Case Report

Differential Diagnosis and Treatment in a Patient With Posterior Upper Thoracic Pain

Background and Purpose. Determining the source of a patient's pain in the upper thoracic region can be difficult. Costovertebral (CV) and costotransverse (CT) joint hypomobility and active trigger points (TrPs) are possible sources of upper thoracic pain. This case report describes the clinical decision-making process for a patient with posterior upper thoracic pain. **Case Description.** The patient had a 4-month history of pain; limited cervical, trunk, and shoulder active range of motion; limited and painful mobility of the right CV/CT joints of ribs 3 through 6; and periscapular TrPs. Interventions included CV/CT joint mobilizations, TrP release, and flexibility and postural exercises. **Outcomes.** The patient reported intermittent mild discomfort after 7 physical therapy sessions. Examination findings were normal, and he was able to resume all preinjury activities. **Discussion.** This case suggests that CV/CT mobilizations and active TrP release may have been beneficial in reducing pain and restoring function in this patient. [Fruth SJ. Differential diagnosis and treatment in a patient with posterior upper thoracic pain. *Phys Ther.* 2006;86:254–268.]

Key Words: *Clinical decision making, Costovertebral and costotransverse joints, Differential diagnosis, Joint mobilization, Manual therapy, Rib, Trigger point, Upper thoracic pain.*

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Patients often come to physical therapists with little diagnostic information. They may be referred by a physician with a description of symptoms (such as "knee pain" or "low back pain") rather than a medical diagnosis, or, in states with direct access, they may come to physical therapists without prior medical evaluations. Physical therapists need to conduct a thorough examination and evaluation to formulate the most probable hypotheses related to a patient's symptoms so that appropriate interventions can be provided.

Although literature on dysfunction and pain in the lumbar and cervical regions is abundant, similar information related to the thoracic region remains relatively scarce.[1–3] Similarly, a great deal of literature exists on shoulder pain, yet little exists in the area of periscapular or rib pain.

This case report involves a patient referred for physical therapy by his primary care physician with the diagnosis of "(R) [right] upper back pain." Given the anatomical complexity of the thoracic and shoulder areas, the potential sources of pain in this region are numerous.[1,4] Possible musculoskeletal sources of thoracic pain include muscle strain, vertebral or rib fracture, zygapophyseal joint arthropathy, active trigger points (TrPs), spinal stenosis, costovertebral (CV) and costotransverse (CT) joint dysfunction, ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, intervertebral disk herniation, intercostal neuralgia, and T4 syndrome.[4–7] Pain also can be referred to the thoracic region from visceral sources, which may indicate serious disease. Cancer, cardiac, pulmonary, gall bladder, hepatobiliary, renal, and gastroesophageal conditions are all potential causes of referred thoracic or scapular pain.[4,8–10]

The purposes of this case report are: (1) to outline the differential diagnosis and clinical decision-making process that was used based on history, patient presentation, and examination findings and (2) to describe the rationale for intervention and intervention techniques chosen in the management of this patient.

This case report describes the clinical decision-making process, interventions, and outcomes for a patient with a 4-month history of posterior upper thoracic pain.

Case Description

Patient History and Demographics

The patient was a 35-year-old man (185.5 cm, 93.4 kg) employed as a youth minister, with an unremarkable past medical history except for a hernia repair as an infant and an appendectomy at the age of 10 years. He was the father of 4 young children and led a fairly active lifestyle. He participated in recreational basketball and softball and took part in his children's activities of soccer, ice hockey, and baseball. He said he had no previous injury or pain in the upper back or shoulder areas. His current medications included a muscle relaxant (cyclobenzaprine HCl, 10 mg, 3 times daily) and an anti-inflammatory agent (naproxen, 375 mg, 3 times daily), both of which he was taking as directed by his primary care physician.

The patient interview revealed that his upper thoracic pain began 4 months prior to the examination after sitting on bleachers for 3 hours at an ice hockey game. He reported no pain during the game or the rest of the day, but noticed stiffness in both shoulders the following day. The right upper thoracic pain began 2 days after the game, localized between the scapula and spine. The pain became progressively worse over the next 6 weeks before he made an appointment with his primary care physician, who prescribed cyclobenzaprine HCl and naproxen, as well as physical therapy.

Two months after the onset of pain, the patient underwent 3 weeks of physical therapy at another facility that included exercise, modalities, thoracic spine mobilizations, and massage. Although he reported temporary pain relief after each session, the pain soon returned to its initial level. After this initial course of physical therapy, the patient returned to his primary care physician who then increased the dosage of cyclobenzaprine HCl (20 mg, 3 times daily), ordered plain film radiographs of the thoracic and cervical spines and right shoulder, and referred the patient to our clinic for a second attempt

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at physical therapy. The radiographic examination revealed no fracture or degenerative changes.

I first saw this patient approximately 4 months after his onset of pain. His chief complaint was worsening posterior upper thoracic pain on the right side that occasionally "spread" to the front of the chest, especially with deep breathing, coughing, and sneezing. The patient described his pain at rest as a constant, deep ache with an occasional burning sensation between the scapula and the spine, as well as a knotted feeling under the scapula. He rated the pain as 7.5/10 on an 11-point (0–10) visual analog scale (VAS). The pain became sharp and stabbing and increased to 9/10 with quick trunk or upper-extremity (UE) movements, deep breathing, coughing or sneezing, and changing positions in bed. The patient said he did not have night sweats, fever, chills, radicular pain or paresthesia into the right UE, or headaches. He did report an increasing level of fatigue, but attributed this to the stress of constant pain and lack of sleep.

