

Unmasking Rib Pain

Differentiation and management of atraumatic rib pain

Shayne Watson

BPhty, MPhty (Musc) student

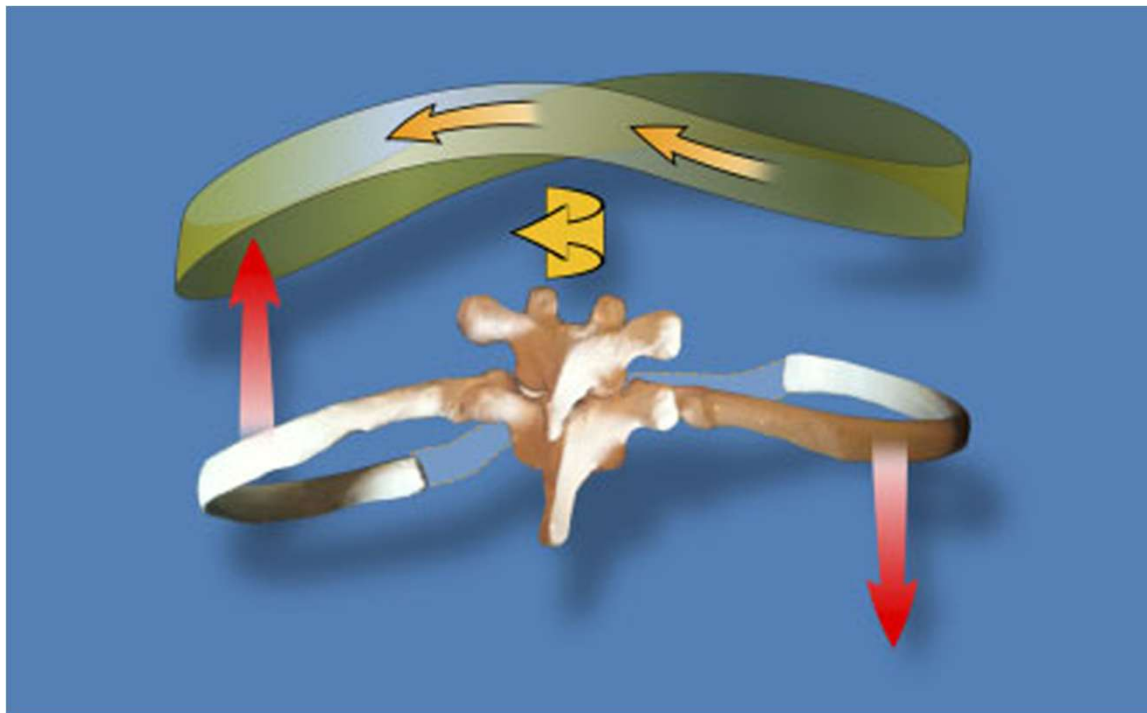
Why rib pain?

- Ribs are essential for functional integrity of the thorax
- Currently there is a lack of research into thoracic and particularly rib pain
- Musculoskeletal chest wall pain accounts for 44.6% (Verdon et al., 2007) and 46.6% (Bösner et al., 2010) of patients presenting to GP with chest pain
- Many different conditions and masqueraders that can present with thoracic pain

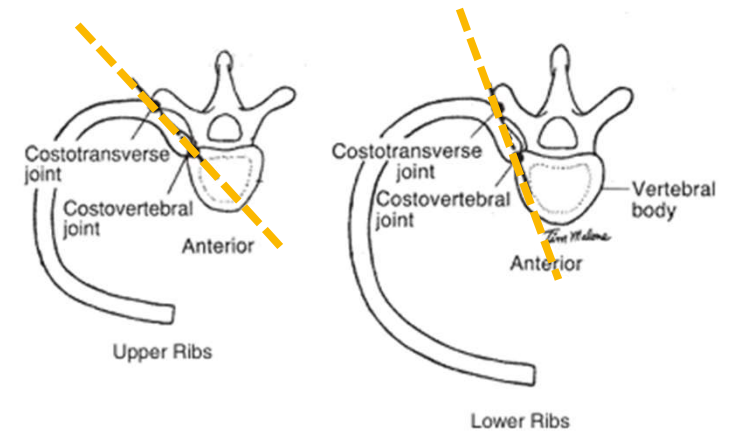
Contents

- I. Biomechanics of the ribs
- II. Red flag screening
- III. Anterior rib pain
- IV. Lateral rib pain
- V. Posterior rib pain
- VI. Management
- VII. Take home messages

Biomechanics



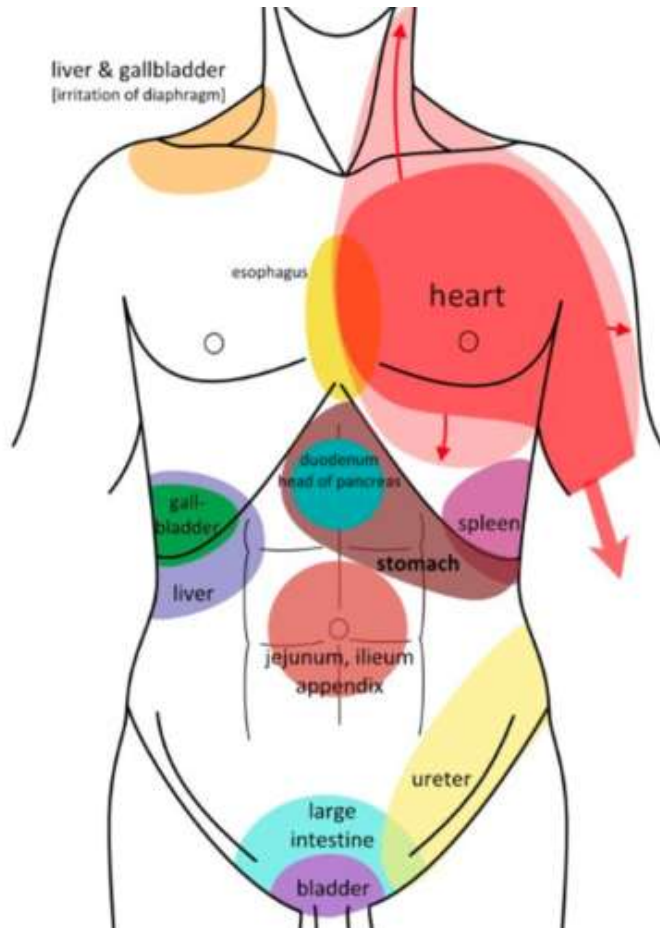
Asymmetrical rib motion during right vertebral rotation. The ipsilateral rib posteriorly rotates, while the contralateral rib anteriorly rotates. (Lee, 2015)



The ribs rotate along the line of the neck of the rib - which changes orientation from the upper to lower ribs (Levangie & Norkin, 2011)

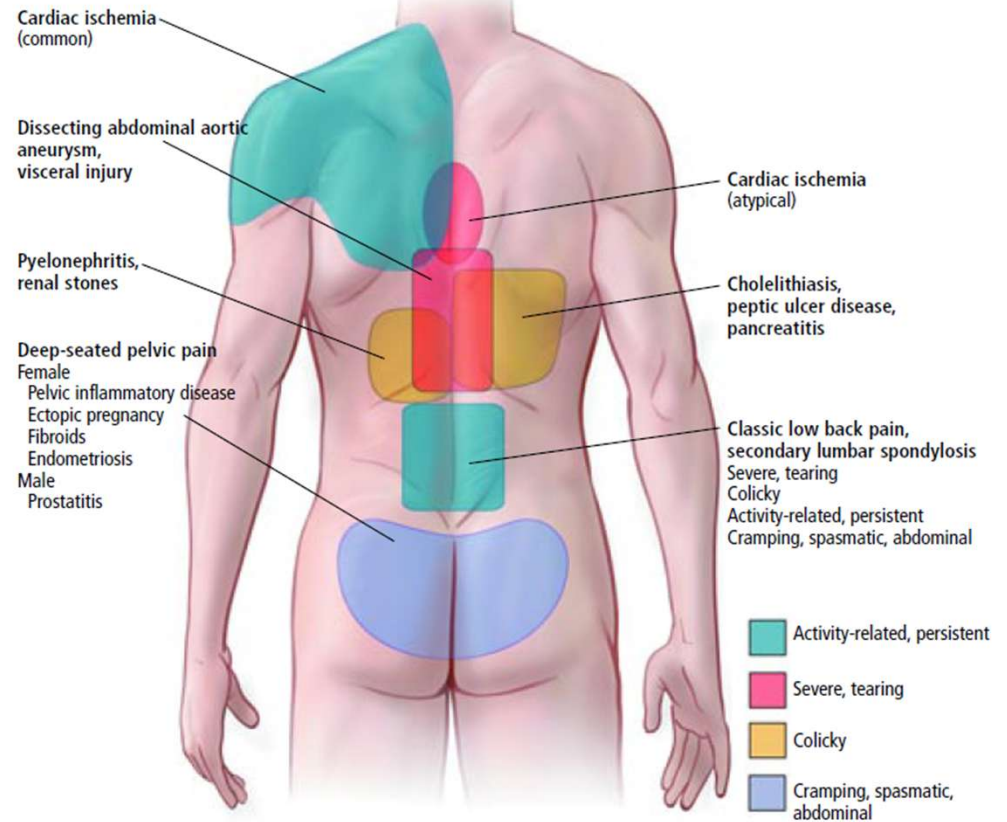


Challenges in diagnosing rib pain



When back pain isn't just back pain

(Klineberg et al., 2007)



