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Restoring Functional Mobility In A 51-Year-Old Male Post Intramedullary Limb Lengthening Surgery Following Helicopter Crash: A Case Report

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Shawn Novella, BS, is a DPT student at the
University of New England, 716 Stevens Ave., Portland, ME 04013
Address all correspondence to Shawn Novella at: snovella@une.edu

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The patient signed an informed consent allowing the use of medical information, pictures, and video footage for this case report and received information on the institution's policies, regarding the Health Insurance Portability and Accountability Act

Key Words: intramedullary limb lengthening, femoral fracture, traumatic injury, home health, bone growth

Abstract

Background and Purpose: The annual incidence of femoral shaft fractures is about 10 per 100,000. When these injuries prompt bone to be resected, limb lengthening surgery may be utilized. However, the surgery takes a toll on the patient's postoperative functional mobility. There is limited information regarding specific home health rehabilitation programs post-surgery. The purpose of the report was to investigate the effect of a comprehensive home health PT program on the patient's LE functional mobility, post bilateral limb lengthening surgery. Case Description: The case report details a 51-year-old male patient's traumatic bilateral femoral fractures, osteomyelitis, and intramedullary limb lengthening surgery using the Precice System. The patient underwent an eight-week home health physical therapy program three times a week. This consisted of stretching the hamstring muscles, standing balance training, strengthening the hamstring, quadricep, calf, and hip muscles, and gait training as these have potential to promote long bone regeneration, strength, and functional mobility in the lower extremities. Outcomes: The patient displayed improvements in lower extremity strength (2-3/5 to 3-3+/5), range of motion of the knees (left, 50° of flexion and -20° of extension to 65° and -7°) (right, 90° of flexion and -20° of extension to 122° and -5°), and the Tinetti Balance Assessment Tool (8/28 to 18/28). Discussion: Noted improvements were made in the patient's outcomes, which may have been due to the physical therapy treatment provided. Despite positive outcomes, the patient had residual weakness, ROM impairment, limited mobility and remained at risk for falling. Increasing intervention intensity may expedite results, but may also slow or damage the limb lengthening process. Further research is warranted to fine-tune a safe exercise intensity.

(Manuscript word count: 3,500 words)

Introduction/Background and Purpose

Femoral fractures, although relatively uncommon, are usually quite traumatic and are easily refractured during the recovery process. Several studies have found that the average annual incidence of femoral fractures in the United States range from 0.1 to 3% of injuries per year, or 37 per 100,000 people.[1] More specifically, the annual incidence of femoral shaft fractures in the United States is about 10 per 100,000.[2] Most of these injuries have been associated with young adult males who experienced major trauma from a high-energy impact.[1] If surgical intervention is not performed, many femoral shaft fractures can lead to hemorrhaging, infections, malunion, and shortening of the femur and associated soft tissues.[1] Surgery, while necessary, can also be counterproductive if performed incorrectly. Damage control orthopaedics such as hemorrhage control, open wound debridement, vascular repair, and rapid external fixation must be performed carefully for surgery to be effective.[1]

Limb lengthening surgery has evolved in the last 100 years to reduce the risks associated with femoral shaft surgery and improve the functional outcome of the patient.[3] In 1951 Gavriil Ilizarov discovered the biological law of tension stress, or distraction histogenesis.[3] He showed that gradual traction on living tissues, such as bone, causes stress that stimulates the regeneration and growth of those tissues along the axis of the applied traction.[3] This principle still applies today with current internal magnetically motorized intramedullary limb lengthening surgical procedures such as the Precice method.[3] The method consists of an intramedullary nail, composed of titanium, that is electromagnetically motorized by a magnetic remote control. When the nail lengthens inside the patient's leg, traction is applied to the bone, forcing it to elongate and regenerate.[3]