Table 1 provides information regarding the patient's initial ability ratings on a functional shoulder questionnaire. This functional rating system was created by physical therapists within our clinic based on their experience and opinions about common functional activities that require use of the UEs. The scale has not been evaluated for reliability or validity. In addition to the items on this scale, the patient was concerned about his inability to play with his children and participate in their activities, increasing irritability at home because of the pain, and difficulty concentrating on his responsibilities at work. The patient's goals included: (1) decreased daily pain, (2) improved ability to play with his children, (3) return to recreational softball, and (4) improved ability to sleep at night.

Table 1.
Comparison of Patient's Initial and Final Functional Shoulder Questionnaire Ratings[a]

Functional Activity	Initial Patient Rating	Final Patient Rating
Reach behind your back to tuck in your shirt	2	4
Fasten your bra (females)	NA	NA
Wash under the opposite arm	2	4
Feed yourself with a fork or spoon	4	4
Comb or style hair	3	4
Use your hand with your arm at shoulder level	1	4
Dress yourself	2	4
Carry 4.5–6.8 kg (10–15 lb) with your affected arm at your side	3	4
Sleep	0	3
Pull with your affected arm	2	4
Use your affected arm overhead	1	4
Throw a ball underhand with the affected arm	4	4
Throw a ball overhand with the affected arm	2	4
Lift 0.45 kg (1 lb) (can of vegetables) to shoulder level	2	4
Lift 3.6 kg (8 lb) (gallon of milk) to shoulder level with elbow straight	1	4
Perform child care	1	4
Reach the middle shelf of a cupboard	3	4
Perform normal work duties	3	4
Perform normal sport	0	4
Total functional score	36/72	71/72

[a] Scoring key: 4=normal function, 3=a little difficult, 2=moderately difficult, 1=extremely difficult, 0=unable to do, NA=does not apply/does not normally do this.

Examination

Table 2[6,11–20] outlines the examination scheme and findings from the initial examination. I made all observations and assessments.

Posture/observation. The patient was observed in relaxed stance from the posterior, lateral, and anterior aspects with his shirt removed. Deviations from an ideal posture, as described by Kendall et al,[11] were noted. The reliability of visual observation of posture has not been reported.

Range of motion. Active range of motion (AROM) of the cervical, shoulder, and trunk regions was assessed to determine pain-provoking movements. I chose to estimate AROM visually instead of measuring with a goniometer or inclinometer because, at the time of the examination, I was more interested in determining *which* motions provoked pain than *how much* motion was available at each joint. Cervical and trunk AROM were estimated based on comparisons of pain-free motion in the opposite direction (if present) or an estimated range of normal.[12] It is acknowledged that visual estimation of AROM for the cervical and trunk regions has no known reliability.[13] Right shoulder AROM was estimated by visually comparing with the patient's left shoulder, which was normal and pain-free. This method has been shown to yield fair to good estimates of reliability for the shoulder joint.[14,15]

Strength. Manual muscle testing (MMT), as described by Hislop and Montgomery,[16] was used to assess the patient's UE strength (force-generating capacity of muscle), modified with the patient in a sitting position to avoid multiple position changes. If the patient was unable to hold a position against resistance because of pain, strength was not graded.[16(p8)] When resistance did elicit pain, the patient was asked to describe the location and intensity of pain. Because the standard testing positions were altered, reliability of this strength assessment cannot be assumed.

Table 2.
Findings During Initial and Final Patient Examinations[a]

Examination Item	Findings at Initial Examination	Findings at Final Examination	Method
Posture/observation	Forward head, chin moderately protracted R shoulder elevated, scapula retracted Moderate thoracic kyphosis; normal to flat lumbar spine Slight rotation of upper trunk to R	Forward head, chin moderately protracted R shoulder slightly lower than L Moderate thoracic kyphosis; normal to flat lumbar spine No trunk rotation	As described by Kendall et al,[11] patient standing
AROM			
Cervical	Extension, R SB, bilat rot: ~75% of normal (slightly painful) Flexion, L SB: normal; tightness bilat upper thoracic area (R > L)	All motion normal, symmetrical, pain-free	Visual observation; patient seated[12,13]
Trunk	Flexion: ~60% of normal (tightness, pain at upper thoracic area) R SB: ~25% of normal (sharp pain upper thoracic area) Extension, L SB, bilat rot: ~75% of normal (moderate pain upper thoracic area)	All motion normal, symmetrical, pain-free	Visual observation; patient standing[12,13]
Shoulder	Flexion, abduction: ~75% of normal (moderate upper thoracic pain) IR (hand behind back): thumb to level of lumbosacral junction (moderate upper thoracic pain) ER at 90° of shoulder abduction (supine): ~50% (periscapular pain) Horizontal adduction: ~75% of normal (periscapular tightness) All left shoulder AROM normal and pain-free	All motion normal, equal to L UE, pain-free	Visual observation; patient seated[14,15]
Strength	Resistance applied to shoulder abduction, flexion, extension, ER, and horizontal abduction caused intense pain in the upper thoracic/scapular area; not graded because of pain Shoulder horizontal adduction, internal rotation, elbow and wrist flexion and extension: graded normal and pain-free	All shoulder musculature graded normal, all pain-free upon resistance	As described by Hislop and Montgomery[16] modified with the patient seated to minimize painful position changes
Sensation	No sensation deficits found in C4–T4 dermatomes or cutaneous distribution of the shoulder complex	No sensation deficits noted	Two-fingertip light stroking in a gross dermatomal or cutaneous distribution pattern as outlined by Magee[17(pp48,289)]
Spinal accessory motion	Moderate P/A stiffness and discomfort T2–T6 (moderate pain at T3–T5) No P/A stiffness or pain in lower cervical or lower thoracic regions	Moderate P/A stiffness (T2–T6), pain-free	As described by Maitland,[18(p76)] patient positioned prone
Rib accessory motion			
Posterior (patient positioned prone)	Limited motion found with P/A mobility testing of the R CV and CT joints, ribs 3–6 (intense posterior and moderate anterior pain; not well tolerated) versus the L Normal, pain-free P/A mobility of R CV and CT joints at rib 2 and ribs 7–10 Normal, pain-free P/A mobility of L CV and CT joints at ribs 2–10	Apparent equal mobility of R CV and CT joints (ribs 3–6) versus L Pain-free mobility assessment	As described by Bookhout[6(pp155–158)] and Maitland[19(pp290–291)]
Anterior (patient positioned supine)	Slight stiffness and dull ache with A/P mobility testing of R ribs 3–6 (just lateral to CS joint junctions) as compared with the L No restrictions or pain with bilat assessment of ribs 7–10 (medially directed compression through lateral aspect of the trunk)	Apparent equal, pain-free mobility of R CS junctions (ribs 3–6) versus L	As described by Maitland[19(pp290–292)]