Differential Diagnosis



Musculoskeletal chest wall pain

At least 2 of the following;

- Stinging or stabbing pain
- Well localised
- Neither retrosternal nor oppressive
- Pain reproducible by palpation

(Bösner et al., 2010)
(Ronga et al., 2012)



Pain of cardiac origin

Deep, substernal pain that may radiate
Shortness of breath
Pain on exertion
Diaphoresis
Pallor
Nausea

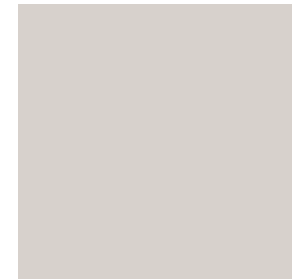
(Mott et al., 2021)
(Fruth, 2006)



Pain of pulmonary origin

Pleuritic chest pain
Associated with fatigue and/or dyspnoea
Asymmetrical lung expansion
Persistent cough
Changes on auscultation

(Tamariz et al., 2004)
(Grief & Loza, 2018)
(Currie et al., 2007)

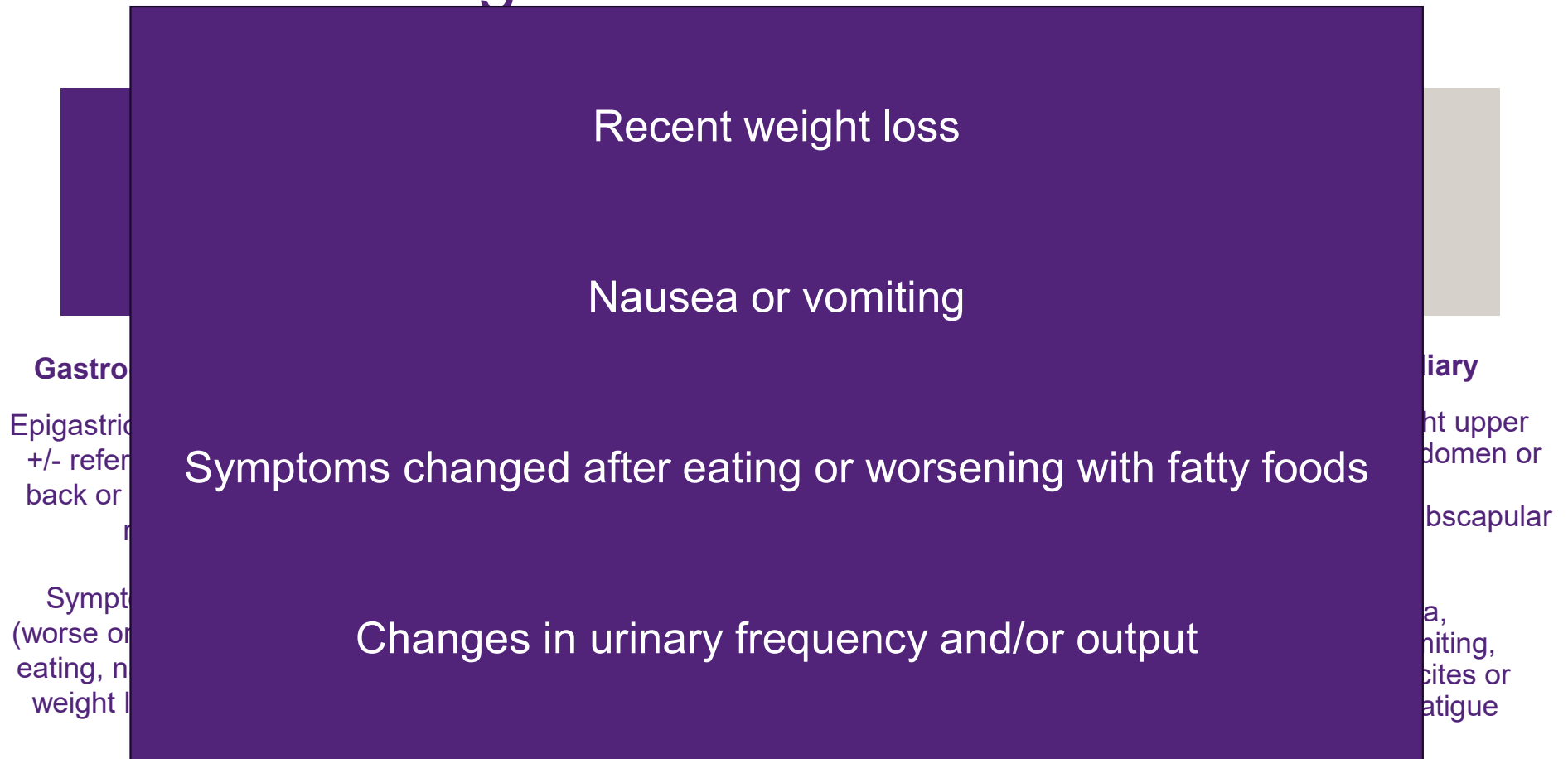


Malignancy/Infection

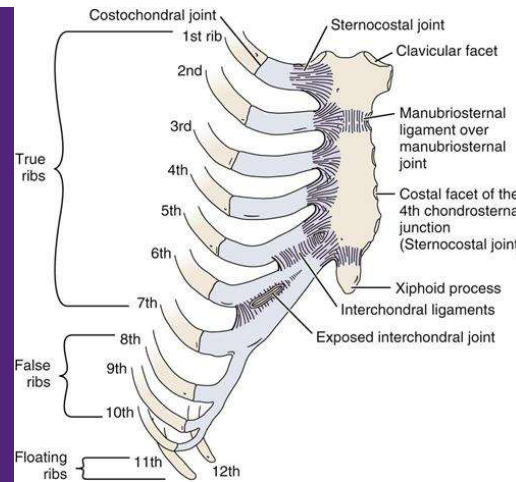
Progressively worsening symptoms
Recent surgery or needle use
History of cancer or immunosuppression
Recent weight loss

(Fruth, 2006)
(Finucane et al., 2020)