A study evaluated the outcomes of limb lengthening surgery of 21 adults, ages 21-65, by the same surgeon using the Precice magnetic intramedullary limb lengthening procedure.[4] All

patients in the study achieved correct lengthening (mean gain of 36.5 mm) and consolidation of their regenerated bone (mean of 268 days), making the Precice System a reliable device for intramedullary limb lengthening surgery in skeletally mature patients.[4] However, the surgery is rather extensive and takes a toll on the patient's postoperative functional mobility. Functional limitations in mobility, gait, range of motion (ROM), strength, and balance of the affected lower extremity (LEs) is common.[4] Weakness and tightness in the hamstrings, quadriceps, and hip abductors are usually easily identified.[4]

A physical therapy (PT) program focused on stretching and transfer training is frequently emphasized in a rehabilitation facility after surgery.[5] After a month the patient is usually sent home to continue with either home health or outpatient PT.[5] Unfortunately, there is limited information regarding specific home health rehabilitation programs for adults post-intramedullary limb lengthening surgery, especially those with significant co-morbidities. The case report details a 51-year-old patient's traumatic bilateral (B/L) femoral fractures, open reduction internal fixation (ORIF) surgery, osteomyelitis, and intramedullary limb lengthening surgery. The purpose of the report was to investigate the effect of a comprehensive home health PT program on the patient's LE functional mobility.

Patient History and Systems Review

This 51-year-old divorced white male was seen for home health PT status-post B/L intramedullary limb lengthening surgery of the right and left femoral shaft using the Precice System, 5 months after injury. Fractures to his right and left femurs occurred after crashing the helicopter he was piloting. Sections of both femoral shafts were shattered as a result. Two days later, the patient underwent surgical resection of the shattered sections and an ORIF of both femurs. The patient's acute care was complicated by fevers with concern for pneumonia, for

which he completed a 14 day course of antibiotics. Despite his non-weight bearing (NWB) status for his right and left lower extremity (RLE, LLE), he was deemed an appropriate inpatient rehabilitation facility (IRF) candidate and transferred to a rehabilitation facility after finishing the course of antibiotics. The patient's intensive rehabilitation therapy program consisted of PT, occupational therapy (OT), nursing, and physician care for a month. He was then transferred to an acute care facility for surgical implantation of an antibiotic cement spacer in his left femur.

Prior to surgery the patient was diagnosed with acute hematogenous osteomyelitis of the left femur and underwent the surgery with repeat incision and drainage (I & D). The patient was then transferred to a skilled nursing facility (SNF) for six weeks. He later underwent surgery to remove the external fixation plate, screws, and the antibiotic cement spacer from the left femur. A new antibiotic cement spacer and intramedullary rod and nail were placed in the left femoral shaft, with proximal and distal interlocking screws. A week after surgery an antibiotic cement spacer was placed in the right femur. Two weeks later the patient was admitted back to an IRF for 14 days. The rehab program focused on improving LE strength, balance, and ROM to promote safe functional mobility. The program also included wheelchair (WC) and self-care training to allow the patient additional independence with daily activities.

After leaving the IRF, the patient transferred home to continue PT with home health services. The patient remained NWB on both LEs, limiting his independence with transfers and WC mobility within his home. A ramp was installed by the entryway for easy access with WC. The patient was left-handed and remained weight bearing as tolerated (WBAT) in his upper extremities (UE). Shortly after returning home, the patient received intramedullary limb lengthening surgery to both femurs, using the Precice System. Two weeks post-surgery the patient was allowed to bear weight as tolerated of his LEs. A PT examination was performed and a general systems review can be seen in Table 1.