(continued)

Table 2.
continued

Examination Item	Findings at Initial Examination	Findings at Final Examination	Method
Scapular Mobility			
Active	Observation during bilat repeated shoulder flexion and abduction (within patient's available range) suggested limited lateral rotation and scapular elevation on the R	Scapulae appeared symmetrical with active UE motion through full shoulder motion	As described by Hislop and Montgomery[16(pp64–65)]
Passive	Limited mobility on the R, especially in directions of protraction, lateral rotation and depression (patient reported discomfort with these motions)	Slight stiffness with passive mobility on the R versus L (protraction, lateral rotation)	As described by Magee[17(pp232–234)]; patient positioned prone and side lying
Palpation	Tenderness/tension found in the R upper trapezius, levator scapulae, pectoralis minor, and scalene muscles Pain with pressure over rib angles and intercostal spaces at ribs 3–6	Slight tenderness along medial scapular border	As described by Magee[17(pp456–58)]
	Active TrPs located in R rhomboideus and middle trapezius muscles (along the medial scapular border) referring pain to the area between the scapula and spinous processes and along the scapular spine	Slight tenderness over rib angles (ribs 3–5) No active TrPs located	As described Travell and Simons[20(pp59–63)]

[a] R=right, L=left, bilat=bilateral, SB=side bending, rot=rotation, IR=internal rotation, ER=external rotation, CV=costovertebral joint, CT=costotransverse joint, CS=costosternal joint, P/A=posterior to anterior, A/P=anterior to posterior, AROM=active range of motion, TrPs=trigger points.

Sensation. A gross sensory examination using light touch over the UEs and upper thoracic area was performed to determine whether nerve root or peripheral nerve lesions were present.[17(pp289–290)] Reliability of data obtained during sensory testing using this method is not known.

Accessory motion. Accessory motion, or joint play, of the thoracic spine was assessed with the patient in a prone position. Pressure directed from posterior to anterior (P/A), as described by Maitland,[18(p76)] was used to assess joint play from C7 through T12. Accessory motion of the CV and CT joints (ribs 2–10) was assessed in a similar manner, with a P/A force at each rib level, as described by Bookhout[6(pp155–158)] and Maitland.[19(pp290–291)] Although the CV and CT joints are 2 separate articulations, they are often grouped together in the literature (CV/CT) because movement at one joint cannot occur without movement at the other joint.[4,10] Costosternal (CS) joint play was assessed with the patient in a supine position, with pressure directed anterior to posterior (A/P) at each rib level, as described by Maitland.[19(pp290–292)] For each assessment, the presence of pain and relative mobility, as compared with the left side, were noted.

Although assessment of "joint integrity and mobility . . . (and) joint play movements" is part of the physical therapy examination process according to the *Guide to Physical Therapist Practice*,[21(p184)] interrater reliability of data obtained with these techniques, both in the extremities and at various spinal levels, generally has been poor.[22–26] To my knowledge, there are no studies that specifically address passive mobility assessment at the CV, CT, or CS joint. Pain provocation with palpation or mobility testing has been found to yield more reliable scores than accessory motion testing for identifying symptomatic structures, and several authors[23,24,27–29] have suggested that pain provocation may be used as a basis of clinical decision making. Again, the cervical and lumbar spines are the most common areas described when examining the reliability of pain provocation scores, and I am aware of no studies that specifically address the CV, CT, or CS joint.

Scapular mobility. Active and passive scapular mobility were examined because of the patient's lack of shoulder AROM and the proximity of his pain to the scapula. Active mobility and symmetry of scapular motion were observed during repeated bouts of shoulder flexion and abduction within the patient's available AROM.[16(pp64–65),17(pp222–232)] Passive mobility was assessed with the patient in prone and contralateral side-lying positions.[17(pp232–234)] The presence of pain and relative mobility (right versus left) were noted. The reliability of active and passive scapular mobility assessments using these methods has not been reported in the literature.

Palpation. The cervical, shoulder, and upper trunk regions were palpated. When a specific area of soreness or pain was encountered, the patient was asked to describe the pain and whether the pain referred to an area other than that being palpated. I also noted whether the pain was associated with a taut band of muscle or a local twitch response from the patient. Referred pain alone, although possibly useful information, is an indistinct finding.[30,31] However, referred pain in combination with a local twitch response or a jump sign in a palpable taut band is indicative of an active TrP.[20(p2),30–34] There are conflicting findings in the literature regarding the accuracy and reliability of detecting TrPs.[30,34–37] Several researchers[30,36,37] have found the reliability of locating TrPs to be fair to poor, but some authors[34,35] have suggested that specific training in TrP identification seems to improve reliability to at least moderate.