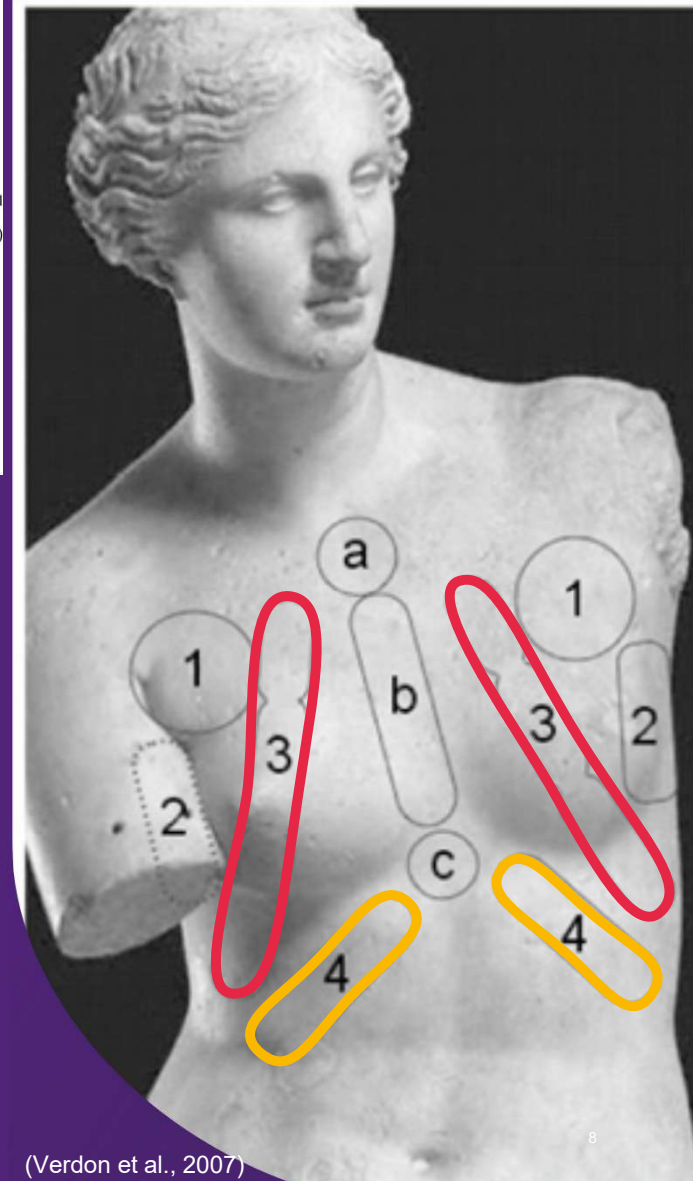
Differential Diagnosis



Anterior rib pain



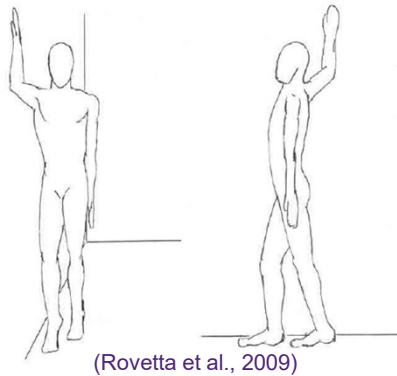
Condition	Pain Quality	Aggravating factors
Costochondritis	Aching, sharp or pressure like pain	• Stretching • Sneezing • Coughing • Inspiration • Trunk flexion
Tietze's syndrome	Sharp and stabbing pain at onset, persisting as a dull aching pain	• Stretching • Sneezing • Coughing • Inspiration • Trunk flexion • Prone lying
Slipping rib syndrome	Sharp, stabbing pain sometimes associated with an audible click	• Trunk flexion • Twisting • Strong abdominal contraction



(Verdon et al., 2007)

Anterior rib pain

Costochondritis



Crowing rooster manoeuvre



(Mott et al., 2021)

Examination

- Pain well localised by history and/or examination and reproduced on palpation (Ronga et al., 2012)
- Crowing rooster manoeuvre (Epstein et al., 1979)
- Horizontal adduction manoeuvre (Epstein et al., 1979)
- Exclusion of other causes of chest pain

Management

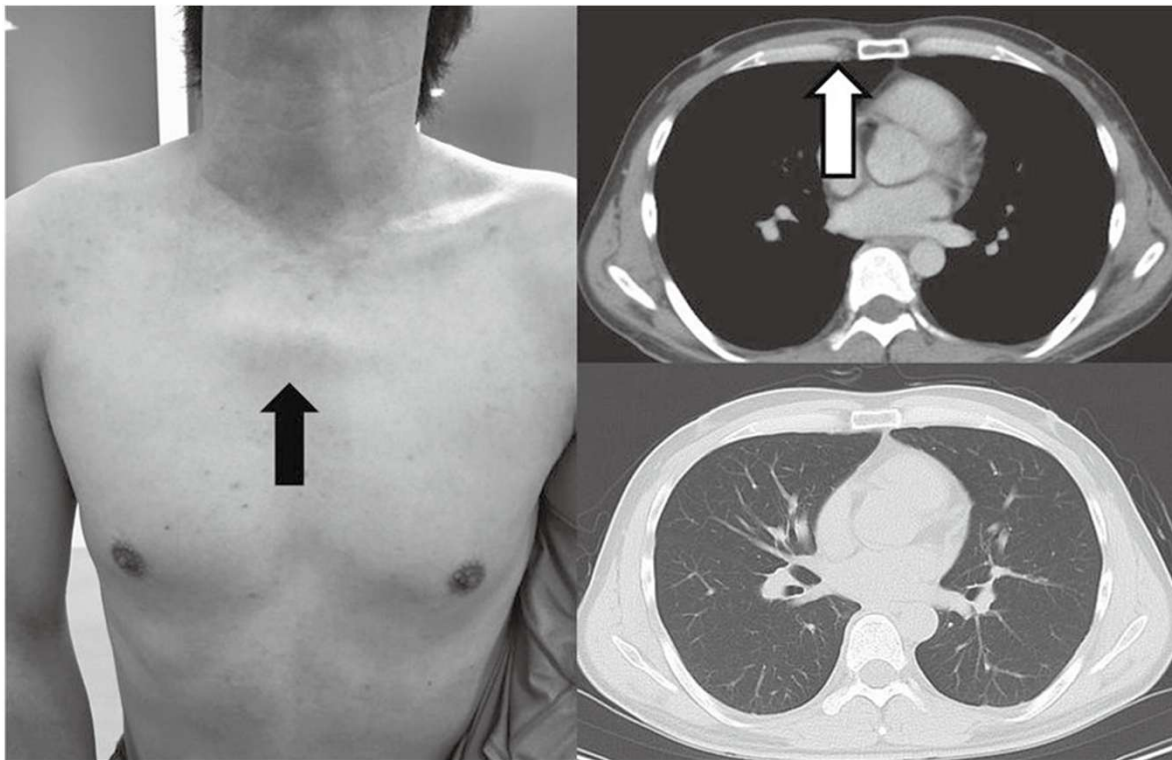
- No high-quality studies have examined the effectiveness of any treatment options for costochondritis (Mott et al., 2021)



Horizontal adduction manoeuvre

Anterior rib pain

Tietze's syndrome

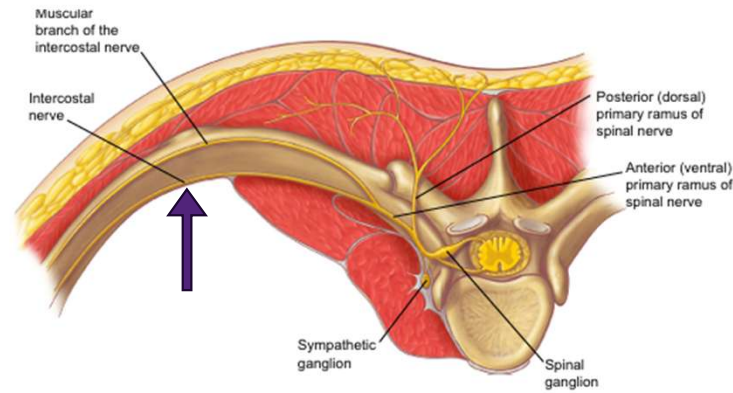


(Sawada et al., 2019)

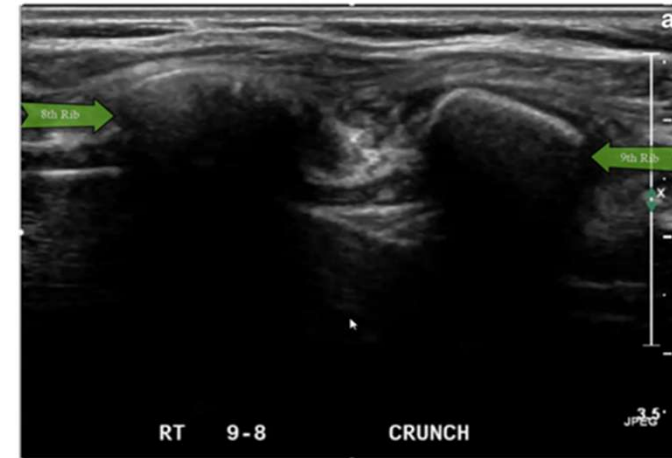
- Sharp and stabbing pain at onset, persisting as a dull aching pain (Ayloo et al., 2013)
- Typically involves the costochondral junction of ribs 2 and 3 (Mott et al., 2021)
- Key physical examination finding is tenderness and visible swelling of the costal cartilages (Calabro et al., 1980)
- CT imaging may be important to rule out other causes (Thongngarm et al., 2001) (Sik et al., 2009)

Anterior rib pain

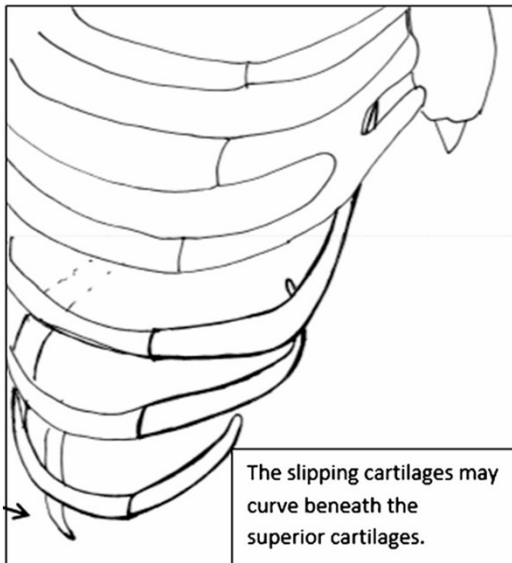
Slipping rib syndrome



Underside view of the intercostal nerve which is vulnerable to irritation(Vallières, 2007)



