Effects of Social Determinants of Health and Diabetes on a Lower Extremity Workplace Injury: A Disablement Model Case Study

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ABSTRACT

This clinical case study involves a 36-year-old male patient who injured his right lower leg while working in the kitchen at a county correctional institution. The mechanism of injury involved the patient getting his foot caught under a wooden pallet, losing his balance, and then catching himself on his right leg in a twisting motion. The injury led to the patient seeking care in the emergency department and was diagnosed with a nonspecific strain of the right triceps surae muscle group. Upon discharge, the patient was referred to outpatient athletic training services within the hospital system. Follow-up care provided by athletic trainers and athletic training students consisted of an injury evaluation, plan of care discussions, and therapeutic interventions, including moist heat packs, low-level laser therapy, desensitization massage, fluidotherapy, and electrical stimulation implemented over six weeks. During the six weeks of therapeutic intervention, the patient sustained an additional injury resulting in a right ankle sprain with a possible ankle avulsion fracture. Following six weeks of intervention, this patient demonstrated no symptom improvement. Due to the complexity of this patient case, an intentional effort was made to approach care using the International Classification of Functioning, Disability, and Health (ICF) disablement model to better inform the involved clinicians on areas of social determinants of health (SDoH), chronic disease, and acute rehabilitation. In this case, the SDoH and environmental factors contributed to poor patient outcomes, resulting in this patient continuing to seek care from other healthcare disciplines. Overall, this case demonstrates the effects of social and environmental factors on the rehabilitation process of a lower extremity workplace injury.
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INTRODUCTION

Social Determinants of Health (SDoH) are the conditions in which people are born, grow, live, work, and age.[1-2] Characteristics of SDoH are responsible for most health inequities and disparities among U.S. citizens, resulting in adverse patient health outcomes each year.[2] SDoH conditions may include education, job, and transportation, all of which impact a patient's ability to receive care. Athletic trainers (ATs) need to recognize SDoH characteristics to actively work to reduce adverse patient outcomes associated with such characteristics. While SDoH plays a role in all care ATs deliver, this case is a unique combination of social factors not typically seen in the athletic population but includes care ATs provide. This patient case presents the complexities of SDoH and its impact on acute injury rehabilitation within a 36-year-old patient with a workplace injury. This case also demonstrates the impact of uncontrolled Type 1 Diabetes Mellitus (T1DM) on injury rehabilitation. This case study will provide ATs with ideas on approaching unique and complex patient cases related to SDoH and the International Classification of Functioning, Disability, and Health (ICF) disablement model.

PATIENT INFORMATION

Patient

This patient case involves a 36-year-old white male who works in the kitchen at a county correctional institution. This patient's injury occurred in late August while at work, reporting an incident involving his right

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foot getting stuck under a pallet, causing him to lose his balance and catch himself on his right leg with a twisting motion. The patient was initially seen in the emergency department (ED) and was diagnosed with a nonspecific right calf strain. The patient was seen by an occupational medicine doctor after the ED visit and was given a prescription for outpatient athletic training services. The patient presented to athletic training services approximately one week after sustaining his injury at work with a chief complaint of pain and reduced function of the right lower extremity. This patient was seen and treated over approximately six weeks, with one visit taking place about every other week due to the patient's work and transportation limitations. The initial injury took place in late August, the initial AT evaluation was in early September, and treatment lasted through mid-October.

This patient has a medical history of a right ankle fracture as a teenager, bilateral carpal tunnel for which he is a surgical candidate, seven self-reported concussions, and Type 1 Diabetes Myelitis (T1DM). Personal factors relevant to this patient's health condition include a diagnosis of T1DM at the age of 21 and uncontrolled blood glucose levels, including a hemoglobin A1C of 11 as recently as the previous July.

Differential Diagnosis and Evaluation

Following the initial work injury and ED visit in August, in which radiographs of the right knee were unremarkable, this patient was diagnosed with a nonspecific right calf strain. The patient reported pain at rest to be a 7-8/10 on a 0–10-point numeric pain rating scale (NPRS) and described the pain as radiating with numbness and burning from the anterior and posterior right hip down the entirety of the right leg to the bottom of right foot (dermatomes L2-L5 and S1-S2). The patient was hypersensitive to light touch along the right lower leg and posterior thigh and demonstrated no observable deformities, discoloration, or edema.

