 0-105º • Ext 0-30º • Abd 0-30º • Add 0-20º • IR 0-30º • ER 0-40º	• Flex 0-115º • Abd 0-35º • Add 0-25º • IR 0-30º Discontinue with extension and ER once short term goal is met	Interventions encouraged tissue elongations through joint mobilizations and HEP stretches targeting the R LE. 2 x/week for 8 weeks • Caudal glides in 95º of hip flexion, 4 x 30 seconds, grade III-; progressed to grade VI as tolerated • Anterior glides in 20º of hip extension 3 x 30 seconds, grade III-; progressed to grade VI as tolerated • Lateral glides in 90º of hip flexion, 3 x 30 seconds, grade III-; progressed to grade VI as tolerated Patient will demonstrate proficiency in HEP performance. 2 x/day for 8weeks

			• Supine knee to chest stretch 2 x 60 seconds • Standing lunge stretch 2 x 60 seconds • Seated flexion, abduction, external rotation stretch 2 x 60 seconds • Seated flexion, adduction, and internal rotation stretch 2 x 60 seconds
Impaired R hip strength: • Flex 3+/5 • Ext 3+/5 • Abd 3+/5 • Add 3*/5 • IR 4/5 • ER 4/5 (MDC: 1 grade)	• Flex 4/5 • Ext 4/5 • Abd 4/5 • Add 4/5 • IR 5/5 • ER 5/5	• Flex 5/5 • Ext 5/5 • Abd 5/5 • Add 5/5 Discontinue with external and internal rotation once short term goal is met	Interventions encouraged muscle hypertrophy through the overload principles by focusing on functional and task specific strengthening exercises for the lower extremities. 2 x/week for 8 weeks • DL press on shuttle 2 x 10 • SL press on shuttle 2 x 10 • Bridges 2 x 10 • Seated hamstring curls 2 x 10 Progression: • BOW Squats • Squats • SL bridges Patient will demonstrate proficiency in HEP performance. 2 x/day for 8weeks • Posterior pelvic tilts with marching 2 x 15

			• Bridges 2 x 10 • Sidelying clamshells 2 x 10
Pain • Worst Pain 6/10 (CII: -1.74)	• 4/10	• 2/10	Addressed though improved ROM and strengthening interventions above. (E) Patient education on the safety and importance of movement/exercise. Patient education on the healing process and expected outcomes. (C/E) Patient education regarding prolonged use of NSAIDs. Patient was encouraged to discuss medication profile with her physician. A consultation with patient/physician as needed based on signs of substance abuse.
ACTIVITY LIMITATIONS			
Limited lower extremity function as measured by the LEFS • 24/80 points (MDC: 9 points)	• 42/80 points (2 MDC)	• 69/80 points (3 MDC)	Task specific training and functional strengthening exercises described above • Min assist squat pivot transfers • Step-ups on 2-inch step; 2 x 10 forward Progression: • Mod assist squat pivot transfers, varying surface heights

			• Step-up progression: increased step height, added reverse and lateral step-ups. (E) Patient education on body mechanics
PARTICIPATION RESTRICTIONS			
Restricted ability to perform normal social roles	Patient will demonstrate decreased scores on the FABQ by 25% • Total score from 59/96 to 44/96 • FABQ-P score from 16/24 to 12/24 • FABQ-W score from 23/42 to 17/42	Patient will demonstrate decreased scores on the FABQ by 25% • Total score to 33/96 • FABQ-P score to 9/24 • FABQ-W score to 12/42-	Targeted through ROM and strength interventions, and graded return to functional tasks specific to the patient's participation requirements. (E) Patient education on the safety and importance of movement/exercise. Patient education on the healing process and expected outcomes.
Abbreviations: Flex – Flexion, Ext – Extension, Abd – Abduction, Add – Adduction, HEP, home exercise program; R, right; LE, lower extremity; DL, double leg; SL, single leg; ROM, range of motion; LEFS, lower extremity functional scale; CII – clinically important improvement; FABQ, fear avoidance belief questionnaire; FABQ-P, fear avoidance belief questionnaire – physical activity; FABQ-W, fear avoidance belief questionnaire – work activity			
* patient at least a 3 (able to complete full ROM against gravity; deferred application of resistance due to patient irritability)			

