Imaging in conjunction with physical therapy in management of a patient with history of thoracic tumour

Daniel G. Rendeiro^{*1}, Gail D. Deyle², William G. Boissonnault³

¹US Army Warrior Transition Unit, Fort Hood, TX, USA, ²Army-Baylor Doctoral Fellowship in Orthopaedic Manual Physical Therapy, Fort Sam Houston, TX, USA, ³University of Wisconsin-Madison, Madison, WI, USA

Background: Physical therapy care for musculoskeletal conditions includes an ongoing process that systematically considers and prioritises diagnostic hypotheses. These diagnostic hypotheses include those that are typical for common musculoskeletal conditions, and must also include more rare conditions that would require care outside the scope of practice of the physical therapist. When additional screening is required, physical therapists collaborate with other providers or directly order the appropriate tests to rule out suspected pathology.

Case Description: This article illustrates the use of musculoskeletal imaging ordered by a physical therapist to guide ongoing management of a patient with back pain and a history of cancer.

Outcomes: The patient successfully returned to moderate-intensity sport activities after a course of physical therapy.

Discussion: This case provides an example of how clinical diagnostic reasoning combined with clinical privileges to order musculoskeletal imaging can facilitate diagnostic accuracy in a timely and cost-efficient manner.

Keywords: Musculoskeletal imaging, Thoracic spine, Meningioma, Schwannoma, Neurofibromatosis, Diagnosis

Background

As documented by the Guide to Physical Therapist Practice,¹ years of professional development have resulted in physical therapists displaying a carefully defined, expanded diagnostic role in directing the management of musculoskeletal conditions.²⁻⁶ Physical therapists in many settings practice without the capacity to order tests that would allow them to screen the musculoskeletal system. However, physical therapists in the United States Military Health System (MHS) are formally credentialed with clinical privileges to order musculoskeletal imaging and common laboratory tests. The diagnostic success and cost-efficiency of this practice is well documented.⁷⁻⁹ Rhon *et al.*¹⁰ and others¹¹⁻¹⁴ have detailed patient examples from deployed and medical centre-based MHS settings of how physical therapists use these clinical privileges for clinical efficiency and diagnostic accuracy. The purpose of this article is to describe the clinical diagnostic reasoning and use of musculoskeletal imaging by a physical therapist

as part of the physical therapy management of a patient with a history of neurofibromatosis.

Patient Characteristics

The patient was a 31-year-old US Army dentist with a primary medical diagnosis of neurofibromatosis type II. The patient was very active, competing in downhill and stunt skiing to age 20. More recently his activities included rock climbing, triathlon events, mountain biking, weightlifting, crossfit, golf and yoga. He denied any history of tobacco or alcohol use. His prior competitive skiing resulted in multiple pelvic fractures, a vertebral body compression fracture of the fourth thoracic vertebra and a left shoulder dislocation with a labral tear treated with an open repair. While performing a 100-lb military press at age 29, he felt a 'pop' and pain (that became chronic) in his mid- and upper back. No specific diagnosis emerged from the military and civilian healthcare providers he attended immediately afterwards.

Shortly, after his 30th birthday, he experienced an episode of flu-like symptoms, lightheadedness, and sinus pressure over several months, followed by progressively worsening mid-back pain. Several months later, he fell face-first in a wakeboarding accident,

Correspondence to: Daniel G. Rendeiro, US Army Warrior Transition Unit, 36046 Wratten Road, Fort Hood, TX 76544, USA. Email: Ldrendeiro@vwm.com

with subsequent persistent tinnitus, hearing loss, and a fullness sensation in his left-sided lymph nodes and left ear. A screening MRI after 4 months revealed schwannomas in his left acoustic nerve (2.4×3 mm), left brachial plexus (13×7.6 mm) and left vagus nerve (11.8×17.2 mm); and an intradural extramedullary meningioma (9.4×9.4 mm) at the second thoracic vertebral level. The thoracic meningioma was resected 2 months later, and the acoustic nerve schwannoma as well as the patient's left inner ear and mastoid process were resected the following month. Graft tissue for the left posterolateral skull had been obtained from the patient's left lower abdomen. His medications included amitriptyline, gabapentin and flexeril.

At his point of entry to the physical therapy clinic 8 months following his acoustic tumour resection, the patient had sustained an abundance of imaging, and had a history of known pathology in his cervical and upper thoracic regions. However, pathology responsible for the symptoms for which he was seeking physical therapy care had not conclusively been revealed.

Examination: chief presenting complaint

The patient identified several areas of chronic pain via an interview and completion of a pain map (Fig. 1). He noted pain from the mid-to-upper thoracic spine to approximately the T8 or T9 level, as well as along the left more than right medial scapular borders and latissimus dorsi muscle bellies, both pectoralis minor muscles and lateral shoulders. He described persistent overall body tightness that was transiently relieved during the fully warmed-up period of an exercise bout, but quickly returned following the exercise session. His thoracic pain varied between 3 and 5/10 at baseline, and was aggravated to the level of 7/10 on a numeric pain rating scale, by taking a deep breath. He reported that since the surgeries for tumour resection, he had lost 35 lb and his energy level was low. These symptoms had been stable over the previous few months.