Prior to the helicopter crash the patient worked in information technology as a lead technical manager and took helicopter lessons as a hobby. At that time, he was independent with all functional mobility without the use of an assistive device (AD). Other past medical history included: Gastroesophageal reflux disease (GERD), hypertension (HTN), hyperlipidemia (HLD), sleep apnea, internal carotid dissection. Other past surgical history included: cholecystectomy, tracheostomy, gastrostomy tube (G-tube) removal. A list of the patient's medications can be found in Table 2. Upon initial examination the patient was living with his daughter, who was a registered nurse (RN) and available for his daily assistance for three months. The patient lived in a single level home and reported his chief compliant after surgery to be pain and weakness with involved LEs. Following surgical corrections of the femoral shafts, the patient stated that his main goal for PT was to return to standing and walking safely and independently without the use of an AD. The patient was motivated with PT and was optimistic with achieving his therapy goal.

The patient was chosen for this case report due to the extent of his injuries and unique limb lengthening surgical procedure contributing to his recovery. The patient agreed to participate in this PT case report and signed an informed consent, allowing medical information and photographs to be used.

Examination – Tests and Measures

An initial PT examination was completed. Strength, ROM, Tinetti Balance Assessment Tool (POMA),[9] balance, gait, pain, and functional mobility were assessed and appear in Table 3. LE strength was measured using manual muscle testing (MMT) and graded accordingly as described by Kendall.[6] However, for patient comfort, all MMTs were performed in the seated position. In a 2007 study, MMTs were shown to have excellent reliability with test-retest

intraclass correlation (ICC) ranging from 0.80-0.99.[7] ROM was assessed both passively and actively by the physical therapist. Flexion and extension ROM of the knee was documented through the use a long arm goniometer by the physical therapist.[8] In a 2018 study, goniometry was shown to have excellent reliability with an inter-rater and intra-rater ICC of >0.99 and >0.98 respectively for the knee.[8]

Balance and gait were assessed utilizing the balance grades as described in the POMA, to determine the patient's fall risk.[9] The POMA has an minimal detectable change (MDC) score of 4.0-4.2 for individual assessments.[9] The patient's gait was not tested at the time of the initial examination due to instability. However, the patient's static standing and dynamic balance were tested during the initial examination with use of the patient's rolling walker. The patient was determined to be steady with his static balance. The patient was unsteady and needed standby assistance (SBA) during dynamic balance testing. It was noted that the patient used his UEs for stability due to weakness in the LEs. The patient was also asked to perform sit to stand transfers from his toilet and bed to determine need for assistance. The patient was able to perform these motions but required SBA due to instability. It was determined that the patient would be able to perform transfers during his activities of daily life (ADL) with the help of his daughter while he recovered.

Pain measurements were assessed using the numeric pain rating scale (NPRS).[10] The patient's pain ratings appear in Table 3. The pain rating scale has a minimal clinically important difference (MCID) of 1.3 points for patients who are in the hospital.[10]

Clinical Impression: Evaluation, Diagnosis, Prognosis

Following examination, the initial clinical impression was confirmed. The patient's functional limitations in mobility, gait, ROM, strength, and balance of both LEs were related to

post-surgical limitations. More specifically the weakness and tightness in his B/L hamstrings, quadriceps, and hip abductors were identified as main contributing factors to these limitations. The patient continued to be an appropriate case study due to the unique mechanism of his injury, rarely performed B/L limb lengthening procedures, and his complicated mix of multisystem impairments. There was minimal rehabilitation research and no specific protocols or contraindications in place to guide clinical decision-making. However, the surgeon required the patient to remain NWB for one month post-surgery and walk independently with a rolling walker after that month. The patient was given the verified ICD-10-CM diagnosis codes as follows: V95.01XD: Helicopter crash injuring occupant, subsequent encounter; S72.491H: other fracture of lower end of right femur, subsequent encounter for open fracture type I or II with delayed healing; S72.491K: other fracture of lower end of left femur, subsequent encounter for closed fracture with nonunion; and M86.152: other acute osteomyelitis, left femur.