Differential Diagnosis

Table 3[4,5,9,10,13,14,38–46] outlines the clinical decision-making process used with this patient with the focus on differential diagnosis. There were several musculoskeletal and visceral sources I was able to consider "not likely" early in the process, because the patient demonstrated few or none of the expected signs and symptoms. Plain film radiographs were unremarkable, and the patient had no history of trauma, making the likelihood of vertebral or rib fracture low.[47] Because there was no history of trauma, no sensory or motor changes, and no lumbar or abdominal wall pain, I considered intervertebral disk herniation to be of low likelihood.[4,38] The patient did not have any of the typical signs and symptoms of spinal stenosis,[5,41] diffuse idiopathic skeletal hyperostosis,[5] intercostal neuralgia,[9] or T4 syndrome,[42] making the probability of these conditions low. The likelihood of ankylosing spondylitis also was low due to the absence of sacroiliac pain, the presence of normal hip range of motion, and pain that worsened with activity.[48] The patient did not have any common signs and symptoms of cancer or cardiac or renal dysfunction, and these conditions therefore were considered unlikely.

Upon further evaluation, additional sources of pain also were thought to have low likelihood. The patient did report pain in the area of the middle trapezius and rhomboideus muscles and pain that worsened with UE resistance. However, I believed the probability of muscle strain was low because the patient did not report any event that would have caused a strain, and the pain had not responded to rest, medications, or previous treatment.[5,6] Referred pain patterns for the lungs, gall bladder, liver and bile ducts, and esophagus are similar to this patient's presentation. He had no additional signs, however, that would have indicated that these structures were involved, such as substernal pain or changes in pain with eating (esophageal),[45(p349)] coughing or dyspnea (lung),[45(pp314)] or jaundice and nausea/vomiting (gall bladder and liver).[9,45(pp369–396)] In addition, pain intensity was specific to active or passive motion and palpation, which is usually not the case with viscerally referred pain.[4,49]

The remaining possibilities included zygapophyseal joint arthropathy, CV and CT joint dysfunction, and active TrPs. Although the zygapophyseal joints were a possible source of pain, little research exists concerning the pain-generating mechanisms of these structures in the thoracic spine.[46] One study[46] determined that the referral pattern of these joints overlap considerably in the thoracic area, and no referral zone can be attributed solely to one joint. In addition, it is difficult to palpate these joints.[17(p458)] Therefore, these structures remained possible causes of the patient's pain, but I decided to attempt treatment of other probable structures first.

This patient's presentation was very consistent with the following description of CV and CT joint dysfunction given by Scaringe and Ketner:

> Patients with costovertebral (or costotransverse) joint dysfunction will present with localized pain to the posterior thorax that may radiate to the anterior chest or along the associated rib. The symptoms are usually unilateral and painful upon deep inspiration, coughing, or sneezing. Passive or active thoracolumbar flexion, rotation, and/or lateral flexion may increase the symptoms. Palpable tenderness of the involved costotransverse joint and rib angle is noted upon joint challenge. Adjacent thoracic vertebral and rib segments are usually restricted, may complicate the clinical picture, and stimulate or exacerbate protective muscle spasm.[4(p22)]

The facet of ribs 1 through 6 at the CT joint is convex and cylindrical, and the corresponding facet on the transverse process is slightly concave. The facets of ribs 1 through 6 at the CV joint are concave, and the facets on the corresponding vertebrae are slightly convex.[50,51] During normal trunk side bending to the right, the ribs on the right approximate before thoracic motion is complete. This forces the ribs to glide superiorly at the CV and CT joints and rotate slightly anteriorly at the CT joint as the ipsilateral transverse process glides inferiorly.[50,52] Similarly, during normal trunk flexion, the ribs rotate anteriorly at the CT joint and glide superiorly at the CV and CT joints.[50,52] This patient's trunk side bending to the right and forward flexion were limited due to sharp pain in the upper thoracic region. In addition, when assessing P/A accessory motion of individual CV and CT joints in this patient, I found limited joint play and a considerable increase in pain at the level of ribs 3 through 6 on the right as compared with the left. Although no studies have examined the reliability of accessory motion testing at the CV and CT joints, I thought the pain provoked when assessing the mobility of these joints to be important.[23,24,27–29] This guided my

Table 3.
Clinical Decision-Making Process for Differential Diagnosis[a]