Plan of Care – Interventions

See Table 3 above

Overall Approach

The overall treatment focused on an impairment based approach. Joint mobilization techniques were used to address the patient's ROM impairments. The patient's strength impairments were addressed with therapeutic exercises through the overload principle by varying the parameters of frequency, intensity, type and time. The patient's functional limitations were addressed through task specific training with augmented feedback for improved neuromuscular control. Interventions for the patient's participation restrictions focused on patient education and graded return to activity through the above BSF and activity treatments. Intensity and vigor for each treatment session was based on the patient's symptom severity and irritability. Initial rehabilitation focused primarily on improving ROM and symptom modulation, while later techniques focused more on improving LE strength and reducing activity limitations.

PICO question

(P) For a 65-year-old female patient with subacute fractures of the right pubic rami and sacral ala (I) is outpatient physical therapy more effective (C) than an unsupervised home exercise program (O) at improving strength?

Binder et al.[30] performed a level 1B, randomized control trial comparing the effects of supervised exercise at an outpatient physical therapy clinic and unsupervised home exercise program (HEP) on muscle strength, walking speed and balance. The study included 90 patients with hip fractures with a mean age of 80 years ($\pm$7).[30] Muscle strength was measured via maximal voluntary muscle contraction of the knee extensors and knee flexors with Cybex isokinetic dynamometry.[30] Gait speed was

measured with a self-selected comfortable and maximum gait speed 7 meter walk test.[30] Balance testing was assessed via the Progressive Romberg Test, Berg Balance Instrument, and a timed single-limb stance test.[30]

The physical therapy intervention entailed 2 phases of exercise training, each 3 months long with 3 exercise sessions per week.[30] The first phase of the program focused on building tolerance for progressive resistance training through exercises intended to build flexibility, balance, coordination, movement speed, and, to a lesser extent strength in major muscle groups.[30] Progression of exercise in this phase was performed by increasing the number repetitions and by progressing the level of complexity in the movement when the participant could easily perform the current exercise and safely perform the more challenging one.[30] During phase 2 patients continued to perform an abridged version of their phase 1 exercises and added in progressive resistance training.[30] Protocol for the first portion of phase 2 had patients perform 1-2 sets of 6-8 repetitions at 65% of their one-repetition maximum (1-RM) of each of the following exercises: knee extension, knee flexion, seated bench press, seated row, leg press, and biceps curl.[30] Progression was performed by increasing the number of sets to 3 sets of 8-12 repetitions at 85-100% of their 1-RM.[30]

The unsupervised HEP group was provided with low-intensity exercises designed to mimic post-fracture standard care rehabilitation.[30] The exercise program contained 9 of the exercises prescribed in phase 1 of the physical therapy group program.[30] The participants were instructed to the perform the exercises a minimum of

three times per week and were required to attend a monthly group session, in which the HEP was performed.[30] Weekly, 10 minute, phone conversations were also conducted.[30]

After 6-months the physical therapy group showed greater improvement in knee extension strength on the involved limb (P = 0.004), faster walking speed (P = 0.008) and increased single-limb stance time on the involved limb (P = 0.04).[30]

Physical therapy intervention based research for pelvic fracture was not available at the time this paper was written. Therefore, the research included in this PICO question is not explicitly applicable to the patient addressed in this paper. The participants in this study experienced hip fractures instead of pelvic ring fractures, however both the hip and pelvis are essential for static and dynamic weight-bearing activities.[2] The participants in this study were older than the featured patient. In terms of outcomes the featured patient may have realized greater improvements following this program due to her younger age. Another significant difference was the above research utilized tri-weekly treatment sessions over six months, whereas the featured patient was only afforded bi-weekly treatment sessions for eight weeks. Unlike the physical therapy participants in the above study the featured patient was assigned a progressive and individualized HEP. While these are important differences that decreased the applicability of this study to the featured patient, it is reasonable to expect based on the design of this program that she would benefit from a similarly designed exercise program focusing on progressive resistance training for strength and flexibility.