The patient's prognosis for improvement with PT was good due to sufficient remaining bone support, adequate patient cooperation and neuromuscular control with strengthening and mobility interventions, proper care of the osteomyelitis infection, and absence of red flags. The PT intervention plan included LE stretching and strengthening exercises, as well as a gradual progression with balance, transfer, and gait training. As described in two separate case reports, stretching exercises focused on the hamstring and quadriceps muscles to improve flexion and extension ROM of the knees.[5,11] Standing balance and strengthening exercises were included to target abdominal oblique muscles and hip abductor, extensor, and flexor muscles.[5,11] This was intended to help prevent fall risk and pelvic misalignment, or hip hiking, on either side during gait training.[5,11] Including these exercises into the PT plan of care has the potential to improve a patient's prognosis by promoting long bone regeneration and strengthening, as well as preventing contractures of the LEs.[11]

The patient was also referred to an OT and a RN. The OT addressed the patient's decreased independence with instrumental activities of daily life (IADL) and home safety with such things as bathing, meal prepping, and laundry. The RN provided the patient with proper wound care and assisted with collection of detailed lab assessments.

An outcome assessment plan was scheduled at week four and eight of therapy. These tests included MMTs,[6] ROM in both knees,[8] the POMA,[9] and the NPRS.[10] The patient's short-term goals and long-term goals for PT appear in Table 4.

Intervention and Plan of Care

The patient underwent an eight-week PT program three times a week. This consisted of stretching the hamstring muscles, standing balance training, strengthening the hamstring, quadricep, calf, and hip muscles, and gait training. Throughout the program the patient demonstrated comprehension of and adherence to each intervention, both verbally and physically.

Stretching the hamstring muscles was meant to improve flexion and extension ROM of the knees, as well as prevent contractures of the LEs.[5,11] For patient comfort, the patient was instructed to perform these stretches in supine on his bed. A belt was looped around the forefoot of one leg and the knee placed in full extension. The opposite leg was flexed at the knee to help maintain core stability and prevent trunk rotation during the stretch. While maintaining full knee extension, the patient flexed the hip of the belted leg. Using his UEs, the patient pulled down on the opposite end of the belt to initiate dorsiflexion of the ankle and help stabilize the stretch. The patient performed the stretch on each LE seven times a week for three repetitions of 30 seconds. Although five sets have been indicated for maximal change, three sets were encouraged due to the patient's bilateral involvement and onset of fatigue before reaching five sets with both LEs.[11]

The patient continued with this intervention throughout the duration of this study. Due to patient pain and discomfort while in prone and sidelying positions, quadricep stretches were not included.

Standing balance training was included to mitigate the patient's use of his AD while performing ADLs. Once the patient transferred from his bed to the WC, he was placed facing the kitchen countertop. The patient was instructed to hold on to the counter with both UEs and transfer to a standing position. In doing so, the patient was advised to only use his UEs for stability, and focus more on extension of the knees and hips to come to standing. Once the patient was stable in standing, the WC was removed and the patient was instructed to hover his hands over the counter for 10 seconds in standing. This intervention was chosen as it was shown to reduce static standing fall risk, and could easily be progressed.[12] The intervention was performed three days a week for five repetitions of an attempted 10 seconds, as this was indicated for maximal change in balance.[11] By the end of week one the patient was able to meet the 10 second mark, and thus progressed to more difficult stances. These stances included: parallel stance (feet together) by week two, semi-tandem stance (instep of one foot touching the big toe of the other foot) by week four, and tandem stance (heel to toe) by week six. Pain in the quadriceps prevented the patient from progressing to a single leg stance by the end of the study.