Examination: posture; active range of motion; strength

The patient was a very fit-appearing, lean but muscular individual, and had no observable gait deviation. His upper torso was shifted laterally to the right slightly from his waist in relaxed standing, and his head was slightly forward. A deep breath aggravated thoracic pain. He displayed average combined hip and torso flexibility; his sit-and-reach flexibility test was 16", limited more by stiffness than pain, which indicated that he had relatively average (70th percentile) flexibility on that specific test.¹⁵ He held a straight baton across his posterior neck and shoulders with difficulty secondary to bilateral shoulder stiffness.

The patient's bilateral shoulder motion was stiff but painless through the available range, with elevation to 120° with scapular winging; external rotation to 40°; and internal rotation/hand behind back to thumb at T8. Shoulder motion could not be passively progressed further due to combined bilateral stiffness and pain. Multisegment thoracolumbar flexion, extension, rotation and sidebending were stiff, especially in the mid- and upper thorax, with aggravation of his pain at end ranges of bilateral rotation. Strength testing of bilateral shoulders and elbows was normal (5/5) and painless. Grip dynamometry testing yielded 102 and 91 lb for the right and left sides, respectively (lower than expected) and was painless.

Examination: palpation and joint play assessment

The patient exhibited passive segmental joint stiffness at all lower cervical and thoracic levels. Passive glenohumeral accessory glides were slightly stiff and painless in all directions bilaterally. Palpation-provoked local upper quarter pain was generally consistent with the patient's self-drawn pain map, although it was minimal on his right side and more pronounced on his left side. His thoracic spine was tender from T1 to the level of T4, as well as at T8 and T9. He also exhibited marked tenderness in his left lower trapezius and subscapular soft tissue, as well as rib angles at the level of T5, T6 and T7 on the left.

Examination: neurological Screen

The patient's upper extremity muscle stretch reflexes were of average briskness (2+), and his myotomes were intact. He had normal sensitivity to light touch in all areas except his bilateral thumbs and fifth digit sides of the hands, which displayed mild paraesthesia without pain. He reported a previous diagnosis of bilateral Guyon's tunnel syndrome in the past year.

Clinical Impression

The patient's overall history and clinical presentation were consistent with multisegmental upper- and mid-thoracic spinal dysfunction as well as bilateral shoulder internal derangement. Previous imaging findings documented structural changes in these areas – upper thoracic scoliosis and degenerative disc changes; an upper thoracic tumour; and bilateral shoulder labral and rotator cuff mild-to-moderate pathology. His history of an overhead lifting injury would have stressed the musculoskeletal system in all these areas. This pattern supported the idea that his impairments, symptoms and functional ability might improve with a course of physical therapy. Given the patient's known history of schwannoma and meningioma, the physical therapist remained alert to the possibility that some or all of the patient's symptoms were generated by yet-

Figure 1 Baseline patient pain map. Patient-reported significant pain locations.

to-be-discovered pathology. The patient's report of significant weight loss coincided with a reduction in strength training and concomitant reduction in caloric intake; his weight was stable over the previous few months. Had his weight loss been unstable/unexplained, it would have constituted a red flag to physical therapy intervention.¹⁶ The physical therapist decided to initiate treatment, but also to order additional imaging consisting of current plain radiographs of the thoracic spine detailing the symptomatic area on the radiographic request. These were interpreted by the radiologist to reflect degenerative structural changes in the region, but were otherwise normal. The physical therapist then confirmed with the radiologist that the more sensitive test for detecting pathology in this patient's case would be MRI with contrast.^{17–19} The subsequent MRI revealed a previously undetected extramedullary, intradural mass (which was later characterised as a meningioma that warranted monitoring but not resection) at the level of T9 (Figs. 2 and 3). The MRI findings allowed the physical therapist to continue treatment while facilitating appropriate caution to avoid excessive exercise or manual forces that could

cause injury to any musculoskeletal tissues weakened by the tumour. The MRI also served as a patient education tool for selecting fitness activities.

Intervention

The physical therapist chose interventions that targeted the patient's prioritised, identified impairments in accordance with the principles of evidence-based practice.²⁰ The interventions were progressed in vigour as the patient reported lower pain levels; further, interventions were progressed from more passive, to more active through the course of treatment.

Because the patient presented with multiple impairments across several body regions, the physical therapist was able to focus direct mechanical interventions such as thrust and non-thrust manipulation away from the mid-to-lower thoracic spine until that area could be cleared with appropriate imaging and medical follow-up. It was then confirmed that although that area harboured a previously unidentified tumour, it was not malignant and so did not warrant a reduction in normal movement through that part of the body. Thrust joint manipulation was not applied directly to the lower

Figure 2 T1-weighted sagittal magnetic resonance image with gadolinium contrast. White arrow points to extramedullary, intradural meningioma at ninth thoracic level.