Conditions/Diseases Ruled Out Early in the Examination Process	Typical Signs and Symptoms	Diagnostic Tests or Criteria Used to Rule In or Rule out Conditions/Diseases	Decision and Rationale for Ruling In or Ruling Out Conditions/Diseases
Musculoskeletal			
Vertebral or rib fracture	Focal pain in the area of the fracture; usually the result of trauma; *pain on inspiration* (rib fracture); *pain reproduced with movement*; small spinal motions, very painful in all directions (spinal fracture); if not acute, pain will subside at rest; pain usually subsides in 6–12 wk[5,38,39]	Roentgenogram, CT scan, MRI[39]	Low likelihood: no trauma, plain film radiographs unremarkable, pain present 3 mo
Intervertebral disk protrusion or herniation	Very rare in the thoracic spine (usually T9 or lower if thoracic), often the result of axial trauma[39]; often causes lumbar region and abdominal wall pain[40]; nerve root compression may cause paresthesias, weakness, or sensory changes; band-like lower chest wall pain[47]; dermatomal sensory changes possible[5]	MRI, CT scan[39]	Low likelihood: no trauma, no lumbar or abdominal wall pain, no motor or sensory changes, no dermatomal or band-like pain pattern
Spinal stenosis	Rare in the thoracic spine,[41] typically occurs in older individuals, sensory symptoms often present when standing erect or walking, patient prefers flexed position; reflexes often hyperactive due to cord compression from a thickened ligamentum flavum[5]	Roentgenogram, CT scan, MRI[39]	Low likelihood: patient <40 y of age, no sensory symptoms; normal reflexes, no change in symptoms with standing or walking
Diffuse idiopathic skeletal hyperostosis (DISH)	Affects older men (>40 y of age), morning spinal stiffness, spinal tenderness; osteophytes evident on plain film radiograph, trunk flexion limited, loss of normal lumbar lordosis[5,9]	Roentgenogram, CT scan[9,39]	Low likelihood: no morning spinal stiffness, plain film radiographs unremarkable, trunk flexion WNL
Intercostal neuralgia	Often follows injury or thoracic surgery, burning pain and paresthesias in the thorax or abdomen that usually follow the path of the nerve, focal tenderness over affected intercostal area[9]	Clinical findings and patient presentation	Low likelihood: no injury or surgery, pain with ipsilateral side bending, pain sharp and achy
T4 syndrome	Constant or intermittent diffuse bilateral upper thoracic pain, affected spinous processes very tender, bilateral upper extremity paresthesias with glove-like presentation, headache usually present, more prevalent in women than in men by a 4:1 ratio[42]	Clinical findings and patient presentation	Low likelihood: no sensory changes or UE paresthesias, no headache
Ankylosing spondylitis	*Incidence is 3:1 for men to women*, insidious onset, spinal pain and stiffness worse in the morning or after rest, pain decreases with mild activity or exercise, limited spinal and hip motion, limited chest expansion, bilateral pain in sacroiliac/hip joints[5,6]	Laboratory evaluation, roentgenogram, CT scan[39]	Low likelihood: pain worsened with activity or exercise, no sacroiliac or hip pain, pain lateral to the spine
Visceral			
Cancer	Weight loss, pain of unknown origin, increased pain at night, malaise; constant pain not relieved by rest, night sweats, enlarged lymph nodes[43,44]	Radiographic and laboratory evaluations, biopsy[45(pp130–166)]	Low likelihood: no weight loss, no increased pain at night, able to provoke pain with motion or resistance
Cardiac	Substernal pain; shortness of breath; increased pain with exertion; frequent left shoulder, medial arm, and jaw pain[47]	Electrocardiogram, echocardiogram, radionuclide imaging[45(pp241–292)]	Low likelihood: no left-sided pain, no shortness of breath, able to provoke pain with isolated right UE or trunk motions
Renal	Referral pattern is to the ipsilateral subcostal and costovertebral regions at the level of T10–T12, pain is typically dull and aching, may report changes in urinary frequency or output[9,45(pp397–421)]	Laboratory evaluation, ultrasonography, urinalysis, radiologic exam[45(pp397–421)]	Low likelihood: pain present in upper thoracic region, no change in urinary output or frequency

(continued)

Table 3.
continued

Conditions/Diseases Ruled Out after Further Assessment During the Examination	Typical Signs and Symptoms	Diagnostic Tests or Criteria Used to Rule In or Rule out Conditions/Diseases	Decision and Rationale for Ruling In or Ruling Out Conditions/Diseases
Musculoskeletal			
Muscle strain (erector spinae, lower and middle trapezius, rhomboideus, latissimus dorsi, levator scapulae, and intercostal muscles)	Often the result of trauma or heavy exertion, *tenderness through muscle belly, painful resisted motions of specific muscles*, pain usually localized to affected muscle, typically responds to rest, does not typically refer pain[17(pp23–24),39]	Clinical findings and patient presentation	Low likelihood: no trauma, pain not localized, pain occasionally referred to the right shoulder to 1 or 2 muscles, no pain reduction with extended rest
Visceral			
Pulmonary	*Increased pain with deep inspiration or coughing; pain often well localized; pain can refer to anterior, lateral, or posterior chest*; may have persistent cough, dyspnea, and fatigue; deep, often crushing-type pain[45(pp307–341)]	Radiographic examination, spirometry, biopsy, laboratory evaluation[45(pp307–341)]	Low likelihood: no cough, dyspnea, or fatigue; pain sharp and provoked with UE or trunk motions; plain film radiographs unremarkable
Esophageal	Band-like pain around mid-thorax at level of lesion, *referred pain to the mid thoracic area*, symptoms often improved or worsened by eating, nausea/vomiting, weight loss, heartburn or substernal pain, stabbing or burning chest pain[45(pp342–368)]	Esophagoscopy, radionuclide imaging[45(pp342–368)]	Low likelihood: no change in pain with eating; pain not substernal; no nausea, vomiting, or weight loss; no band-like pain
Gall bladder	Pain in the right mid-epigastric region (T8–T9 level); *pain referred to the mid-back between the scapulae, right upper trapezius muscle, and right subscapular area*; jaundice; fever, chills; indigestion; nausea/vomiting; intolerance of fatty foods[9,45(pp369–396)]	Ultrasonography, scintigraphy[45(pp369–396)]	Low likelihood: no fever, chills, jaundice, nausea; no change in pain with ingestion of fatty foods
Hepatobiliary	Pain in right upper quadrant of abdomen; *pain referred to right interscapular and subscapular areas; right shoulder pain*; anorexia, nausea, vomiting; jaundice; ascites; significant fatigue[45(pp369–396)]	Ultrasonography, CT scan, biopsy, laboratory evaluation[45(pp369–396)]	Low likelihood: no anorexia, nausea, vomiting, jaundice, ascites, or fatigue