Chapter 6

Outcomes

Table 4

Outcomes

OUTCOMES						
BODY FUNCTION OR STRUCTURE IMPAIRMENTS						
Outcome Measure	**Initial**		**Follow-up (DC)**		**Change**	**Goal Met? (Y/N)**
Hip AROM	R Flex: 0-95º Ext: 0-20º Abd: 0-25º Add: 0-15º IR: 0-20º ER: 0-35º	L Flex: 0-110º Ext: 0-30º Abd: 0-30º Add: 0-20º IR: 0-40º ER: 0-45º	R Flex: 0-115º Ext: 0-30º Abd: 0-35º Add: 0-25º IR: 0-40º ER: 0-45º	L Flex: 0-115º Est: 0-30º Abd: 0-35º Add: 0-25º IR: 0-40º ER: 0-45º	R Flex: +20º Ext: +10º Abd: +10º Add: +10º IR: +20º ER: +10º	R Flex: Y Ext: Y Abd: Y Add: Y IR: Y ER: Y (MDC_{90}: 7.1-11.0º)
Hip MMT	R Flex: 3+/5 Ext:3+/5 Abd: 3+/5 Add: 3*/5 IR: 4/5 ER: 4/5	L Flex: 4/5 Ext: 4/5 Abd: 5/5 Add: 4/5 IR: 5/5 ER: 5/5	R Flex: 5/5 Ext: 4/5 Abd: 4/5 Add: 4/5 IR: 5/5 ER: 5/5	L Flex: 5/5 Ext:4/5 Abd: 5/5 Add: 4/5 IR: 5/5 ER: 5/5	R Flex: + 1 1/2 Ext: + 1/2 Abd: + 1/2 Add: + 1 IR: + 1 ER: + 1	R Flex: Y Ext: N Abd: N Add Y IR: Y ER: Y (MDC: 1 grade)
NPRS	6/10	0/10	2/10	0/10	4 point decrease	Y (CII: -1.74)
ACTIVITY LIMITATIONS						

Outcome Measure	Initial	Follow-up (DC)	Change	Goal Met? (Y/N)
LEFS	24/80 (70% impairment)	73/80 (9% impairment)	49 points (61% less impaired)	Y (MDC: 9 points)
PARTICIPATION RESTRICTIONS				
Outcome Measure	**Initial**	**Follow-up (DC)**	**Change**	**Goal Met? (Y/N)**
FABQ	59/96	4/96	55 points	Y
FABQ-P	16/24	3/24	13 points	Y (MDC: 6.1)
FABQ-W	23/42	1/24	22 points	Y (MDC: 12. 1)
Abbreviations: DC – discharge, Y – yes, N – no, AROM – active range of motion, R – right, L – left, F – Flexion, E – Extension, Abd – Abduction, Add – Adduction ER – external rotation, IR – internal rotation, MDC – minimal detectable change, MMT – manual muscle test, CII – clinically important improvement, NPRS - numeric pain rating scale, LEFS – lower extremity functional scale, FABQ – fear avoidance belief questionnaire, FABQ-P – fear avoidance belief questionnaire physical activity subscale, FABQ-W – fear avoidance belief questionnaire work subscale				
* pt at least a 3 (able to complete full ROM against gravity; deferred application of resistance due to pt irritability)				

Discharge Statement:

The patient was seen in outpatient physical therapy for treatment of a stable pelvic fracture involving the right inferior and superior pubic rami and the right sacral ala. The patient was treated twice weekly for six weeks and once weekly for two weeks. The patient received joint mobilizations, stretching activities, strengthening exercises, and a HEP. At the time of the initial evaluation, the patient was seven weeks post injury. Deficiencies were found at all levels of the ICF classification system. BSF

impairments in the right lower extremity included decreased active ROM, strength and pain. Activity limitations consisted of diminished ability to perform usual ADLs. The patient was on medical leave from work due to restrictions in her ability to perform her usual work duties. The patient presented with fear and anxiety regarding her return to work. Over the course of therapy, the patient achieved goals for improved active ROM, strength, pain, functional activities, and returned to work without restrictions. The patient achieved independence in her HEP and demonstrated knowledge of appropriate exercise progressions. The patient was discharged to continued independent community living with a HEP for maintained gains in strength and ROM.

DC G-Code with modifier:

DC with modifier: G8980 – CI 8.75% impairment based on LEFS

Chapter 7

Discussion

As the prevalence for pelvic ring fractures is low, working with this patient provided a unique opportunity. As previously indicated, most fractures heal without adverse events. This patient's recovery was uneventful. She returned to her prior level function 15 weeks after her injury. This patient's high motivation and knowledge of the rehabilitation process undoubtedly contributed to the success of her recovery.