Figure 3 T1-weighted axial magnetic resonance image with gadolinium contrast. White arrow points to extramedullary, intradural meningioma at ninth thoracic level.

thoracic region, but this was because by the time that area was fully medically characterised, the patient had progressed to primarily active, guided exercise. The patient underwent 3 months of a guided home exercise programme, 10 sessions of joint manipulation and mobilisation and postural correction exercise targeted at his shoulders and upper- and mid-thoracic spine and four sessions of trigger point dry needling to the thoracic erector spinae, bilateral latissimus dorsi and left lower trapezius muscles. High-quality studies have not been published that demonstrate the value of dry needling for musculoskeletal pain, but this

intervention has been shown to have low risk and to benefit at least some patients.²¹ In this case, the patient presented with focal pain areas and he was amenable to the dry needling intervention concurrently with other interventions. After four sessions, the dry needling was discontinued due to a lack of perceived benefit.

Outcomes

The patient demonstrated some improvement in his ability to move with less thoracic pain than before physical therapy intervention. Bilateral shoulder elevation had improved to 175° without pain. Torso rotation to either side generated pain at the intensity of 4/10 in his thorax from approximately T7 down to the thoracolumbar junction. Active scapular retraction generated transient ‘electrical burn’ pain in his interscapular region. He was able to draw a deep breath without exacerbation of his baseline thoracic pain. Functionally, he returned to moderately vigorous road bicycling, yoga, weightlifting and golf among other fitness conditioning activities. However, his global rating of change (GROC) score was plus-1 (a tiny bit better). This level of improvement does not represent a minimal clinically important difference (MCID) for this instrument.²² Further, he returned to 4-hour workdays as a dentist, but reported increased mid-back pain at the end of each shift. Overall, he reported approximately the same levels of pain although he had significantly increased his work, leisure and fitness conditioning activities compared to their intensity and duration levels at the start of physical therapy care.

Discussion

Aboukais *et al.*²³ summarise the uncertainty clinicians face in managing patients with neurofibromatosis type II. ‘Although spinal tumours are frequent [in this population], many issues concerning their prognosis and management still have to be clarified’. Meningiomas, in general, are most frequently well-circumscribed and slow-growing; they account for almost half of spinal neoplasms, and usually occur in the thoracic spine.²⁴ The patient in this case had two spinal meningiomas; among patients with neurofibromatosis type 2, spinal meningiomas indicate a poorer prognosis.²³ Physical therapists have been shown to appropriately use imaging and have reduced the use of imaging in the healthcare system.⁶ This case highlights several factors germane to the role of diagnostic imaging as a component of musculoskeletal care. The patient had already undergone prior imaging of some of his symptomatic areas. However, over time, other areas of dysfunction and pain – in this case the mid-to-lower thoracic spine – emerged as significant for the patient. The history of schwannoma and neuroma, the patient’s medical diagnosis of neurofibromatosis type II, and his report of recent-onset symptoms in other areas mandated further

consideration of those areas in a comprehensive way by the physical therapist. There were no indications to terminate treatment, so the physical therapy plan of care could continue as this process moved forward.¹⁶

Second, the regional specificity of imaging was important. The patient's surgeon had scheduled imaging (MRI) of the neck to assess the status of known tumours in the vagus nerve and brachial plexus. However, the patient had pain and dysfunction in his mid-thoracic torso, so further imaging was necessary to include that region.

Third, the physical therapist consulted other members of the healthcare team. In this case, the physical therapist consulted with a radiologist to confirm the most appropriate diagnostic screening study given the patient's known medical diagnosis. The radiologist confirmed that MRI with contrast would be the most appropriate test.¹⁷⁻¹⁹

The knowledge obtained from the diagnostic imaging and additional medical follow-up it generated in this case, resulted in a higher level of confidence that physical therapy interventions were not increasing the risk of harm in someone whose medical diagnosis placed him at greater risk of harm.²³

Orthopaedic physical therapists have high levels of musculoskeletal expertise^{7,8} and extensive knowledge of typical patterns and behaviours of musculoskeletal conditions. These competencies and experiential knowledge enable them to appropriately recognise situations requiring additional diagnostic screening for non-musculoskeletal pathology.¹⁶ This case demonstrates how privileges to order musculoskeletal imaging studies assisted the physical therapist in providing optimal, patient-centred care. The physical therapist in this case was able to continue treatment without multiple referrals back to the medical provider to obtain imaging, and so provided more cost-efficient and convenient care. Efforts to expand the scope of practice for appropriately trained physical therapists to include such privileges will require promulgating the ways in which it offers both improved and more cost-effective healthcare.

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