It was evident after evaluation that this patient's symptoms were more complex than an isolated musculoskeletal injury and were impacted by his extensive history of comorbidities and health disparities. Many of this patient's post-injury symptoms were similar to those seen in cases of chronically uncontrolled diabetes, as the most common complication of diabetes is neuropathy.[4] Diabetic neuropathy is characterized by loss of sensory function and pain distally, most commonly in the toes.[4] No definitive diagnosis was made after evaluating this patient's initial work injury; however, differential diagnoses included calf strain, hamstring strain, neuralgia, and diabetic neuropathy.

Three weeks following the initial injury, in mid-September, this patient sustained a secondary injury from falling down his stairs while using a unilateral crutch due to his first injury. The patient landed on his right leg and immediately experienced pain in his right ankle. He was seen in the ED for this injury on the same day, and radiographic imaging was performed. Radiographs of the right ankle showed deep vein grooves, atherosclerotic changes inconsistent with the patient's age, and ossicles along the lateral and medial malleolar regions. Radiographic imaging did not indicate whether ossicle formations were pre-existing or due to acute avulsion injury. The patient's secondary ankle injury was ultimately diagnosed in the ED as a nonspecific right ankle sprain with a possible avulsion fracture. After the diagnosis was determined and initial treatment was deemed ineffective, an effort was made to re-evaluate this case study using the ICF disablement model for guidance.

Body Structure and Function

Upon initial evaluation of a right lower extremity work injury with athletic training services in early September, the patient demonstrated increased tone along the right gastrocnemius, with visible and palpable spasms along the right gastrocnemius and hamstring. The patient could not tolerate range of motion (ROM) assessment and special testing due to pain and discomfort. Right ankle manual muscle testing (MMT)

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performed demonstrated results of Dorsiflexion (DF): 5-/5, Plantarflexion (PF): 5-/5, Inversion (INV): 4/5, and Eversion (EV): 4/5. MMT of the left ankle was within normal limits. The patient had a reduced right patellar tendon reflex when compared bilaterally. Upon evaluation of the patient's secondary injury to his right ankle in mid-September, the patient reported right ankle pain at rest to be an 8-10/10 on a 0-10-point NPRS. The patient continued to experience pain and hypersensitivity of the entire right leg; however, he reported that the right ankle pain was more intense than the right leg pain. Findings of the evaluations conducted by athletic training services of both the initial and secondary injuries did not support the diagnoses of an acute non-specific calf strain or ankle sprain, which the ED provided due to the patient's intense symptoms that were inconsistent with these musculoskeletal injuries.

During the evaluation of this patient's secondary ankle injury, right ankle active ROM was performed, demonstrating limitations in all directions due to pain, with measurements of DF: 0 degrees, PF: 30-35 degrees, INV: 20 degrees, and EV: 5 degrees. Right ankle MMT measurements conducted included DF: 4-/5, PF: 4-/5, INV: 4-/5, and EV: 4-/5. The patient demonstrated limited ability to provide consistent resistance in all directions of ankle mobility with slight manual resistance. All MMTs also reproduced the patient's ankle pain. Ankle special tests were performed with the following findings: Anterior drawer test: negative on the right and left; Talar tilt inversion and eversion: negative on the left, laxity noted for both inversion and eversion on the right; Squeeze test: positive for pain in the right calf, but no severe pain down the tibial shaft. The patient demonstrated apprehension and muscle guarding during all special tests, which likely impaired testing accuracy. Using a floor scale, the patient could put 50 pounds of weight through his right leg.

Activity and Participation

The patient demonstrated severe functional limitations due to pain, including an inability to ambulate without crutch assistance. The patient reported alternating between single and bilateral crutch assistance due to discomfort with bilateral crutch use caused by pre-existing bilateral carpal tunnel. The patient demonstrated severe activity limitations, including discomfort during sleep resulting in lack of sleep; functional limitations with all activities of daily living (ADLs) such as ascending/descending stairs, as well as prolonged sitting and standing tolerance; requirement of crutch assistance for ambulation; and inability to tolerate everyday work tasks. The patient continued to work after the injury; however, he was restricted to sitting jobs and tasks only, demonstrating significant limitations to his role as a correctional institution kitchen staff member.