9th rib motion in a patient with slipping rib syndrome viewed by dynamic ultrasound while performing abdominal crunch (Van Tassel et al., 2019)



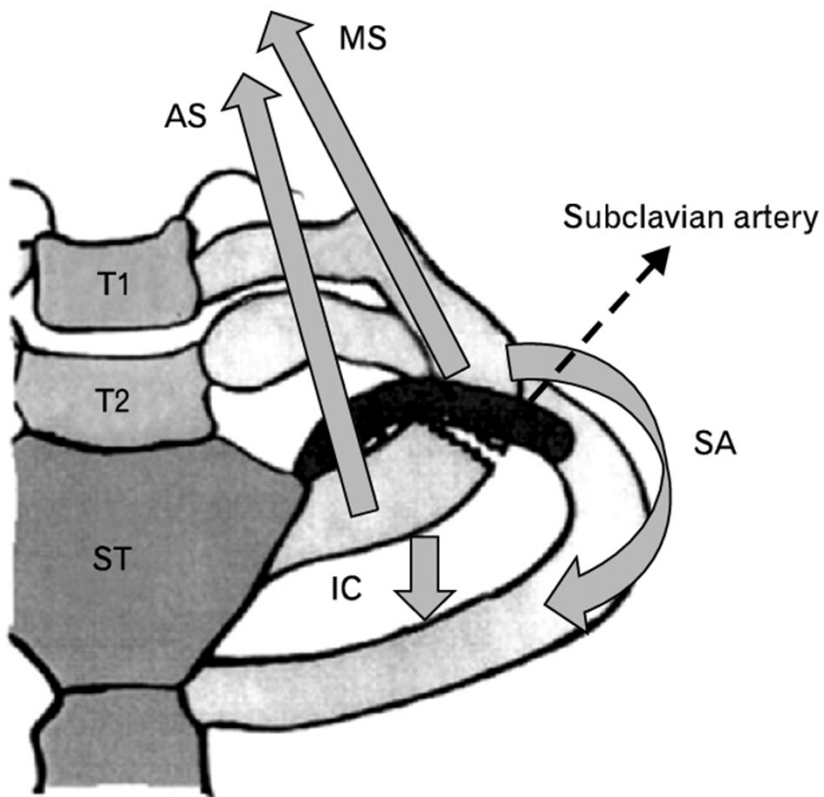
Slipping of the costal cartilages (Van Tassel et al., 2019)



Hooking manoeuvre (McMahon, 2018)

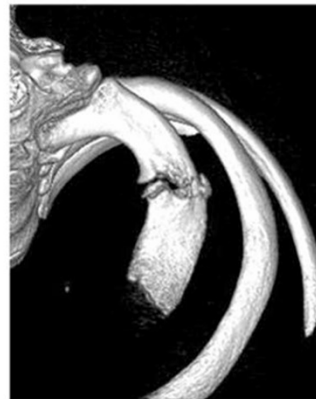
Stress Fracture

First rib



Opposing forces of the scalenes and serratus anterior which contributes to the development of first rib stress fracture (Kim & Hong, 2017)

Type1



Center
Transverse

Type2



Center to posterior
Oblique

Type3



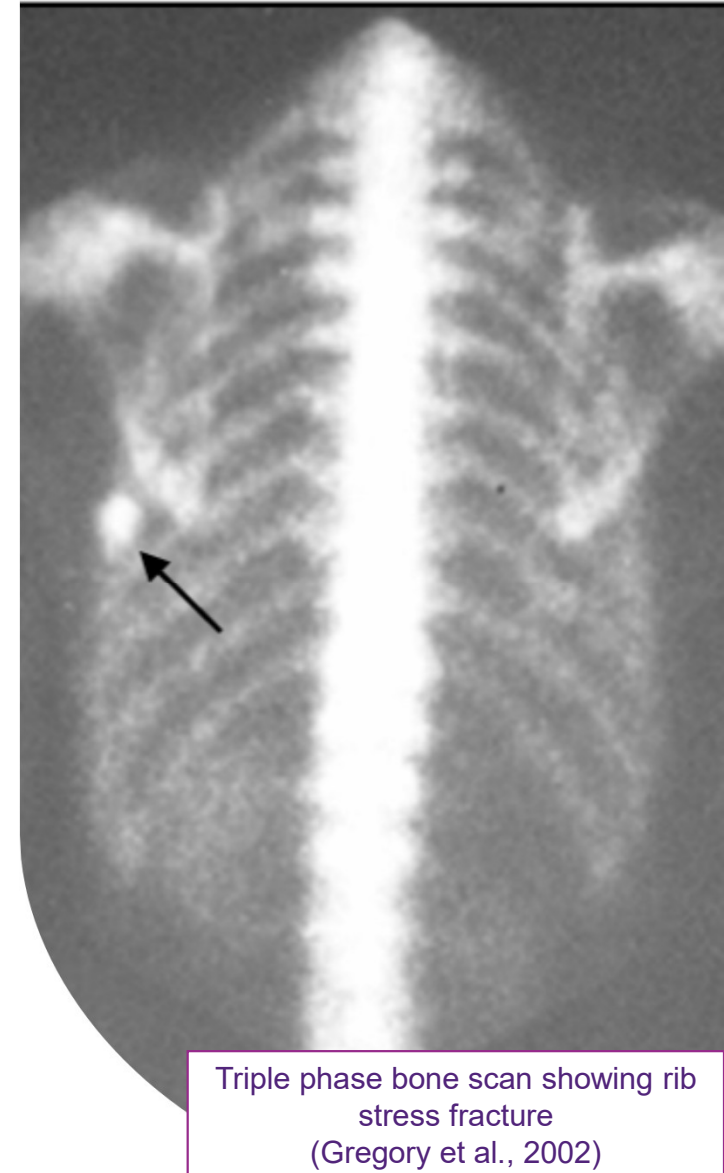
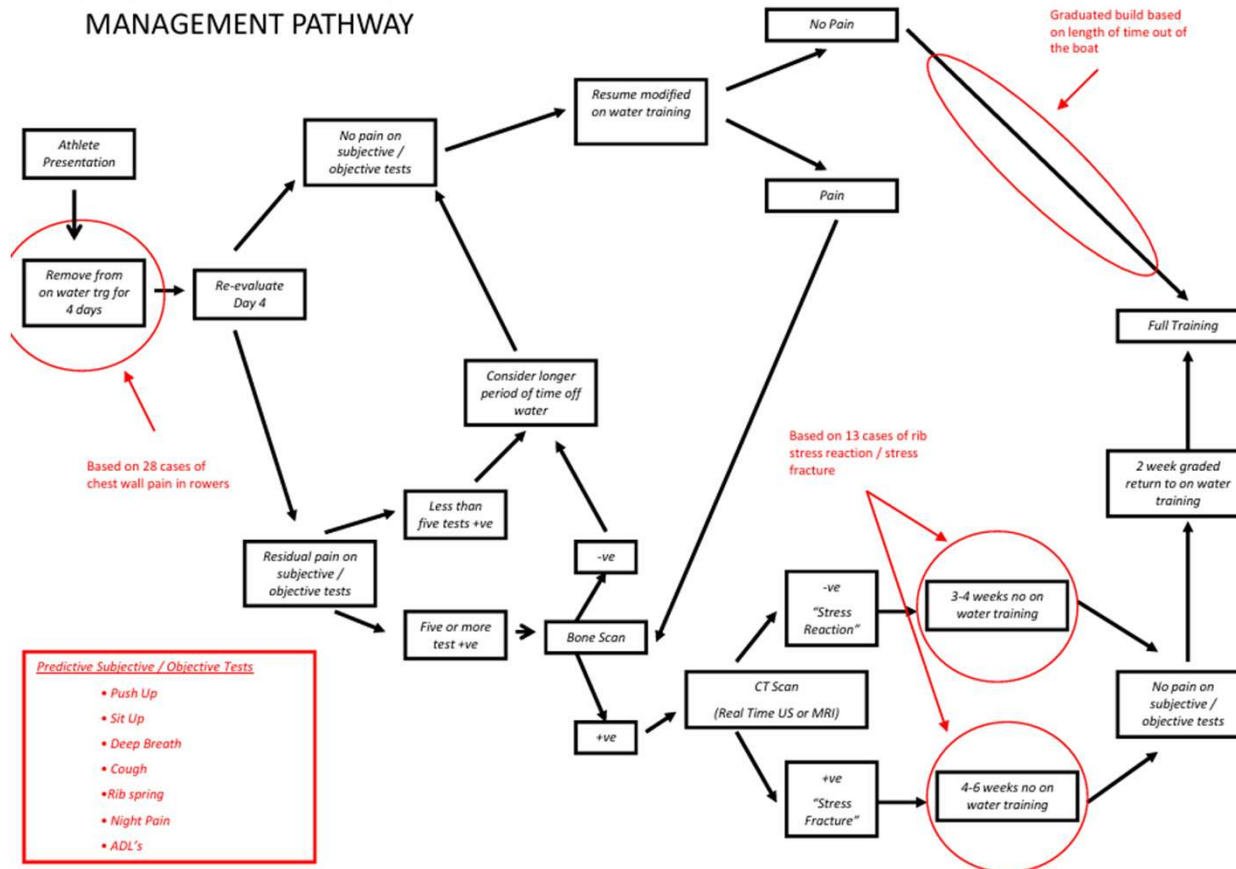
Posterior
Transverse