Initially this patient presented with problems and deficits at all levels of the ICF classification system and required an assistive device for ambulation. Over the course of eight weeks she progressed through an impairment based treatment approach that focused on progressive strengthening and ROM restoration. In the clinic, joint mobilizations were used to improve ROM while a progressive resistance training program was used to improve strength, balance, and ambulation. The patient demonstrated excellent adherence to her individualized HEP to improve ROM and strength. The strength portion of her HEP focused on muscle hypertrophy and endurance. The ROM portion utilized static hold stretches and physiologic mobilizations. The exercise progression was appropriate for this patient and sufficiently addressed the patient's impairments as well as her specific preferences. The split design of in-clinic and home exercises allowed for a timely progression of the exercises while limiting symptom aggravation. After 8 weeks of outpatient therapy she was discharged from physical therapy to return to work without restrictions and resume normal ADLs.

In retrospect, there are aspects of the evaluation and plan of care that could have been improved. While MMT was the only tool available in the clinic for quantifying the patient's strength, dynamometry may have improved the objectivity of strength assessments. Additionally, utilization of outcome measures such as the five time sit-to-stand (5XSTS), the timed up and go test (TUG), and the two-minute walk test (2MWT) earlier on in the evaluation/treatment process would have provided valuable objective data for assessing functional changes. The 5XSTS and TUG were administered around week four and at the discharge session as a means of assessing functional lower extremity strength and mobility. In four weeks, the patient made meaningful improvements on both outcome measures, however the changes did not reflect the total amount of progress realized throughout the duration of care. A 2MWT was not administered, however it would have provided valuable objective data on the patient's cardiovascular endurance, gait and mobility. A single-limb stance test was used to assess balance. The patient obtained 28 seconds on the involved limb and 30 seconds on the uninvolved limb during the initial evaluation, thereby approaching a ceiling effect for this outcome measure. Finally, another self-report form could have been used to assess changes in participation, perhaps the pelvic girdle questionnaire[25,26] or the SF-36.[31] While the FABQ-W informed plan of care, specifically patient education, it may not have fully encompassed the patient's participation restrictions.

Research on assessment and treatment of patients with nondisplaced pelvic ring fractures is limited. Further research on the applicability and psychometrics of commonly used outcome measures would improve patient care.

References

1. Khurana B, Sheehan SE, Sodickson AD, Weaver MJ. Pelvic ring fractures: what the orthopedic surgeon wants to know. *Radiographics.* 2014;34(5):1317-1333.
2. Flint L, Cryer HG. Pelvic fracture: the last 50 years. *J Trauma.* 2010;69(3):483-488.
3. McCormack R, Strauss EJ, Alwattar BJ, Tejwani NC. Diagnosis and management of pelvic fractures. *Bull NYU Hosp Jt Dis.* 2010;68(4):281-291.
4. Rommens PM, Wagner D, Hofmann A. Surgical management of osteoporotic pelvic fractures: a new challenge. *Eur J Trauma Emerg Surg.* 2012;38(5):499-509.
5. Gustavo Parreira J, Coimbra R, Rasslan S, Oliveira A, Fregoneze M, Mercadante M. The role of associated injuries on outcome of blunt trauma patients sustaining pelvic fractures. *Injury.* 2000;31(9):677-682.
6. O'Brien D P, Luchette FA, Pereira SJ, et al. Pelvic fracture in the elderly is associated with increased mortality. *Surgery.* 2002;132(4):710-714; discussion 714-715.
7. Hernandez RK, Do TP, Critchlow CW, Dent RE, Jick SS. Patient-related risk factors for fracture-healing complications in the United Kingdom General Practice Research Database. *Acta Orthop.* 2012;83(6):653-660.
8. Calori GM, Albisetti W, Agus A, Iori S, Tagliabue L. Risk factors contributing to fracture non-unions. *Injury.* 2007;38 Suppl 2:S11-18.

9. Papasotiriou AN, Prevezas N, Krikonis K, Alexopoulos EC. Recovery and return to work after a pelvic fracture. *Saf Health Work.* 2017;8(2):162-168.

