Differential examination, diagnosis and management for tingling in toes: fellow's case problem

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ABSTRACT

Background: The diagnosis of chronic exertional compartment syndrome can be challenging as other pathologies involving bone, muscle, nerve and vascular structures can mimic the syndrome. The purpose of this Fellow's Case Problem is to describe the clinical decision-making and physical therapy differential diagnosis regarding a 25-year-old patient with un-resolved neurovascular complaints following chronic exertional compartment syndrome surgical release.

Diagnosis: After surgery, the patient's previous complaint of numbness and tingling in the plantar surfaces of her first and second toes of right foot was still present. The patient's concordant symptoms in toes were reproduced proximally in the lumbar spine and distally in the tarsal tunnel.

Discussion: The lumbar spine can refer symptoms to the lower extremities and needs to be ruled out as the source of the patient's complaint whenever neurovascular symptoms such as numbness and tingling are present. The discovery of the relationship of the lumbar spine with the tingling in the toes addressed one of the patient's primary concerns that was not resolved from the surgery.

Level of Evidence: 4.

KEYWORDS

Medial plantar nerve; anterolateral release; mechanical diagnosis and treatment; chronic exertional compartment syndrome; popliteal artery entrapment; nerve entrapment

Background

The diagnosis of chronic exertional compartment syndrome (CECS) can be challenging as other pathologies involving bone, muscle, nerve and vascular structures can mimic the syndrome.[1] The incidence of reported CECS is between 14 and 27% in active individuals.[2,3] When accurately diagnosed, the standard of care for CECS is surgical compartment release.[4] The purpose of this Fellow's Case Problem is to describe the clinical decision-making and physical therapy (PT) differential diagnosis regarding a 25-year-old patient with un-resolved neurovascular complaints following CECS surgical release.

Patient description

In April 2013, a 23-year-old female reported to a physician with numbness and tingling in the first and second toes of her right foot. Symptoms limited her walking to only a few steps until she reported complete right foot numbness. Continued walking would elicit severe numbness and tingling of the entire lower leg followed by posterior lower leg cramping which would ultimately force her to stop walking. Following magnetic resonance imaging, she was diagnosed with popliteal artery entrapment (PAE) secondary to an osteochondroma on

her right posterior tibial metaphysis. Following surgical resection of the osteochondroma, the patient was able to walk without cramping, but still reported numbness and tingling in first and second toes of right foot. Following surgical intervention, the patient then received PT care at another facility for six sessions over four weeks that focused on balance, range of motion (ROM) and strengthening. Despite this course of care, the patient continued to report numbness and tingling in the first and second toes of right foot.

In June 2015, two years after the osteochondroma was resected and symptoms of PAE resolved, the patient was evaluated by a physician for a new complaint of cramping in right anterolateral lower leg with running less than two minutes and continued numbness and tingling in her first and second toes. In her right anterolateral leg, cramping would worsen with exertional activities such as walking, running or using the elliptical, and dissipate with rest. The only relevant finding from the physician's initial examination was decreased sensation to light touch over the right anterolateral compartment. Ultimately, the physician confirmed the diagnosis of CECS with a one-minute post exercise pressure measurements. The patient yielded values greater than 30 mm Hg bilaterally in the anterolateral compartments, which is indicative

Figure 1. The body chart patient filled out at first physical therapy visit.

of CECS.[5] Surgical consultation was then pursued and the patient received full-length fasciotomies over both anterolateral compartments of the lower legs.

Diagnosis

In October 2015, three weeks after the bilateral anterolateral compartment fasciotomies, the patient was referred again to outpatient PT and was evaluated by the Fellow-in-Training (FiT). Figure 1 illustrates the region of complaints for the patient during her initial PT evaluation. The patient yielded a score of 67% on the Foot Ankle Ability Measure (FAAM) Activities of Daily Living (ADL), and 21% on the sports section.[6] Aforementioned patient history was clarified during the subjective examination, and summarized in Figure 2.

During the initial PT sessions, the patient reported numbness and tingling in the first and second toes of the right foot. Numbness in her toes was reproducible while driving, riding stationary bike and walking. Additionally,

Figure 2. Timeline of patient's episodes of care.