Observed patterns in first rib stress fracture in relation to the groove for the subclavian artery (Kawashima et al., 2020)

Stress fracture

Ribs 4-8

CHEST WALL PAIN CLINICAL MANAGEMENT PATHWAY



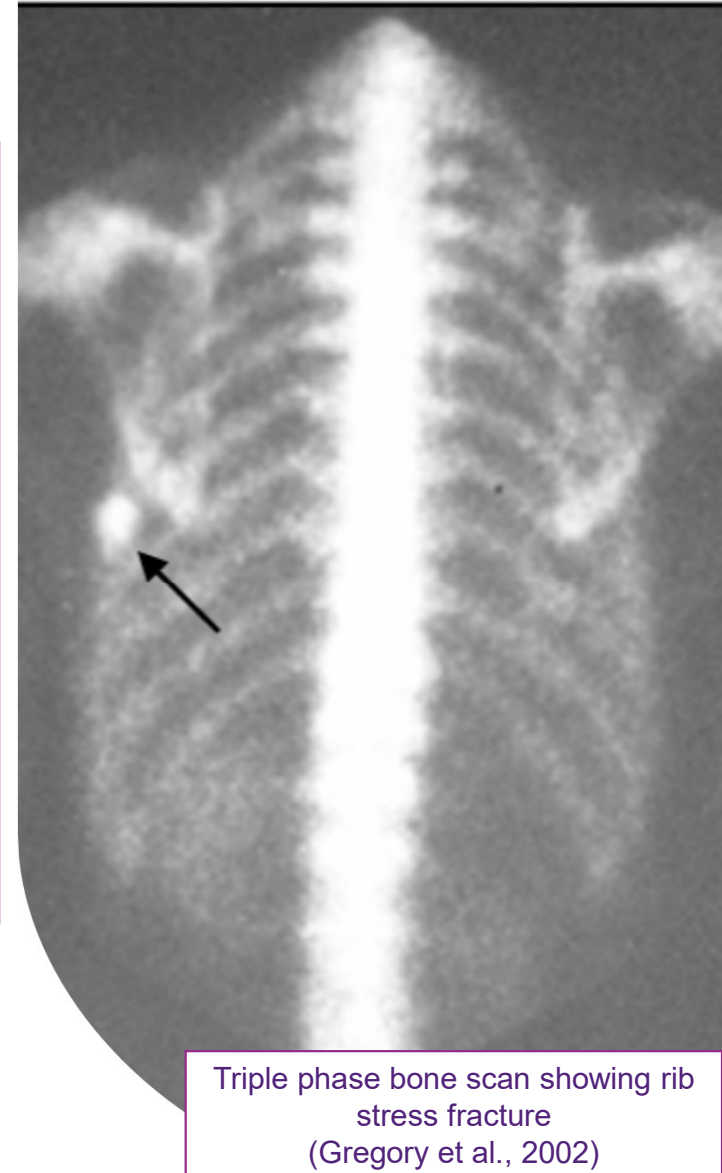
Triple phase bone scan showing rib stress fracture
(Gregory et al., 2002)

Stress fracture

Ribs 4-8

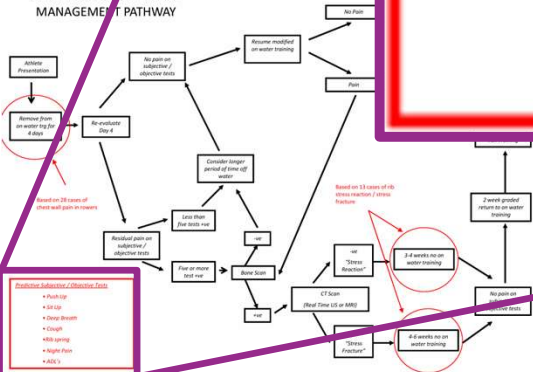
Predictive Subjective / Objective Tests

- Push Up
- Sit Up
- Deep Breath
- Cough
- Rib spring
- Night Pain
- ADL's



Triple phase bone scan showing rib stress fracture
(Gregory et al., 2002)

CHEST WALL PAIN CLINICAL MANAGEMENT PATHWAY

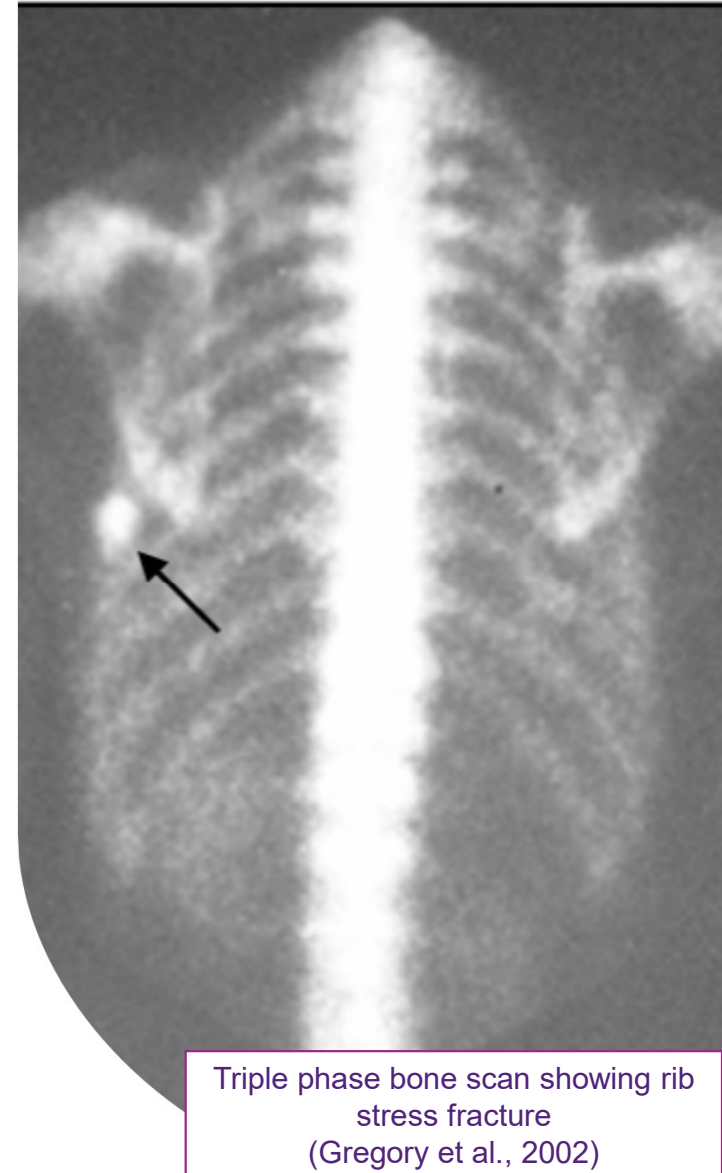
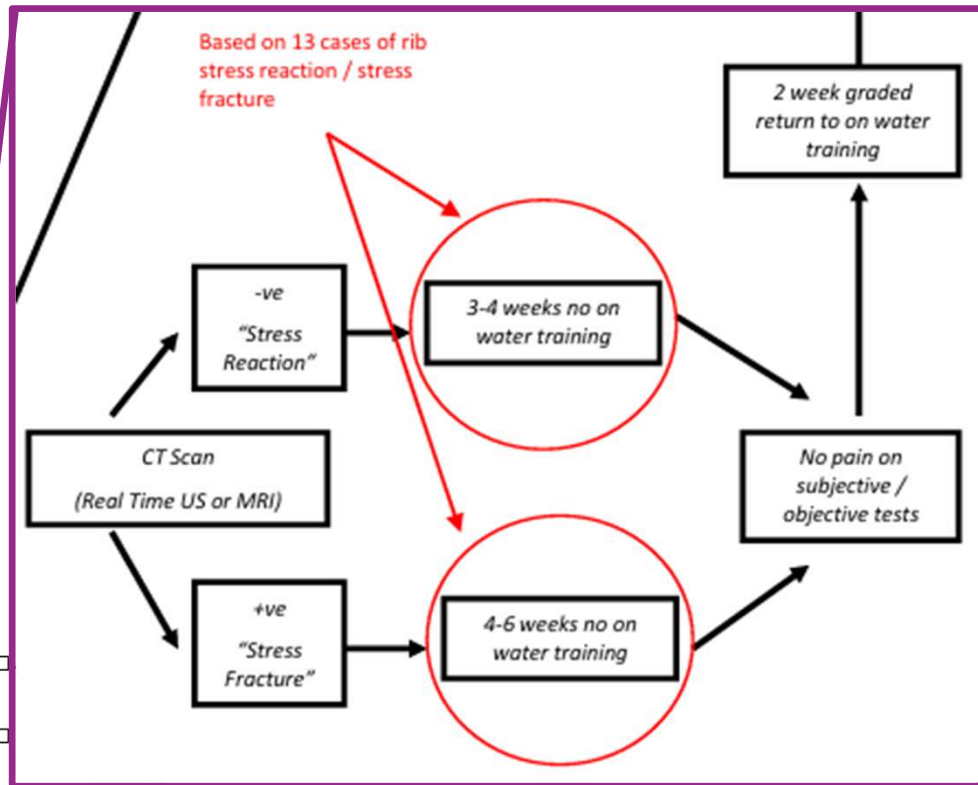