Conditions/Diseases Remaining as Possibilites for Clinical Working Hypothesis	Typical Signs and Symptoms	Diagnostic Tests or Criteria Used to Rule In or Rule Out Conditions/ Diseases	Decision and Rationale for Ruling In or Ruling Out Conditions/Diseases
Zygapophyseal joint arthropathy	More common in *upper* and lower (versus mid) thoracic region, *unilateral pain unless bilateral joints affected, inconsistent and overlapping segmental referral patterns along the ipsilateral spinal region*, all pain referred inferiorly from the level of the joint[46]	Clinical findings and patient presentation, advanced degenerative changes evident on radiographic examination[46]	Moderate possibility: pain present in the spinal region, pain unilateral, multisegmental area of pain
Costovertebral/ costotransverse joint dysfunction	*Pain localized to the posterior thorax; pain may radiate to the anterior chest wall; symptoms unilateral; pain with deep breathing, coughing/ sneezing; increased pain with flexion*, rotation, *and ipsilateral side bending; palpable pain at costotransverse joint and rib angle*[4,10]	Clinical findings and patient presentation	Strong possibility: nearly all signs/symptoms present, except rotation was not particularly painful
Active trigger points	*Palpable and painful tight bands within muscles, referred pain in characteristic patterns (per muscle) with pressure over the painful taut band, presence of a local twitch response or "jump sign"*[20(pp60–62)]	Clinical findings and patient presentation	Strong possibility: patient reported referred pain in characteristic patterns with palpation of painful bands within the middle trapezius muscle, the rhomboideus muscle, and eventually the serratus posterior superior muscle

[a] Italicized item indicates signs and symptoms consistent with the patient's presentation.
MRI=magnetic resonance imaging, CT=computerized tomograpnhy, WNL=within normal limits, UE=upper extremity.

clinical decision-making process to include CV/CT joint mobilizations as a component of patient intervention.

In addition to the potential of right rib restrictions, I thought the presence of active periscapular TrPs also might be contributing to this patient's pain and functional limitations. Travell and Simons defined a *trigger point* as "a focus of hyperirritability in a muscle or its fascia that is symptomatic with respect to pain; it refers a pattern of pain at rest and/or on motion . . . , refers pain on direct compression, (and) mediates a local twitch response when adequately stimulated."[20(p1)] The presence of these signs helped me differentiate pain from an active TrP and pain from a restricted CV or CT joint, which, although quite uncomfortable upon palpation, did not refer pain and did not elicit a jump sign or twitch response. In addition, the taut bands that referred pain were found in soft tissue along the medial scapular border, whereas the pain from the CV and CT joints was located at the bony articulation of the ribs and transverse processes. Despite the lack of consensus about reliability and accuracy of detecting active TrPs,[30,34–37] I believed that the presence of referred pain with compression over these taut bands should not be ignored. My decision to address active TrPs as an intervention component was guided by the best available evidence[2,20] as well as my previous experience.

Physical Therapist Diagnosis

I classified this patient into "Preferred Physical Therapist Practice Patterns: Musculoskeletal—Pattern D: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Connective Tissue Dysfunction," in accordance with the *Guide to Physical Therapist Practice*.[21(p179)] I then formulated a clinical working hypothesis of (1) CV and CT joint hypomobility at the level of ribs 3 through 6 and (2) periscapular pain secondary to the presence of active TrPs. The estimated range of visits, based on the patient's presentation, his severity of symptoms, and my previous experience with similar conditions was 6 to 12 visits within 2 to 8 weeks.

Rationale for Treatment

According to Scaringe and Ketner[4] and Triano et al,[10] treatment of CV and CT joint dysfunction should include attempts to normalize mechanics by soft tissue and joint mobilization or manipulation, scapular stabilization and postural reeducation, and any necessary pain control measures. Based on this recommendation and the clinical findings for this patient, I decided to focus my interventions on CV and CT joint mobilizations and active TrP release, complemented with scapular stabilization and postural exercises. I was unable to find any studies that examined the effects of joint mobilization on either the thoracic spine or the CV and CT joints. Moreover, there is no consensus regarding the efficacy of joint mobilizations in reducing low back pain or cervical pain.[53–56] Joint mobilizations, however, are common manual interventions used by physical therapists.[54,57,58] In addition, the *Guide to Physical Therapist Practice*[21(p191)] indicates that components of physical therapy interventions include mobilization or manipulation of soft tissue and spinal and peripheral joints.

A variety of techniques have been suggested for management of active TrPs, including vapocoolant spray-and-stretch,[20(pp63–71),59,60] dry-needling,[61–63] local injections using an anesthetic[62] or botulinum toxin,[64] and ischemic compression.[2,20,59,65–67] However, high-quality controlled trials that examine the effects of any of these interventions are scarce. At the time of this case, the majority of my experience and training in the management of active TrPs involved the use of ischemic compression as described by Travell and Simons.[20(pp86–87)]

This patient had been in pain for 4 months, and none of the passive or active treatments he had tried had offered lasting benefits. Therefore, despite the lack of scientific evidence, I decided that joint mobilizations at the restricted CV and CT joints and active TrP release using ischemic compression were reasonable interventions for this patient.

Interventions

The patient was seen for 7 physical therapy sessions over a 4-week period. Table 4 outlines the sequence of intervention in each session and provides details of patient positioning and the intervention techniques. Additional information that helped to guide the direction of interventions is provided below.

The patient did not tolerate rib mobility assessment well during the examination, so I decided to address the active TrPs in the middle trapezius and rhomboideus muscles using ischemic compression.[20] Sustained digital compression was provided at each taut band that referred pain, holding 60 to 90 seconds or until the patient reported minimal to no pain with further pressure. Each release was followed by passive stretching of the middle trapezius and rhomboideus muscles to assist in restoring normal muscle length and function.[20(pp86–87),68] Because the patient reported an approximate 30% decrease in pain following TrP release, I decided to attempt gentle, grade II mobilizations to the CV and CT joints. With the patient in a prone position, I performed slow, large-amplitude P/A oscillations at ribs 3 through 6 to the point where I felt a restriction, according to the method described by Maitland.[18(pp17–18)] Costosternal mobilizations at ribs 3 through 6 were performed in the same manner.[7,18(pp245–249)] The patient reported no increase in pain with these mobilizations. I gave him a home exercise program (HEP) consisting of a gentle

Table 4.
Outline of Interventions During Each Physical Therapy Session[a]