Table 1. Differential diagnosis.

	Lumbar derangement	Tarsal tunnel syndrome	Double crush nerve injury
Description	<ul style="list-style-type: none"> Derangement is classification used for Mechanical Diagnosis and Therapy when a patient's symptoms have a rapid response to repeated movements and/or changes in postures. 	<ul style="list-style-type: none"> Symptoms of tarsal tunnel syndrome can affect either the lateral plantar nerve or the MPN. 	<ul style="list-style-type: none"> Double crush can occur when the nerve is entrapped or injured both proximally and distally.
Subjective	<ul style="list-style-type: none"> Patient reported symptoms when driving. 	<ul style="list-style-type: none"> Report of numbness with running shoes. No numbness with sandals. Numbness produced with exertion. 	<ul style="list-style-type: none"> Symptoms reproduced while driving and with exertional activities such as walking and riding bike.
Objective	<ul style="list-style-type: none"> + Slump Test + SLR No effect with repeated motions. Change in lumbar posture abolished symptoms. Numbness in toes produced with central PA mobilization to L2 and L5. 	<ul style="list-style-type: none"> + External compression test + Tinel's sign 	<ul style="list-style-type: none"> Symptoms produced proximally with lumbar assessment. Symptoms produced distally with assessment of tarsal tunnel.
Clinical Interpretation	<ul style="list-style-type: none"> Cannot rule out lumbar spine as potential cause of symptoms. 	<ul style="list-style-type: none"> Diagnostic utility of tarsal tunnel syndrome is limited. 	<ul style="list-style-type: none"> Positive testing both proximally and distally could indicate double crush of the nerve. She also had positive neurodynamic test with sciatic nerve bias on the right.

Note: SLR: Straight leg raise. MPN: medial planter nerve. PA: posterior anterior.

when she wore her running shoes, she would experience intermittent numbness in toes, but never when she wore her sandals. Since the surgery, she had not experienced any cramping in her legs.

She reported 3 out of 10 pain with ambulation due to post-operative soreness, and discontinued use of crutches a week after surgery. Her occupation required bouts of sitting for prolonged periods, with no other physical demands other than occasional standing and walking. The patient's primary goal for PT was to return to running and resolve all symptoms.

Examination revealed increased sensitivity to light touch at distal anterolateral aspect of tibia near incisions bilaterally. Dorsiflexion, eversion and inversion passive ROM was 10°, 5° and 10°, respectively, and bilaterally. Manual muscle testing of hip, knee and ankle yielded scores of four out of five in all planes of motion. Trace swelling was present in the anterolateral compartments of lower legs. There appeared to be no asymmetry in ROM or strength. Patient's gait was normal. Patient had a positive Tinel's test just posterior and inferior to the right medial malleolus.[7] Tingling in toes was also produced when external pressure was applied to tarsal tunnel by therapist.[8]

Figure 3. Sensory distribution of the medial plantar nerve highlighted in dark grey.

At this point of the examination, the FIT's suspicion of tarsal tunnel syndrome was increased (Table 1).[9] The patient's primary complaint since surgery and even since she had PAE, had been numbness and tingling in her first and second toes. Tarsal tunnel syndrome affecting the medial plantar nerve (MPN) could explain the symptoms in her toes (Figure 3). The reproduction of numbness into the first and second toes of her right foot with external compression to the tarsal tunnel and Tinel's sign gave support to this diagnosis.

While the patient was sitting on the plinth table with her feet dangling, she reported symptoms into her toes. Observation of her posture demonstrated a flexed lumbar spine and lack of lordosis. When she was cued to tilt her pelvis anteriorly and extend her low back, the symptoms were abolished. Patient denied history of low back pain or radiculopathy. Further examination revealed a positive right straight leg raise with sciatic nerve bias while the left straight leg raise was negative.[10] Lumbar ROM was within normal limits in all planes. Prior to repeated motions testing in standing there were no symptoms in her toes.[11] Repeated motion testing had no effect on the patient's symptoms, however she reported having no symptoms in toes prior to and during the testing. Grade IV PA mobilizations of lumbar vertebrae two and five increased numbness in first and second toes of right foot.