Initially, strengthening of bilateral hip abductor, extensor, and flexor muscles consisted of two sets of eight repetitions. These were performed in the standing position while holding onto the counter. Hip abduction was performed by bringing the leg out to the side while keeping the knee extended, and avoiding external rotation of the LE and excessive side-bending of the trunk. Hip extension was performed by bringing the leg back as if to kick with the heel. Again, while keeping the knee extended and avoiding external rotation of the LE and excessive forward trunk flexion. Hip flexion was performed by bending the knee and bringing it as close to the chest as

possible in a marching motion, while avoiding excessive trunk flexion. The exercises and dosing regimen were shown to provide adequate changes in hip ROM and strength, and help prevent fall risk and pelvic misalignment during gait training.[5,11]

During week four of PT, the hip strengthening regimen was increased to three sets of 10 repetitions, and calf raises and mini-squats were included. Both additional interventions were carried out in the standing position at the counter. Calf raises were performed by extending the ankles to lift the heels off the ground and stand on the forefoot of both feet, then slowly lowering the heels back to the ground. Calf raises consisted of three sets of 10 repetitions, as this was shown to improve ankle and knee ROM and strength.[11] Mini-squats were performed by flexing the knees and hips as if to sit, then slowly extending both to return to the standing position. Mini-squats consisted of three sets of six repetitions, as this was shown to increase quadricep strength in a lower body strength training study.[13] Squats have been shown to improve flexion and extension ROM and strength of the hips.[5,11,13] Both calf raises and squats have also been shown to improve flexion and extension ROM and strength of the knees, as well as help prevent fall risk and pelvic misalignment during gait training.[5,11,13]

As per the surgeons request, the patient's gait training also began on week four of PT. Gait training was performed with the use of a rolling walker, and consisted of ambulating 30 ft within the patient's home. Minimal assistance was provided, and verbal cues were given to initiate a heel strike while using a step-to gait pattern.[11] Initially, this distance and gait pattern were chosen due to similar studies showing significant gains in patient's strength, ROM, and mobility without increasing the risk of pain, falls, or damage to the limb-lengthening process.[5,11] During the sixth week of PT, the gait training parameters progressed to 60 ft and included turning in place at the 30 ft mark. By week seven the patient was confident enough to inquire

about using two canes instead of the rolling walker. By week eight, however, the patient was unable to attempt this due to quadriceps pain and fear of falling.

Outcomes

Over the course of PT the patient reported a gradual increase in LE ROM, strength, and balance, as well as a reduction in pain. To establish an accurate comparison to baseline testing, on week eight all outcome measures were performed identical to the initial examination, detailed in Table 3. The patient's MMT scores improved from 2-3/5 to 3-3+/5. ROM of the left knee improved from 50° of flexion and -20° of extension to 65° and -7°. The right improved from 90° of flexion and -20° of extension to 122° and -5°. Pain measurements were assessed using the NPRS, both at rest and while standing.[10] The patient's pain reduced from 5-6/10 to 3-4/10 at rest and 7-8/10 to 5-6/10 while standing.

The patient required the use of a rolling walker throughout the POMA[9] and remained steady during the static balance section. However, during dynamic balance testing, the patient continued to use his UEs to push off from a chair during a sit to stand transfer. While turning 360° in place, the patient broke the activity into parts. He paused to lift and rotate his walker, then planted and pushed off from the walker with his UEs to help lift and rotate his feet. The patient was able to clear the ground with both feet during the gait section, but only managed a step-to gait pattern without intense pain and fear falling. Due to the patient's progress and ability to participate in the gait section of the POMA,[9] his score improved from 8/28 to 18/28. This meant the patient's balance improved, but he remained at high risk of falls.

Discussion

The intended purpose of this case report was to investigate the effect of a comprehensive

home health PT program on the patient's LE functional mobility post traumatic B/L femoral fractures, ORIF surgery, osteomyelitis, and intramedullary limb lengthening surgery. This was demonstrated by the noted improvements in the patient's gait, ROM, strength, and balance of both LEs over eight weeks. Although the patient did not fully reach his goals by the end of the study, the results were consistent with those found in similar studies.[5,11] Therefore, the similar approach used in this study may have contributed to the improvements in the patient's functional mobility.