10. Rice PL, Jr., Rudolph M. Pelvic fractures. *Emerg Med Clin North Am.* 2007;25(3):795-802, x.

11. Lunsjo K, Tadros A, Hauggaard A, Blomgren R, Kopke J, Abu-Zidan FM. Associated injuries and not fracture instability predict mortality in pelvic fractures: a prospective study of 100 patients. *J Trauma.* 2007;62(3):687-691.

12. Calculate Your Body Mass Index. nhlbi.nih.gov. https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.html. Updated July 24, 2017. Accessed September 10, 2017.

13. Drugs, Herbs and Supplements. medlineplus.gov. https://medlineplus.gov/druginformation.html. Updated April 28, 2015. Accessed September 10, 2017.

14. World Health Organization. International classification of functioning, disability and health ICF. 1.0. ed. Geneva: World Health Organization,; 2001.

15. Norkin CC, White DJ. *Measurement of joint motion: a guide to goniometry.* 4th ed. Philadelphia: F.A. Davis; 2009.

16. Pua YH, Wrigley TV, Cowan SM, Bennell KL. Intrarater test-retest reliability of hip range of motion and hip muscle strength measurements in persons with hip osteoarthritis. *Arch Phys Med Rehabil.* 2008;89(6):1146-1154.

17. Hislop HJ, Avers D, Brown M, Daniels L. *Daniels and Worthingham's muscle testing: techniques of manual examination and performance testing.* 9th ed. St. Louis, Mo.: Elsevier; 2014.

18. Wadsworth CT, Krishnan R, Sear M, Harrold J, Nielsen DH. Intrarater reliability of manual muscle testing and hand-held dynametric muscle testing. *Phys Ther.* 1987;67(9):1342-1347.

19. Cuthbert SC, Goodheart GJ, Jr. On the reliability and validity of manual muscle testing: a literature review. *Chiropr Osteopat.* 2007;15:4.

20. Farrar JT, Young JP, Jr., LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain.* 2001;94(2):149-158.

21. Mehta SP, Fulton A, Quach C, Thistle M, Toledo C, Evans NA. Measurement Properties of the Lower Extremity Functional Scale: A Systematic Review. *J Orthop Sports Phys Ther.* 2016;46(3):200-216.

22. Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. North American Orthopaedic Rehabilitation Research Network. *Phys Ther.* 1999;79(4):371-383.

23. Holden J, Davidson M, Tam J. Can the Fear-Avoidance Beliefs Questionnaire predict work status in people with work-related musculoskeletal disorders? *J Back Musculoskelet Rehabil.* 2010;23(4):201-208.

24. Fritz JM, George SZ. Identifying psychosocial variables in patients with acute work-related low back pain: the importance of fear-avoidance beliefs. *Phys Ther.* 2002;82(10):973-983.

25. Grotle M, Brox JI, Vollestad NK. Reliability, validity and responsiveness of the fear-avoidance beliefs questionnaire: methodological aspects of the Norwegian version. *J Rehabil Med.* 2006;38(6):346-353.

26. Grotle M, Garratt AM, Krogstad Jenssen H, Stuge B. Reliability and construct validity of self-report questionnaires for patients with pelvic girdle pain. *Phys Ther.* 2012;92(1):111-123.

27. Cleland JA, Fritz JM, Brennan GP. Predictive validity of initial fear avoidance beliefs in patients with low back pain receiving physical therapy: is the FABQ a useful screening tool for identifying patients at risk for a poor recovery? *Eur Spine J.* 2008;17(1):70-79.

28. Modi S, Deisler R, Gozel K, et al. Wells criteria for DVT is a reliable clinical tool to assess the risk of deep venous thrombosis in trauma patients. *World J Emerg Surg.* 2016;11:24.

29. Rockwood CA, Green DP, Bucholz RW. *Rockwood and Green's fractures in adults.* 7th ed. Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2010.

30. Binder EF, Brown M, Sinacore DR, Steger-May K, Yarasheski KE, Schechtman KB. Effects of extended outpatient rehabilitation after hip fracture: a randomized controlled trial. *JAMA.* 2004;292(7):837-846.

31. Lefaivre KA, Slobogean GP, Ngai JT, Broekhuyse HM, O'Brien PJ. What outcomes are important for patients after pelvic trauma? Subjective responses and psychometric analysis of three published pelvic-specific outcome instruments. *J Orthop Trauma.* 2014;28(1):23-27.