Session	TrP Release	Mobilizations (Structure, Direction, Grade, Patient Position)	Exercises Added to HEP
1	Rhomboideus and middle trapezius muscles	Ribs 3–6, CV and CT joints, P/A, Gr II, 10–20 s/3–5 times, rpone Ribs 3–6, CS joint jucntion, A/P, Gr II, 10–20 s/3–5 times, supine	Middle trapezius and rhomboideus muscle stretch (Fig. 1) (3×30 s; 2–3 times daily) Prone on elbows with upper thoracic extension (3×30 s; 2–3 times daily)
2	Rhomboideus and middle trapezius muscles	Ribs 3–6, CV and CT joints, P/A and I/S, Gr II–III, 10–20 s/3–5 times, prone Ribs 3–6, CS joint junction, A/P, Gr II–III, 10–20 s/3–5 times, supine	Pectoralis muscle stretch in a corner (3×30 s; 2–3 times daily) Alternate middle trapezius and rhomboideus muscle stretch (Fig. 2) (3×30 s; 2–3 times daily)
3	Rhomboideus, middle trapezius, and SPS muscles	Ribs 3–6, CV/CT joints, P/A and I/S, Gr III–IV, 10–20 s/3–5 times, prone Ribs 3–6, CS junction, A/P, Gr III–IV, 10–20 s/3–5 times, supine Ribs 3–6 CV/CT joints, P/A and I/S, Gr II–III, 10–20 s/3–5 times, L side lying/R side bent over small bolster	Scapular retraction with resistive band (2×20–30 repetitions; 1–2 times daily) Prone middle trapezius muscle strengthening (3–5×8 repetitions; 1–2 times daily) Push-up with a "plus" at a wall (2×20–30 repetitions; 1–2 times daily) Trunk rotation stretch seated in chair (Fig. 3) (3×30 s; 1–2 times daily)
4	Rhomboideus, middle trapezius, and SPS muscles	Ribs 3–6, CV and CT joints, P/A and I/S, Gr III–IV, 10–20 s/3–5 times, prone Ribs 3–6, CS joint junction, A/P, Gr III–IV, 10–20 s/3–5 times, supine Ribs 3–6, CV and CT joints, P/A and I/S, Gr III, 10–20 s/3–5 times, L side lying/R side bent over bolster	Prone lower trapezius muscle strengthening (3–5×8 repetitions; 1–2 times daily)
5	SPS muscle	Ribs 3–6, CV and CT joints, P/A and I/S, Gr III–IV, 10–20 s/3–5 times, prone Ribs 3–6, CV and CT joints, P/A and I/S, Gr III, 10–20 s/3–5 times, L side lying/R side bent over bolster Scapula; protraction, lateral rotation, depression; Gr III, 10–20 s/3–5 times, L side lying	Postural strengthening/stabilization with back to a wall (Fig. 4) (2×10 repetitions×5 s; 1–2 times daily)
6	SPS muscle	Ribs 3–6, CV and CT joints, A/P and I/S, Gr III–IV, 10–20 s/3–5 times, prone Ribs 3–6, CV and CT joints, A/P and I/S, Gr III, 10–20 s/3–5 times, L side lying/R side bent over bolster Scapula, lateral, outward rotation, inferior; Gr III, 10–20 s/3–5 times, L side lying	
7		Scapula, protraction lateral rotation, depression, Gr III, 10–20 s/3–5 times. L side lying	

[a] CV=costovertebral, CT=costotransverse, CS=costosternal, SPS=serratus posterior superior, P/A=posterior to anterior, A/P=anterior to posterior, I/S=inferior to superior, Gr=grade, SB=side bending, R=right, L=left, TrP=trigger point, HEP=home exercise program.

middle trapezius and rhomboideus muscle stretch (Fig. 1) and a positioning exercise to encourage thoracic extension.

At the beginning of the second session, the patient rated his pain as 6/10. Trigger point release and CV, CT, and CS mobilizations were performed as in the first session. The CV and CT joints also were mobilized in the inferior to superior direction as described by Lawrence and Bakkum.[7] I chose this direction based on my earlier hypothesis that the affected ribs were not gliding superiorly and rotating anteriorly. A stretch for the pectoralis major muscle and a second stretch for the middle trapezius and rhomboideus muscles (Fig. 2) were added to the HEP.

The patient rated his pain as 4–5/10 at the beginning of the third session. Right shoulder flexion and abduction were approximately 90% of normal compared with the left side. Cervical AROM was normal but slightly painful

Figure 1.
Passive stretch for middle trapezius and rhomboideus muscles. Model shown in Figures 1 through 4 is not the patient referenced in the text.

Figure 2.
Alternate stretch for middle trapezius and rhomboideus muscles.

at end-range right side bending and right rotation. Interventions were similar to those of the previous sessions, with the addition of TrP release to the serratus posterior superior (SPS) muscle. While palpating under the superiomedial aspect of the scapula, I located a taut band in the SPS muscle that referred pain under the entire scapula and to a small area on the anterior chest wall. This referral pattern is consistent with Travell and Simons'[20(p614)] description of an SPS muscle TrP. Rib mobilizations were more aggressive, taking the joint slightly beyond the point of restriction, using large-amplitude (grade III) and small-amplitude (grade IV) movements.[18(p96)] The CV and CT joints also were mobilized with the patient in the left side-lying position to encourage right thoracic side bending and thus a superior glide of the ribs on the respective transverse processes.[50,52] The exercises added to the patient's HEP focused on middle and lower trapezius and serratus anterior muscle recruitment, as well as upper trunk rotation (Fig. 3).

The patient reported that he had been able to play softball cautiously for about 45 minutes between the third and forth sessions. He had avoided overhand throwing because it increased his pain. The patient also reported a 50% improvement in his ability to sleep. Right shoulder AROM was normal with slight discomfort at end-range flexion and abduction. Intervention was similar to that of session 3 with a lower trapezius muscle strengthening exercise added to the HEP.