Stretching exercises focused on the hamstring muscles were designed to help improve flexion and extension ROM of the knees, and prevent contractures.[5,11] Gradual progression with standing balance and strengthening exercises that targeted the hip abductor, extensor, and flexor muscles were designed to reduce fall risk and hip hiking during gait training.[5,11] However, the referenced studies were conducted on younger patients, less than 33 years of age, while the patient in this study was over 51 years. Also, neither study accounted for B/L intramedullary limb lengthening surgery or an additional osteomyelitis diagnosis. These factors may have contributed to the patient not being able to reach his goals by the end of the study.

The research on successful PT programs post intramedullary limb lengthening surgery is scarce. However, the results show promise for clinical practice. Progressing interventions for a fairly rare condition such as limb lengthening can be difficult for all parties involved; patient, surgeon, and physical therapist. Increasing the level of intensity may slow or damage the limb lengthening process.[5,11] Plus, patient compliance may vary with each session due to pain or fear of falling. Yet, it is important to find a safe maximum level of intensity that speeds recovery and allows the patient further independence. Further research is warranted to fine-tune a limit of intensity that would safely expedite results and instill confidence in the rehabilitation team.

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Tables and Figures

Table 1. Systems Review

Systems	Impaired or Unimpaired
Cardiovascular/Pulmonary	Impaired: Bilateral cyanosis noted of feet due to poor circulation. Once patient stands up and moves around the cyanosis dissipates.
Musculoskeletal	Impaired: Strength: Patient presented with decreased general strength, noted particularly in the right and left quadriceps for knee extension. Range of motion: noted limitations bilaterally with right and left knee flexion and extension due to tightness in the hamstrings and quadriceps. This is particularly more evident in the left knee for both the lack of flexion and extension. Posture: forward head and rounded shoulders noted in sitting. In standing patient demonstrated flexed trunk posture due bilateral tightness in the hamstrings.
Neuromuscular	Unimpaired
Integumentary	Impaired: Incision secondary to surgery on bilateral femoral shafts was noted, but unable to observe secondary to dressings placed by surgeon. Drain pouch noted on left thigh to clear excessive fluid. Bilateral cyanosis noted of feet.
Communication	Unimpaired
Affect, Cognition, Language, Learning Style	Unimpaired: Alert and oriented to person, place, and time. English is spoken. Patient prefers verbal instruction, demonstration, and pictures. Able to properly explain and demonstrate instructions to another person.

Table 2. Medication List at the time of Initial Examination

Medication:	Indication:
Acetaminophen	Pain Management
Oxycodone	Pain Management
Oxycontin	Pain Management
Ibuprofen	Pain Management
Amoxicillin-Clavulanate	Infection
Docusate Sodium	Constipation
MiraLAX	Constipation
Enoxaparin Sodium	Anticoagulation
Lisinopril	Hypertension
Omeprazole	Proton Pump Inhibitor (GERD)
Trazodone Hydrochloride	Insomnia