Based on the patient's location of symptoms and relationship of the numbness in toes with sustained postures of the lumbar spine and lumbar derangement, a classification of the Mechanical Diagnosis and Therapy system developed by McKenzie, was added to the differential diagnoses (Table 1).[11–13] Given the long-standing history of numbness in toes, consideration was also given to a double-crush nerve injury. This was included in the differential diagnosis as the patient's numbness in toes was reproduced proximally in the lumbar spine and distally in the tarsal tunnel (Table 1).

Once symptoms were reproduced in patient's toes, repeated prone press-ups with posterior anterior (PA) pressure to fifth lumbar vertebrae abolished numbness in her toes. She was given repeated prone press ups for home exercise programme to be performed every time symptoms were present and 10 times every waking hour. She was educated on proper posture and how to use a lumbar roll when driving and at work.

The patient continued to perform exercises focusing on postural education, repeated lumbar extension, hip and ankle strengthening and flexibility exercises throughout the plan of care. By the 10th PT visit, the patient reported tingling in her toes had not been present for the last week. She was able to increase volume of walking and running without complication. She was able to return to a sustained lumbar flexed position without reproduction of numbness and tingling in toes. Scores on the FAAM ADL improved to 94%. Scores on the FAAM sports scale improved to 83% (Table 2). Since the patient

Table 2. Measures throughout plan of care.

	Prior to fasciotomies (from surgeon's note)	PT evaluation	PT discharge (visit # 11)	A month from PT Discharge
AROMPROM	• WNL	<ul style="list-style-type: none"> • Ankle PROM: <ul style="list-style-type: none"> ◦ Dorsiflexion 10° ◦ Inversion 5° ◦ Eversion 10° • Ankle AROM: <ul style="list-style-type: none"> ◦ Dorsiflexion 10° ◦ Inversion 5° ◦ Eversion 10° • Lumbar AROM: WNL • Lumbar repeated motions in all planes: No effect • Posture correction (Starting position: lumbar flexed End position: lumbar extended into more lordosis) abolished numbness in toes 	• WNL	• NA
MMT	• 5/5 LE	• 4/5 LE	• WNL	• NA
Pulses	• Normal	• Normal	• Normal	• NA
Swelling	• None	• Trace	• None	• NA
Accessory motion	NA	• Central PA mobilization to L2 and L5 reproduced tingling in toes	• Not assessed.	• NA
Special Tests	<ul style="list-style-type: none"> • Tender to palpation along anterolateral compartment • Pressure testing post 1-min exercise > 30 mmHG bilaterally • Right anterior compartment: 36 mmHG • Right lateral compartment: 54 mmHg • Left anterior compartment: 31 mm Hg • Left lateral compartment: 45 mm Hg 	<ul style="list-style-type: none"> • + External compression test • + Tinel's sign • + Slump Test • + Right SLR 	• No symptoms reproduced in slumped position	• NA
Patient reported limitations	<ul style="list-style-type: none"> • Numbness in toes. • Cramping with running <5 min 	Numbness in toes with <ul style="list-style-type: none"> • Driving • Walking 	Patient able to progress volume of walking and elliptical to 20 min without issue.	Patient able to ride elliptical for 45 min without issue.
FAAM ADL	• NA	• 67%	• 94%	• 96%
FAAM Sport	• NA	• 21%	• 83%	• 94%

Notes: AROM: active range of motion. PROM: passive range of motion. MMT: manual muscle testing. FAAM ADL: Foot and Ankle Ability Measure Activities of Daily Living. FAAM Sport: Foot and Ankle Ability Measure Sport. WNL: within normal limits. LE: lower extremity. NA: not applicable. PA: posterior anterior.

was satisfied with outcome and changing insurance plans, this was the last visit. She was discharged with no tingling in toes.

A month after discharge the patient reported she had been able to ride an elliptical for 45 min without any cramping in anterolateral right leg or numbness in toes. Before surgery she could only ride for two minutes before experiencing cramping. She occasionally had symptoms in the toes of her right foot, but was able to resolve these symptoms instantly with extension-based movements. On the FAAM ADL subscale, the patient improved to 96% a month from discharge. On the FAAM Sport subscale, patient improved to 94% a month from discharge (Table 2).