Predictive Subjective / Objective Tests

- Push Up
- Sit Up
- Deep Breath
- Cough
- Rib spring
- Night Pain
- ADL's

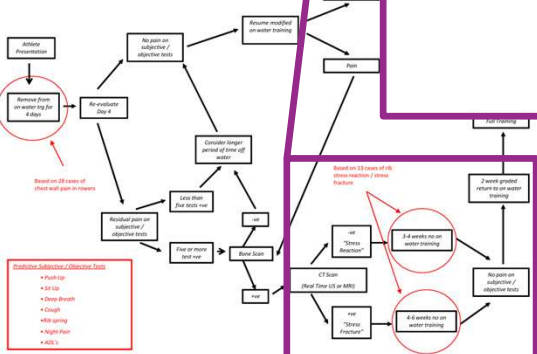
Stress fracture

Ribs 4-8



Triple phase bone scan showing rib stress fracture
(Gregory et al., 2002)

CHEST WALL PAIN CLINICAL MANAGEMENT PATHWAY

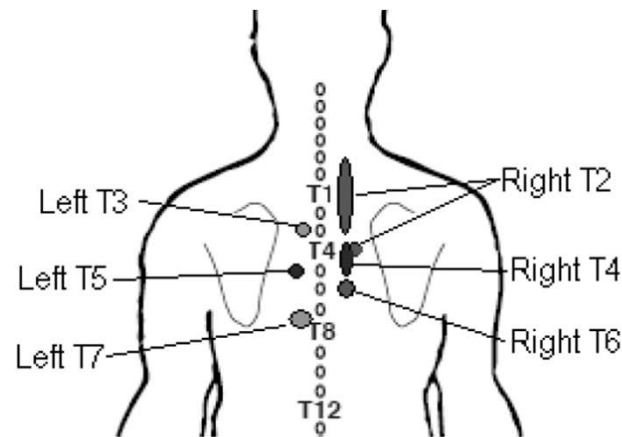
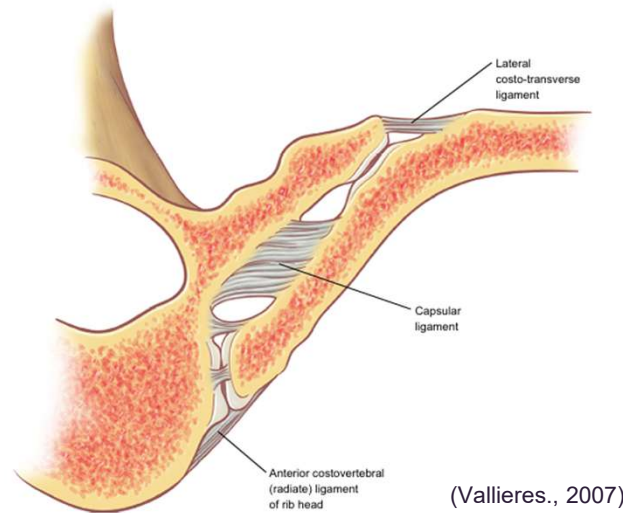


Posterior rib pain

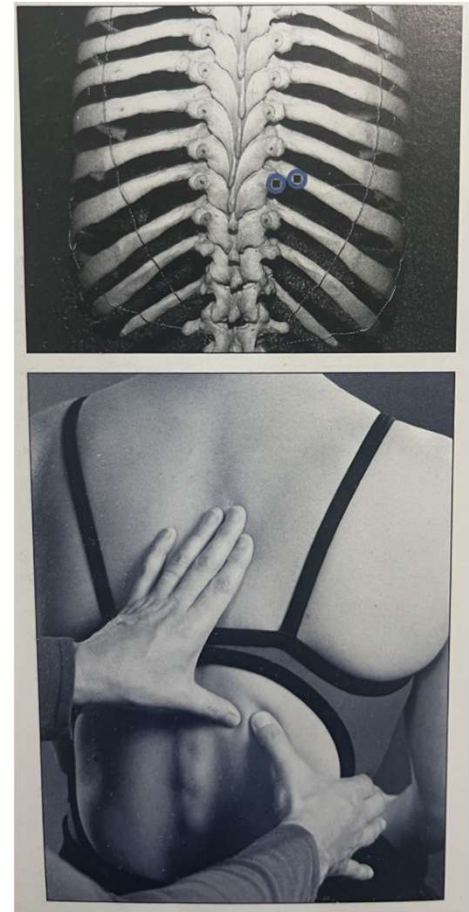
Pain locations are unreliable in diagnosis (Young et al., 2008)

Costotransverse joint restrictions present with a contralateral restriction pattern (Lee., 2003)

Manual examination of rib mobility has moderate intra-rater reliability and fair inter-rater reliability (Cibulka et al., 2023)

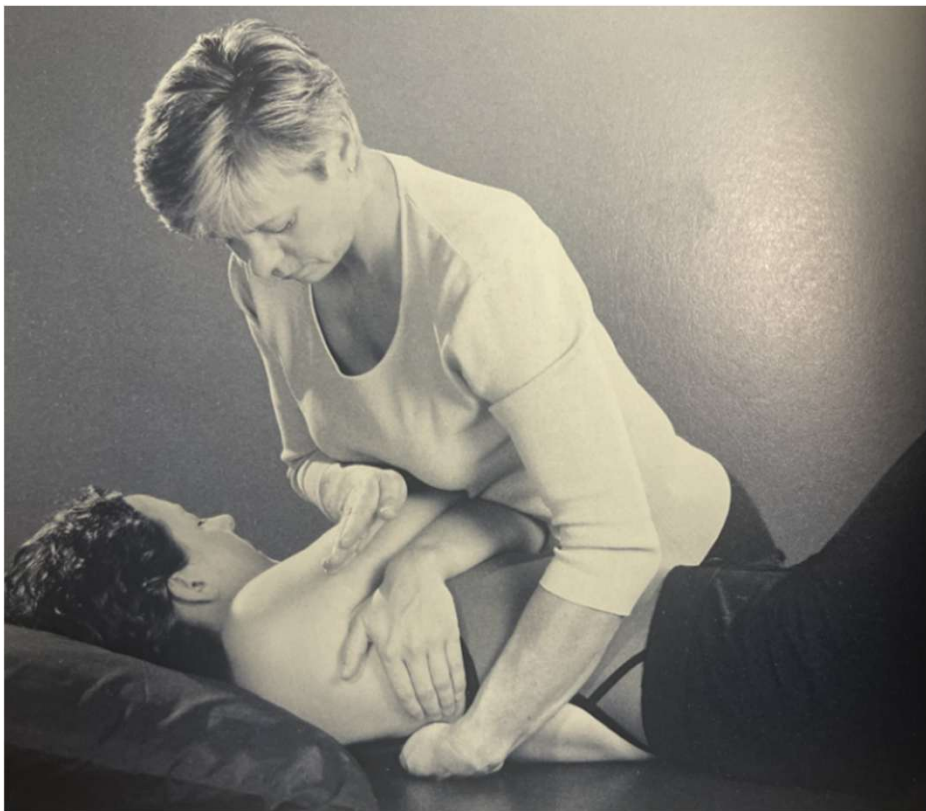


Composite diagram of costotransverse joint pain patterns (Young et al., 2008)