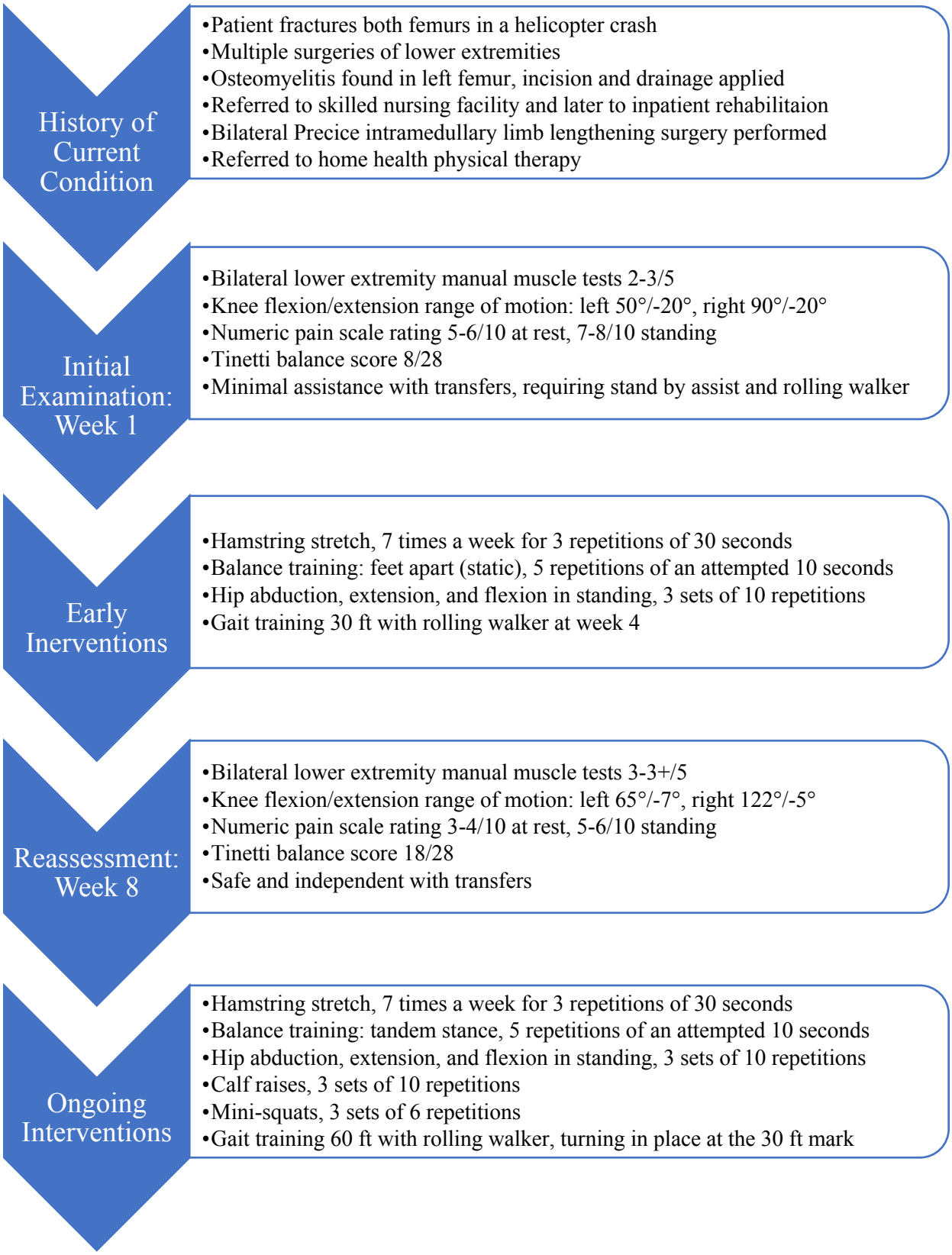
Table 3. Tests and Measures at Initial Examination and Reexamination