Environmental and Personal Factors

Environmental factors related to this patient include the injury taking place at work and, therefore, having to go through workers' compensation for injury evaluation and management. This means the patient is restricted to healthcare services his employer covers. This patient also has an undisclosed criminal history, low economic stability, and lacks access to reliable transportation due to not having a driver's license. Therefore, these factors contribute to the challenges faced by the management of this patient.

Personal factors for this patient include being a parent to a five-year-old child, a high school diploma as the highest level of education, a personal career goal of becoming a correctional officer, and no established primary care provider (PCP). This patient, therefore, uses the ED as his primary access to healthcare. His electronic medical records demonstrated at least one ED visit per month for the previous six months.

INTERVENTIONS

This patient attended therapy appointments for outpatient athletic training services for approximately six weeks, averaging one visit every other week due to work and transportation limitations. At the initial evaluation appointment in early September, the first therapeutic intervention attempted was low-level laser therapy (LLLT). The LLLT intervention was used with the patient in a prone position along eight spots from the distal right calf to the mid-posterior thigh at 5.0 J/cm^2. The patient reported no immediate change in symptoms after this intervention, although he did report a mild numbing effect in the posterior right leg for a short period following the appointment. At following therapy appointments, other therapeutic interventions such as moist heat packs, desensitization massage, fluidotherapy, and electrical stimulation (80-150 Hz, 2.0-3.8 V, 18 min.) were used with the goals of decreasing hypersensitivity of the entire right leg, decreasing muscle spasm and tone, and increasing overall comfort and functional ability of the patient.

At the next visit in mid-September, two moist heating packs were applied to the right posterior thigh and calf for 14 minutes. Then, a desensitization massage technique of the right posterior thigh and calf was performed with no change in the patient's hypersensitivity nor tenderness to palpation. Fluidotherapy was attempted for the right lower extremity in the range of 100-110 degrees Fahrenheit; however, the patient did not tolerate this intervention due to reported pain in the right Achilles and posterior calcaneus region within the first few minutes of treatment. The validity of the fluidotherapy intervention could not be determined since treatment was discontinued after approximately three minutes due to the patient's discomfort.

At the subsequent therapy visit in early October, no therapeutic interventions were attempted due to increased discomfort reported by the patient that day. This visit consisted primarily of discussing the patient's plan of care, including upcoming therapy appointments and goals, appointments with the orthopedic department, and appointments with the patient's nurse practitioner for T1DM management. There was also a lengthy discussion of T1DM homecare and management.

At the following therapy appointment in mid-October, electrical stimulation was used with the patient in a prone position on the mid to distal right hamstring, using pre-modulated, continuous cycle settings at 80-150 Hz and 2.0-3.8 V for 18 minutes. Simultaneously, electrical stimulation was also used on the proximal to distal right calf, using the pre-modulated, continuous cycle settings at 80-150 Hz and 2.2-3.5 V for 18 minutes. LLLT was then used with the patient in a prone position along ten spots from the distal right calf to the mid-posterior thigh at 5.0 J/cm^2. The patient reported that his right leg felt stiff and numb immediately following these therapeutic interventions, but no immediate change in pain or sensitivity.

OUTCOMES

Body Structure and Function

The rehabilitation of this patient was interrupted for six weeks due to the patient leaving town for correctional officer academy training. At the time of the last therapy appointment, the patient demonstrated no improvements in pain, hypersensitivity, ROM, and ability to perform ADLs. The plan of care for this patient includes the continuation of therapy to decrease pain, decrease hypersensitivity, increase ROM, and increase functional abilities.

Activity and Participation

At the last therapy appointment, the patient demonstrated no improvement in activity tolerance and participation. The patient continued to use crutch assistance for ambulation and demonstrated functional limitations with all ADLs. The patient also continued to demonstrate severe discomfort during sleep, thus resulting in a prolonged lack of sleep. Due to these limitations, the patient could not tolerate work tasks and was still restricted to sitting jobs and tasks only.