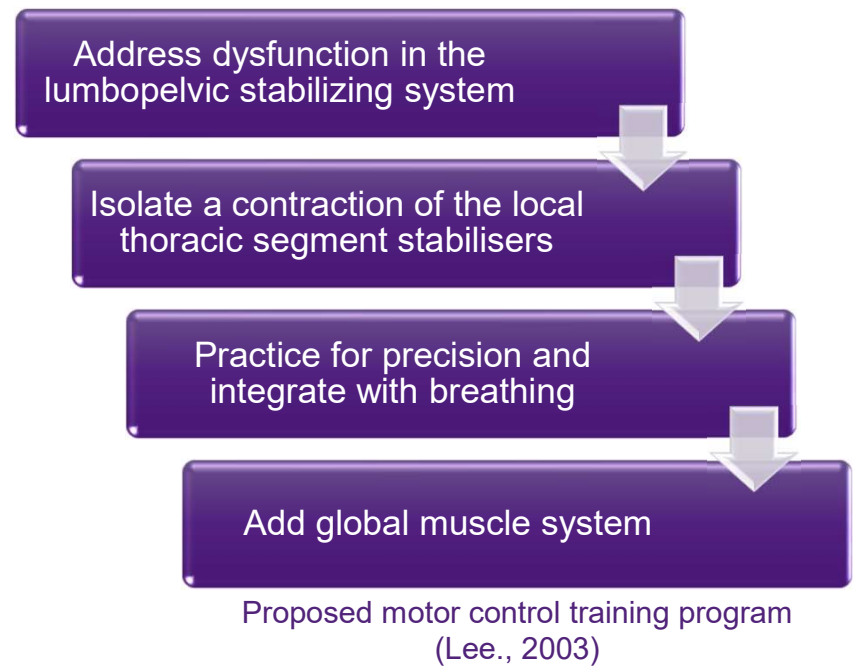


Movement testing of the 9th rib - ask the patient to perform thoracic flexion and evaluate relative motion between rib and transverse process (Lee., 2003)

Management of posterior rib pain



AP manipulation of left 6th rib (Lee., 2003)



Summary

Condition	Location	Interview findings	Key Examination findings
Costochondritis	Usually unilateral 2nd – 5th costochondral junction	- Aching, sharp or pressure like pain - Aggravated by movements that stress the costal cartilages	- Local tenderness - Crowing rooster manoeuvre - Horizontal adduction manoeuvre
Tietze's syndrome	Unilateral 2nd or 3rd costochondral junction	- Sharp and stabbing at onset, with persisting dull aching pain - Aggravated by movements that stress the costal cartilages	- Fusiform or bulbous swelling at the costal cartilage - Local tenderness - Imaging - CT
Slipping rib syndrome	Lower rib cage	- Sharp, stabbing pain sometimes associated with a click or pop - Aggravated by strong abdominal contraction	- Local tenderness - Hooking manoeuvre - Intercostal nerve block
First rib stress fracture	Posterior shoulder and scapula region, may report deep in axilla, clavicle or neck	- Dull aching pain, may have progression to sharp pain - Weightlifting or throwing sports	- Local tenderness - Pain with overhead activity - Imaging – Bone scan, CT, MRI
Lower rib stress fracture	Pain along the medial border of the scapula, radiating laterally around the chest wall	- Dull aching pain, may have progression to sharp pain - Rowing or swinging sports (golf, tennis)	- Local tenderness and rib spring - Functional tests include deep breathing, push ups, sit ups, coughing - Imaging – Bone scan, CT, MRI
Costovertebral or costotransverse joint dysfunction	Well localized and level specific to joint dysfunction	- Dull aching pain, less commonly described as sharp or burning pain - Aggravated by deep breathing, coughing, thoracic movements	- Manual examination of CV/CT joints may demonstrate pain or hypomobility - Contralateral restriction pattern for CTJ dysfunction

Concluding remarks

Thoracic pain should be treated with a high level of suspicion, with care to exclude non-musculoskeletal conditions

Some signs and tests have been described in the examination of rib pain, however there is no validated data to guide their use

Important to be aware of biomechanics and symptom patterns from an examination perspective

Limited data to guide treatment, high emphasis on clinical reasoning to address impairments

Shayne Watson

BPhty, MPhty (Musc) student

shayne.watson@student.uq.edu.au



Reference List

1. Bösner, S., Becker, A., Hani, M. A., Keller, H., Sönnichsen, A. C., Karatolios, K., Schaefer, J. R., Haasenritter, J., Baum, E., & Donner-Banzhoff, N. (2010). Chest wall syndrome in primary care patients with chest pain: presentation, associated features and diagnosis. *Fam Pract*, 27(4), 363-369. <https://doi.org/10.1093/fampra/cm024>
2. Verdon, F., Burnand, B., Herzig, L., Junod, M., Pecoud, A., & Favrat, B. (2007). Chest wall syndrome among primary care patients: A cohort study. *BMC Fam Pract*, 8(1), 51-51. <https://doi.org/10.1186/1471-2296-8-51>
3. Jull, G., Moore, A., Falla, D., Lewis, J., McCarthy, C., & Sterling, M. (2015). *Grieve's Modern Musculoskeletal Physiotherapy* (4 ed.). Elsevier.
4. Lee, D. G. (2003). *The thorax : an integrated approach* ([2nd] ed.). Distributed by OPTP.
5. Ronga, A., Vaucher, P., Haasenritter, J., Donner-Banzhoff, N., Boesner, S., Verdon, F., Bischoff, T., Burnand, B., Favrat, B., & Herzig, L. (2012). Development and validation of a clinical prediction rule for chest wall syndrome in primary care. *BMC Fam Pract*, 13(1), 74-74. <https://doi.org/10.1186/1471-2296-13-74>
6. Litak, J., Czyżewski, W., Szymoniuk, M., Sakwa, L., Pasierb, B., Litak, J., Hoffman, Z., Kamieniak, P., & Roliński, J. (2022). Biological and Clinical Aspects of Metastatic Spinal Tumors. *Cancers*, 14(19), 4599. <https://www.mdpi.com/2072-6694/14/19/4599>
7. Ayloo, A. M. D., Cvengros, T. M. D. C., & Marella, S. M. D. (2013). Evaluation and Treatment of Musculoskeletal Chest Pain. *Prim Care*, 40(4), 863-887. <https://doi.org/10.1016/j.pop.2013.08.007>
8. Calabro, J. J., Jeghers, H., Miller, K. A., & Gordon, R. D. (1980). Classification of Anterior Chest Wall Syndromes. *JAMA*, 243(14), 1420-1421. <https://doi.org/10.1001/jama.1980.03300400010005>
9. Levangie, P. K., & Norkin, C. C. (2011). *Joint structure and function: a comprehensive analysis* (5th ed.). F.A. Davis Company.
10. Gasparri, M., & Gasparri, M. (2018). Rib Fracture Management. In M. de Moya & J. Mayberry (Eds.), (pp. 105-116). Springer International Publishing AG. https://doi.org/10.1007/978-3-319-91644-6_9
11. Fam, A. G. (1988). Approach to Musculoskeletal Chest Wall Pain. *Prim Care*, 15(4), 767-782. [https://doi.org/10.1016/S0095-4543\(21\)01294-X](https://doi.org/10.1016/S0095-4543(21)01294-X)
12. McBeath, A. A., & Keene, J. S. (1975). The rib-tip syndrome. *J Bone Joint Surg Am*, 57(6), 795-797. <https://doi.org/10.2106/00004623-197557060-00012>
13. Sayed, A., Munir, M., & Bahbah, E. I. (2021). Aortic Dissection: A Review of the Pathophysiology, Management and Prospective Advances. *Curr Cardiol Rev*, 17(4), e230421186875. <https://doi.org/10.2174/1573403x16666201014142930>
14. Stein, P. D., & Henry, J. W. (1997). Clinical Characteristics of Patients With Acute Pulmonary Embolism Stratified According to Their Presenting Syndromes. *Chest*, 112(4), 974-979. <https://doi.org/10.1378/chest.112.4.974>
15. Grief, S. N., & Loza, J. K. (2018). Guidelines for the Evaluation and Treatment of Pneumonia. *Prim Care*, 45(3), 485-503. <https://doi.org/10.1016/j.pop.2018.04.001>
16. Currie, G. P., Alluri, R., Christie, G. L., & Legge, J. S. (2007). Pneumothorax: an update. *Postgrad Med J*, 83(981), 461-465. <https://doi.org/10.1136/pgmj.2007.056978>
17. Finucane, L. M., Downie, A., Mercer, C., Greenhalgh, S. M., Boissonnault, W. G., Pool-Goudzwaard, A. L., Beneciuk, J. M., Leech, R. L., & Selfe, J. (2020). International Framework for Red Flags for Potential Serious Spinal Pathologies. *J Orthop Sports Phys Ther*, 50(7), 350-372. <https://doi.org/10.2519/jospt.2020.9971>