Tests & Measures	**Initial Examination Results**		**Reexamination Results**	
Range of Motion	**Left**	**Right**	**Left**	**Right**
Knee Flexion	50°	90°	65°	122°
Knee Extension	-20°	-20°	-7°	5°
Manual Muscle Testing	**Left**	**Right**	**Left**	**Right**
Hip Flexion	2+/5	2+/5	3/5	3+/5
Hip Abduction	2/5	2/5	3/5	3+/5
Hip Adduction	2/5	2/5	3/5	3+/5
Knee Flexion	2+/5	2+/5	3/5	3+/5
Knee Extension	2+/5	2+/5	3/5	3+/5
Ankle Dorsiflexion	3/5	3/5	3/5	3+/5
Ankle Plantarflexion	3/5	3/5	3/5	3+/5
Gait Observation				
Distance:	Patient unable to ambulate safely with rolling walker at this time.		Patient able to ambulate 60 ft with 360° turn at 30 ft.	
Sitting Balance				
Static:	Steady and safe without assistance		Steady and safe without assistance	
Dynamic:	Steady and safe without assistance		Steady and safe without assistance	
Standing Balance				
Static:	Minimal assistance of one for standby guard and rolling walker		Independent and safe with use of rolling walker	
Dynamic:	Moderate assistance of one contact guard and rolling walker		Independent and safe with use of rolling walker	
Transfers				
Sit to stand	Minimal assistance of one and rolling walker		Independent and safe with use of rolling walker	
Bed to chair	Minimal assistance of one and rolling walker		Independent and safe with use of rolling walker	
Toilet	Minimal assistance of one and rolling walker		Independent and safe with use of rolling walker	
Floor	Not tested (expected to require max assist for initial trial)		Not tested (expected to require max assist for initial trial)	
Tinetti Balance Assessment Tool (Performance-Oriented Mobility Assessment)				
Balance Section:	8/16		13/16	
Gait Section:	0/12		5/12	
Total Score:	8/28		18/28	
Numeric Pain Rating Scale				
At Rest	5-6/10		3-4/10	
Standing/Ambulating	7-8/10		5-6/10	

Table 4. Goals

Short Term Goals	Long Term Goals
The patient's bilateral knee extension will improve from -20 degrees to 0 degrees within 4 weeks, in order to lessen the severity of the crouched gait pattern.	The patient's bilateral lower extremity manual muscle tests will improve from 2-3/5 to 4/5 within 8 weeks, in order to properly perform sit to stand transfers without the use of an assistive device.
The patient's numeric pain scale rating will reduce from 7-8/10 to 4-5/10 while standing within 4 weeks, in order to improve endurance with at home activities of daily life.	The patient's total Tinetti balance score will improve from 8/28 to 20/28 within 8 weeks, in order to reduce fall risk with activities of daily life.

353 **Figure 1. Timeline for Episode of Care**



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356 **CARE Checklist**.

CARE Content Area	Page
1. **Title** – The area of focus and "case report" should appear in the title	2
2. **Key Words** – Two to five key words that identify topics in this case report	2
3. **Abstract** – (structure or unstructured) a. Introduction – What is unique and why is it important? b. The patient's main concerns and important clinical findings. c. The main diagnoses, interventions, and outcomes. d. Conclusion—What are one or more "take-away" lessons?	3
4. **Introduction** – Briefly summarize why this case is unique with medical literature references.	4-5
5. **Patient Information** a. De-identified demographic and other patient information. b. Main concerns and symptoms of the patient. c. Medical, family, and psychosocial history including genetic information. d. Relevant past interventions and their outcomes.	5-7
6. **Clinical Findings** – Relevant physical examination (PE) and other clinical findings	7-10
7. **Timeline** – Relevant data from this episode of care organized as a timeline (figure or table).	20
8. **Diagnostic Assessment** a. Diagnostic methods (PE, laboratory testing, imaging, surveys). b. Diagnostic challenges. c. Diagnostic reasoning including differential diagnosis. d. Prognostic characteristics when applicable.	7-10
9. **Therapeutic Intervention** a. Types of intervention (pharmacologic, surgical, preventive). b. Administration of intervention (dosage, strength, duration).	10-13

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c. Changes in the interventions with explanations.	
10. **Follow-up and Outcomes** a. Clinician and patient-assessed outcomes when appropriate. b. Important follow-up diagnostic and other test results. c. Intervention adherence and tolerability (how was this assessed)? d. Adverse and unanticipated events.	1358 359 360 361
11. **Discussion** a. Strengths and limitations in your approach to this case. b. Discussion of the relevant medical literature. c. The rationale for your conclusions. d. The primary "take-away" lessons from this case report.	13-14
12. **Patient Perspective** – The patient can share their perspective on their case.	7
13. **Informed Consent** – The patient should give informed consent.	7