Discussion

The patient was referred to PT following a recalcitrant diagnosis of CECS and subsequent bilateral anterolateral compartment release. After surgery, the cramping in the anterolateral lower legs with running was resolved. However, the remaining tingling and numbness in the

plantar surfaces of the patient's first and second toes of her right foot suggested exploration of alternative pathology.

CECS is usually caused by poor tissue oxygenation due to decreased venous return.[14] Cramping usually occurs when blood flow to the muscle doesn't meet the demand of the required activity.[14] Common symptoms of CECS are numbness, tingling and weakness affecting the nerves of that compartment. Affected compartments may have increased tension and be tender to palpation. [14] Overall surgical management appears to be superior to conservative management.[4] Few studies have demonstrated the effectiveness of conservative management for CECS as most patients experience pain relief, and high satisfaction after surgery.[4,14–16]

The FiT further explored the patient's complaint of numbness and tingling in her first and second toes because it would unlikely be changed by an anterolateral compartment surgical release.[17–19] The patient's symptoms in the first and second toes were associated with the posterior compartment of the lower leg, which is innervated by the tibial nerve.[20]

The FiT initially had tarsal tunnel syndrome high on his working differential diagnoses list. The patient's symptoms of numbness and tingling on the plantar surface of the first and second toes suggested tarsal tunnel syndrome affecting the MPN.[9,21–23] Refer to Figure 3 for sensory distribution of MPN highlighted in dark grey. She had a positive Tinel's test and reproduction of symptoms with external compression of the tarsal tunnel. She also reported having symptoms when wearing running shoes, a higher profile shoe potentially causing pressure on the tarsal tunnel, and no symptoms when wearing sandals. Although medial plantar neuropathy (MPN) could explain some of the symptoms experienced by the patient in this case, the diagnosis seemed unlikely due to the low prevalence rate of MPN.[24] Also, the diagnostic utility of Tinel's sign and compression of tarsal tunnel to shift post-test probability of entrapment being present is poor.[7]

Before diagnosing a patient with an isolated peripheral nerve entrapment, the lumbar spine should be evaluated.[25] The lumbar spine can refer symptoms to the lower extremities and should be ruled out as the source of the patient's complaint whenever neurovascular symptoms such as numbness and tingling are present. In the subjective examination, the patient reported increased symptoms in toes when driving and sitting, which would be uncharacteristic of symptoms related to CECS or even post-operative soreness. The FiT's discovery of the relationship of the lumbar spine with the tingling in the toes addressed one of the patient's primary concerns that was not resolved from the surgery.

It was important to understand the patient's numbness and tingling as it developed two years ago. The osteochondroma that developed on the posterior tibial metaphysis could have caused a neuropraxic injury to the tibial nerve causing her concordant symptoms in toes. Additionally, her work and lifestyle consisted of sitting approximately 40 h per week with a flexed lumbar spine. This theoretically could have caused more stress on the nerve root and produce symptoms associated with a double-crush injury.[26,27]

Conclusion

Post-operative rehabilitation for anterolateral compartment fasciotomies is guided by tissue healing times and physical impairments present.[28,29] However, this unique case highlights several important lessons for clinicians following surgical procedures and chronic complaints. First, it is important for a thorough proximal to distal examination to be performed on all patients with potential neurovascular symptoms in the foot. Secondly, knowledge of the distribution of the nerves in the lower legs can assist a clinician in making an accurate diagnosis. This case could be challenging for many physical therapists, because it's not a typical post-operative case

focusing on the primary impairments of decreased ROM, strength and return of function. The FiT had to generate a comprehensive list of differential diagnoses and critically evaluate the potential relationship to the patient's primary symptoms. The first physical therapist the patient saw after symptoms of PAE resolved did not evaluate the lumbar spine's relationship to her symptoms. The patient in this case considered the surgery a partial failure since the symptoms in the toes had not resolved. The FiT was the only provider to evaluate the lumbar spine in regards to her toes tingling.

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Conflict of interests statement

Authors have no conflicts of interest relevant to this Fellow's Case Problem. Verbal and written consent was obtained from patient.

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