Environmental and Personal Factors

This case study's environmental and personal factors significantly impacted the therapeutic intervention adherence and tolerability for this patient. Scheduling therapy appointments for this patient was challenging due to limitations by this patient's work schedule and his lack of access to reliable transportation. An unexpected challenge within this case was the patient ceasing therapy appointments to leave town for correctional officer academy training. At the time the patient left town for the academy, he had been attending therapy appointments inconsistently for six weeks and had shown no improvement. The patient informed the athletic training staff that his academy training would be six weeks long and was unsure of his ability to attend future appointments. After the patient attended six weeks of correctional officer academy training, he was seen for a follow-up appointment with the orthopedic department. The orthopedic physician told the athletic training staff and students that there was still no symptom improvement. Ultimately, this patient chose not to pursue further therapy treatment after returning from the academy.

DISCUSSION

The case study demonstrated many unique characteristics uncommon for Ats to manage regularly. Due to the non-specific nature of the diagnosis provided by the ED, athletic training services decided to approach treatment from the disablement model perspective to address impairments and barriers associated with SDoH. One unique component of this case includes the lack of symptom improvement following extensive treatment and the continued decline in this patient's health status following six weeks of therapeutic intervention. After taking six weeks off from therapy treatment due to attending a correctional officer training academy, this patient demonstrated no symptom improvement at a follow-up appointment with the orthopedic department. After returning from the academy, this patient did not resume outpatient therapy, likely due to personal and environmental barriers.

This case study uniquely presents the complex interrelationships between SDoH, chronic disease, and acute rehabilitation. This patient had an apparent acute injury; however, the presentation of that injury was very different than typical injuries seen by ATs. The findings of this case study demonstrate how health disparities and underlying chronic conditions can impact patient health outcomes. This patient's lack of a driver's license limited his access to reliable transportation to work, therapy appointments, and appointments related to his T1DM care, resulting in poor appointment attendance. Socioeconomic status, ability to pay, and access to transportation also presented a challenge for this patient when attending healthcare appointments, as he could not afford to miss work. This patient's socioeconomic status also made it more challenging to manage his T1DM successfully, such as accessing healthy food options, affording prescription medications, and seeking assistance from healthcare professionals.

Research has shown that damage and failure of many organs and body systems result from diabetes and chronic hyperglycemia.[3-6] This case is an unusual presentation of the effects of chronically uncontrolled T1DM that were likely systemically triggered by acute injury stress. This is demonstrated by this patient's prolonged nerve-related symptoms and pain patterns and the lack of symptom improvement despite therapeutic

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intervention. Overall, this patient's history of uncontrolled T1DM is also rooted in his barriers related to SDoH.

This case study also uniquely demonstrates the importance of understanding SDoH while emphasizing the importance of providing patient-centered healthcare. ATs need to be able to recognize various health disparities within their patients so they can reduce adverse health outcomes associated with SDoH.[2,7] Throughout the treatment of this patient, it was observed that he had barriers related to all five key areas of SDoH: 1) Healthcare access and quality, 2) Education access and quality, 3) Social and community context, 4) Economic stability, and 5) Neighborhood and built environment. The combination of social barriers identified in this case is not typically seen within patient populations treated by ATs; however, ATs work with patients every day that SDoH impact. Potential interventions to address the underlying causes of observed social barriers in this patient case could include medical rideshare programs, social worker or counselor referrals, diabetes support groups, dietitian referrals, and state or federal financial support programs.

CLINICAL BOTTOM LINE

This unique patient case involving an initial workplace injury, a secondary musculoskeletal injury, chronic T1DM, and other systemic health issues demonstrates the importance of utilizing an approach based on the ICF disablement model, as it allows for ATs to recognize SDoH characteristics and identify social barriers affecting their patients. This case also demonstrates the need for ATs to understand the impact of SDoH and chronic disease on various patient populations and their health outcomes. ATs must understand the importance of managing chronic diseases such as T1DM, as they can adversely affect healing processes when not properly managed. Additionally, ATs must consider health disparities and their underlying causes within every patient case to provide the best quality patient-centered healthcare. Overall, this case emphasizes how applying the disablement model to patient cases allows for the identification of SDoH characteristics related to personal factors, environmental factors, activity, functional limitations, and participation status. This identification then facilitates better quality patient-centered care based on a deeper understanding of underlying causes and how they can complicate and prolong typical rehabilitation processes.

The education of ATs surrounding recognition and identification of SDoH factors is ongoing and is something the profession is continually striving to improve. ATs play an essential role in the healthcare system; this education can make a meaningful difference in patient outcomes.

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