At the beginning of session 5, the patient again reported that he was able to play softball with minimal difficulty, although he avoided overhand throwing and excessive reaching with the right UE. The patient mentioned that he was no longer taking the cyclobenzaprine HCl or naproxen, and he rated his pain as 3–4/10. Treatment consisted of TrP release to the SPS muscle and CV and CT joint mobilizations. I was unable to locate active TrPs in the middle trapezius and rhomboideus muscles, and passive mobility of the CS joint junctions felt equal to the left and was pain-free. Right scapular mobilizations were performed as described by Magee[17(pp207–308)] and Maitland,[19(pp163–165)] gliding the scapula inferiorly, laterally, and rotating outwardly. An exercise to recruit the middle and lower trapezius and rhomboideus muscles was added to the patient's HEP (Fig. 4).

During the sixth session, the patient said that he was almost "back to normal" and was pleased with his

Figure 3.
Trunk rotation stretch in sitting position.

Figure 4.
Exercise for strengthening postural muscles. Patient presses arms into wall (arrows) while retracting scapulae.

progress. Trigger point release to the SPS muscle, CV and CT joint mobilizations, and scapular mobilizations were performed. Cervical, UE, and trunk AROM were normal and pain-free at the end of this session. No additional exercises were given.

At the beginning of the seventh session, the patient reported that his only pain was a faint ache under the right scapula that was present approximately 10% of the time. He rated his average pain over the previous week as 1–2/10. He had played softball 2 times since the previous session with no difficulty and was able to throw overhand without pain. All goals set at the initial examination had been fully met. The only intervention for this session consisted of scapular mobilizations. The patient then was discharged.

Outcomes

This patient was able to return to his normal daily and recreational activities after 7 physical therapy sessions over the course of 4 weeks. He actively participated in his care, reported adherence to his HEP, and did not miss or cancel any sessions. His pain rating at rest decreased from an average of 7.5/10 to 0–1/10, and his pain rating with UE activities decreased from 9/10 to 1–2/10. Table 1 compares the patient's functional questionnaire ratings from the initial session to the final session. The only functional deficit the patient continued to report was infrequent waking at night when changing positions. Again, because this questionnaire has not been tested for reliability or validity, conclusions about this patient's functional improvements cannot be drawn from the ratings and scores.

Table 2 compares the initial and final examination findings for this patient. Upon re-examination, the patient demonstrated symmetrical, nonguarded sitting and standing postures. Cervical, trunk and UE AROM were normal and pain-free. There was no pain and full strength during MMT. The patient said he had no pain with accessory motion testing of the right CV and CT joints or the upper thoracic spine.

All of the patient's initial physical therapy goals were fully met. He reported a considerable decrease in daily pain, full ability to play with and care for his children, unrestricted participation in softball, and minimal to no difficulty sleeping. This patient also was seen informally several times following his discharge. Each time he reported normal function and no residual pain. The last time this individual was seen was 5 years following his discharge, and he again reported full, pain-free function.

Discussion

When a patient has signs and symptoms that do not quickly lead to a probable cause of pain or dysfunction, differential diagnosis becomes important.[69–71] Some of the possible diagnoses may be easy to exclude based on the patient's history and examination findings, whereas others may require more detailed questioning, observation, or measurement. The differential diagnosis process becomes more important when the possibility of visceral involvement or systemic disease is present.[71,72] This case report described the clinical decision-making process and rationale for management in a patient who had pain in an area of diagnostic complexity and clinical findings for which there is relatively little scientific information.

In this case, understanding the anatomy and biomechanics of the ribs and corresponding vertebrae, as well as the typical referral patterns for active TrPs, was important to hypothesize potential dysfunctions. Although the reliability of joint mobility assessments has been found to be poor regardless of the joint being assessed,[22–26] reliability of pain provocation scores has been shown to be fair to good.[23,24,27–29] During the initial examination, I observed that the patient's right CV and CT joints had limited mobility compared with the left side. The patient also reported considerable pain when the mobility of these joints was assessed. Therefore, based on my estimation of joint hypomobility, the presence of pain with mobility assessment, and the limited available literature,[4,10] I hypothesized that the patient might benefit from joint mobilizations. One similar description is in the literature regarding a patient with CV and CT joint dysfunction at ribs 2, 3 and 5.[10] However, local analgesic injections were a part of the interventions and, therefore, a direct comparison with this case could not be made.

The reliability of identifying active TrPs also has been shown to be fair to poor.[30,36,37] Specific training in TrP location seems to improve this reliability to at least moderate.[34,35] With this patient, when pressure was applied over a taut band of muscle, he reported referred pain in a familiar pattern and demonstrated either a jump sign or a local twitch response, signs indicative of an active TrP.[20,32,33] My decision to treat these taut bands with ischemic compression was based on the best available recommendations[20,31] and my previous experience of achieving pain relief in patients with a similar presentation.

The patient demonstrated consistent improvement in both pain levels and functional ability over the course of 4 weeks, and he did not experience a recurrence of symptoms over the next 5 years. Because the patient had pain for 4 months prior to this intervention and had not responded to rest, medication, or previous physical therapy, it is tempting to attribute his improvement to the interventions provided, namely CV and CT joint mobilizations and TrP release. However, as is the nature of a case report, a causal relationship cannot be assumed. It is possible that the patient simply experienced natural healing.

Several aspects of this case report highlight the need for further research. Compared with the literature available in the lumbar and cervical areas, information regarding pain and dysfunction in the thoracic area is limited. There is also a lack of research concerning the reliability of assessments of joint mobility, the reliability of detecting of TrPs, the efficacy of providing joint mobilizations, and the efficacy of TrP release. Because these are all common physical therapist examination or intervention techniques,[2,21,29,31,54,57] additional research is important to provide patients with evidence-based examinations and interventions.

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