18. Van Tassel, D., McMahon, L. E., Riemann, M., Wong, K., & Barnes, C. E. (2019). Dynamic ultrasound in the evaluation of patients with suspected slipping rib syndrome. *Skeletal Radiol*, 48(5), 741-751. <https://doi.org/10.1007/s00256-018-3133-z>
19. Epstein, S. E., Gerber, L. H., & Borer, J. S. (1979). Chest Wall Syndrome: A Common Cause of Unexplained Cardiac Pain. *JAMA*, 241(26), 2793-2797. <https://doi.org/10.1001/jama.1979.03290520017017>
20. Mott, T. M. D., Jones, G. M. D., & Roman, K. M. D. (2021). Costochondritis: Rapid Evidence Review. *American family physician*, 104(1), 73-78.
21. Rovetta, G., Sessarego, P., & Monteforte, P. (2009). Stretching exercises for costochondritis pain. *G Ital Med Lav Ergon*, 31(2), 169-171.
22. Elsayed, H. H., Ali, I., Abdel-Gayed, M., Warda, A. M., & Moharram, A. A. (2022). The efficacy of oral corticosteroids for treatment of Tietze syndrome: A pragmatic randomized controlled trial. *J Clin Pharm Ther*, 47(12), 2279-2286. <https://doi.org/10.1111/jcpt.13810>
23. Sik, E. C., Batt, M. E., & Heslop, L. M. (2009). Atypical chest pain in athletes. *Curr Sports Med Rep*, 8(2), 6-58. <https://doi.org/10.1249/JSR.0b013e31819c7d01>
24. Gress, K., Charipova, K., Kassem, H., Berger, A. A., Cornett, E. M., Hasoon, J., Schwartz, R., Kaye, A. D., Viswanath, O., & Urits, I. (2020). A Comprehensive Review of Slipping Rib Syndrome: Treatment and Management. *Psychopharmacol Bull*, 50(4 Suppl 1), 189-196.
25. Eastwood, N. B. (1980). SLIPPING-RIB SYNDROME. *The Lancet (British edition)*, 316(8198), 809-809. [https://doi.org/10.1016/S0140-6736\(80\)90432-8](https://doi.org/10.1016/S0140-6736(80)90432-8)
26. Germanovich, A. (2016). Multi-Modal Treatment Approach to Painful Rib Syndrome: Case Series and Review of the Literature. *Pain Physician*, 19(3), E465-E471. <https://doi.org/10.36076/ppj/2019.19.E465>
27. Coris, E. E., & Higgins, H. W. (2005). First Rib Stress Fractures in Throwing Athletes. *Am J Sports Med*, 33(9), 1400-1404. <https://doi.org/10.1177/0363546505275349>
28. Gregory, P. L., Biswas, A. C., & Batt, M. E. (2002). Musculoskeletal Problems of the Chest Wall in Athletes. *Sports Med*, 32(4), 235-250. <https://doi.org/10.2165/00007256-200232040-00003>
29. Scott, E. M., & Scott, B. B. (1993). Painful rib syndrome--a review of 76 cases. *Gut*, 34(7), 1006-1008. <https://doi.org/10.1136/gut.34.7.1006>
30. Itoh, Y., Funakoshi, T., Furushima, K., Kusano, H., & Itoh, Y. (2019). First Rib Stress Fracture in Overhead Throwing Athletes. *Orthopaedic journal of sports medicine*, 7(7_suppl5). <https://doi.org/10.1177/2325967119S00434>
31. Holden, D. L., & Jackson, D. W. (1985). Stress fracture of the ribs in female rowers. *Am J Sports Med*, 13(5), 342-348. <https://doi.org/10.1177/036354658501300509>
32. Thongngarm, T., Lemos, L. B., Lawhon, N., & Harisdangkul, V. (2001). Malignant Tumor with Chest Wall Pain Mimicking Tietze's Syndrome. *Clinical Rheumatology*, 20, 276-278.
33. McMahon, L. E. (2018). Slipping Rib Syndrome: A review of evaluation, diagnosis and treatment. *Semin Pediatr Surg*, 27(3), 183-188. <https://doi.org/10.1053/j.sempedsurg.2018.05.009>
34. Kim, J., & Hong, S. (2017). Bilateral First Rib Stress Fractures with Pseudoarthrosis in a Young Weightlifter: A Rare Cause of Shoulder Pain. *The Korean Journal of Sports Medicine*, 35, 121. <https://doi.org/10.5763/kjsm.2017.35.2.121>
35. Kawashima, K., Terabayashi, N., Asano, H., & Akiyama, H. (2020). Classification of stress fractures of the first rib in adolescent athletes. *J Pediatr Orthop B*, 29(4), 409-411. <https://doi.org/10.1097/BPB.0000000000000720>
36. Hooper, I., Blanch, P., & Sternfeldt, J. (2011). The development of a clinical management pathway for chest wall pain in elite rowers. *Journal of science and medicine in sport*, 14, e104-e104. <https://doi.org/10.1016/j.jsams.2011.11.218>

37. Vallières, E. M. D. F. (2007). The Costovertebral Angle. *Thorac Surg Clin*, 17(4), 503-510. <https://doi.org/10.1016/j.thorsurg.2006.12.003>
38. Evans, G., & Redgrave, A. (2016). Great Britain Rowing Team Guideline for Diagnosis and Management of Rib Stress Injury: Part 2 – The Guideline itself. *Br J Sports Med*, 50(5), 270-272. <https://doi.org/10.1136/bjsports-2015-095928>
39. Lord, M. J., Kwon Ick, H., & Kwang Soon, S. (1996). Stress Fractures of the Ribs in Golfers. *Am J Sports Med*, 24(1), 118-122. <https://doi.org/10.1177/036354659602400121>
40. Erwin, W. M., Jackson, P. C., & Homonko, D. A. (2000). Innervation of the human costovertebral joint: implications for clinical back pain syndromes. *J Manipulative Physiol Ther*, 23(6), 395-403. <https://doi.org/10.1067/mmt.2000.108144>
41. Young, B. A., Gill, H. E., Wainner, R. S., & Flynn, T. W. (2008). Thoracic costotransverse joint pain patterns: A study in normal volunteers. *BMC Musculoskelet Disord*, 9(1), 140-140. <https://doi.org/10.1186/1471-2474-9-140>
42. Arroyo, J. F., Jolliet, P., & Junod, A. F. (1992). Costovertebral joint dysfunction: another misdiagnosed cause of atypical chest pain. *Postgrad Med J*, 68(802), 655-659. <https://doi.org/10.1136/pgmj.68.802.655>
43. Saker, E., Graham, R. A., Nicholas, R., D'Antoni, A. V., Loukas, M., Oskouian, R. J., & Tubbs, R. S. (2016). Ligaments of the Costovertebral Joints including Biomechanics, Innervations, and Clinical Applications: A Comprehensive Review with Application to Approaches to the Thoracic Spine. *Cureus*, 8(11), e874-e874. <https://doi.org/10.7759/cureus.874>
44. Nathan, H., Weinberg, H., Robin, G. C., & Aviad, I. (1964). The costovertebral joints. Anatomical-clinical observations in arthritis. *Arthritis Rheum*, 7(3), 228-240. <https://doi.org/10.1002/art.1780070306>
45. Fruth, S. J. (2006). Differential Diagnosis and Treatment in a Patient With Posterior Upper Thoracic Pain. *Phys Ther*, 86(2), 254-268. <https://doi.org/10.1093/ptj/86.2.254>
46. Cibulka, M., Buck, J., Busta, B., Neil, E., Smith, D., & Triller, R. (2023). Intra and inter observer agreement in the mobility assessment of the upper thoracic costovertebral joints. *Physiother Theory Pract*, 39(9), 1993-1999. <https://doi.org/10.1080/09593985.2022.2058439>
47. Heiderscheit, B., & Boissonnault, W. (2008). Reliability of Joint Mobility and Pain Assessment of the Thoracic Spine and Rib Cage in Asymptomatic Individuals. *J Man Manip Ther*, 16(4), 210-216. <https://doi.org/10.1179/106698108790818369>
48. Lee, L.-J. (2008). A Closer look at the Thorax by LJ Lee. *In Touch*.
49. Lee, L.-J., Chang, A. T., Coppieters, M. W., & Hodges, P. W. (2010). Changes in sitting posture induce multiplanar changes in chest wall shape and motion with breathing. *Respir Physiol Neurobiol*, 170(3), 236-245. <https://doi.org/10.1016/j.resp.2010.01.001>
50. Culham, E. G., Jimenez, H. A. I., & King, C. E. (1994). Thoracic kyphosis, rib mobility, and lung volumes in normal women and women with osteoporosis. *Spine (Phila Pa 1976)*, 19(11), 1250-1255. <https://doi.org/10.1097/00007632-199405310-00010>
51. Lee, D. Physical Therapy of the Cervical and Thoracic Spine. In (pp. 320-334). <https://doi.org/10.1016/B978-0-443-06564-4.50019-0>