**Surgical Indications Rib Fracture Fixation**

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**I.** INDICATIONS

Despite a growing amount of evidence strengthening surgical indications, rib fracture fixation is considered to be a relative indication. There are no absolute indications for surgical fixation of ribs.

**A.** Flail Chest (2-7, 9-15,25)

**i.** Most common indication for surgery, and considered to be a strong relative indication.

**ii.** Specific clinical factors associated with a flail chest strengthen the indication for surgery

**B.** Chest Wall Deformity (1,14,16,25)

**i.** Can cause significant loss of thoracic volume

**ii.** Can be a severe impediment to lung expansion

**C.** Concomitant Operative Thoracic Injuries (1,25)

**i.** Displaced ribs and thoracic trauma can cause injuries requiring operative intervention

**ii.** These patients are considered operative candidates for rib fracture fixation in conjunction with or after the pulmonary procedure under the same anesthetic

**D.** Symptomatic Nonunion or Malunion (1,17,25)

**i.** Upper extremity or chest wall motion in this setting may cause symptomatic complaints

**ii.** Surgical stabilization can lead to symptom resolution

**E.** Pain and Disability (1,2,8,9,12,18-21,25)

**i.** Considered to be a relative indication if prevents:

**a.** Mobilization

**b.** Respiratory effort

**ii.** Yet to be definitively demonstrated as an indication in the literature

**II.**  CONTRAINDICATIONS

1. Pulmonary Contusion (3,4,22,25)
2. Originally considered a contraindication
3. More recent literature brings this assumption into question (3,24)
4. Severe Head injury (23)
5. Some authors operative protocols consider this to be a contraindication

Referrences

1. Slater MS, Mayberry JC, Trunkey DD. Operative stabilization of a flail chest six years after injury. Ann Thorac Surg. 2001;72:600-601.
2. Nirula R, Diaz JJ Jr, Trunkey DD, Mayberry JC. Rib fracture repair: indications, technical issues, and future directions. World J Surg. 2009;33(1):14-22. Level III
3. Althausen PL, Shannon S, Watts C, Thomas K, Bain MA, Coll D, O'mara TJ, Bray TJ. Early surgical stabilization of flail chest with locked plate fixation. J Orthop Trauma. 2011;25(11):641-7. Level III
4. Tanaka H, Yukioka T, Yamaguti Y, Shimizu S, Goto H, Matsuda H, Shimazaki S. Surgical stabilization of internal pneumatic stabilization? A prospective randomized study of management of severe flail chest patients. J Trauma. 2002;52(4):727-32. Level I
5. Granetzny A, Abd El-Aal M, Emam E, Shalaby A, Boseila A. Surgical versus conservative treatment of flail chest. Evaluation of the pulmonary status. Interact Cardiovasc Thorac Surg. 2005;4:583-7. Level I
6. Fitzpatrick DC, Denard PJ, Phelan D, et al. Operative stabilization of flail chest injuries: review of literature and fixation options. Eur J Trauma Emerg Surg. 2010;36:427-433. Level V
7. Taylor BC, French BG, Fowler, TT. Surgical approaches for rib fracture fixation. J Orthop Trauma. 2013;27:e168–e173). Level V
8. Mayberry JC, Kroecker AD, Ham LB, et al. Long-term morbidity, pain and disability after repair of severe chest wall injuries. Am Surg. 2009;75:389-394. Level III
9. Ali BA, Sanfilippo F. Management of flail chest in trauma: analysis of risk factors affecting outcomes. ANZ J Surg. 2007;77:A93. Level IV
10. Sirmali M, Turut H, Topcu S, et al. A comprehensive analysis of traumatic rib fractures: morbidity, mortality, and management. Eur J Cardiothorac Surg. 2003;24:133-138. Level IV
11. Wanek S, Mayberry JC. Blunt thoracic trauma: flail chest, pulmonary contusion, and blast injury. Crit Care Clin. 2004;20:71-81. Level IV
12. Ahmed Z, Mohyuddin Z. Management of flail chest injury: internal fixation versus endotracheal intubation and ventilation. J Thorac Cardiovasc Surg.1995;110:1676-1680. Level III
13. Reber PU, Kniemeyer HW, Ris HB. Reconstruction plates for internal fixation of flail chest. Ann Thorac Surg. 1998;66:2158. Level IV
14. Bots J, Wijnaendts LC, Delen S, Van Dongen S, Heikinheimo K, Galis F. Analysis of cervical ribs in a series of human fetuses. J Anat. 2011 Sep;219(3):403-9. Level V
15. Furtado LV, Thaker HM, Erickson LK, Shirts BH, Opitz JM. Cervical ribs are more prevalent in stillborn fetuses than in live-born infants and are strongly associated with fetal aneuploidy. Pediatr Dev Pathol. 2011 Nov-Dec;14(6):431-7. Level IV
16. Chang KZ, Likes K, Davis K, Demos J, Freischlag JA. The significance of cervical ribs in thoracic outlet syndrome. J Vasc Surg. 2013 Mar;57(3):771-5. Level V
17. Merks JH, Smets AM, Van Rijn RR, Kobes J, Caron HN, Maas M, Hennekam RC. Prevalence of rib anomalies in normal Caucasian children and childhood cancer patients. Eur J Med Genet. 2005 Apr-Jun;48(2):113-29. Level IV
18. Thompson D. The management of closed chest injuries. Postgrad Med J. 1964 Feb;40:88-92. Level IV
19. Powell HD. The treatment of simple rib fractures; a criticism of a laissez-faire policy. Br Med J. 1955 Oct 1;2(4943):829-830. Level V
20. Williams MH. Severe crushing injury to the chest: Report of a case having extensive bilateral rib fractures successfully treated by pericostal skeletal traction. Ann Surg. 1948 Nov; 128(5): 1006-1011. Level IV
21. Jaslow IA. Skeletal traction in the treatment of multiple fractures of the thoracic cage. Am J Surg. 1946 Nov; 72(5):753-755. Level IV
22. Richardson DJ, Papper EM. Nerve-blocking therapy for fractured ribs. J Thorac Surg. 1947;16(4):432-437. Level IV
23. Marasco S, Liew S, Edwards E, Varma D. Analysis of bone healing in flail chest injury: Do we need to fix both Fractures per rib? J Trauma, Acute Care Surg. 2014, 77(3):452-458.
24. Taylor BC, Fowler TT, French BG, Dominquez N. Clinical Outcomes of Surgical Stabilization of Flail Chest Injury. JAAOS. 2016;24: 575-580.
25. Fowler, TT, Taylor BC, Bellino MJ, Althausen PL. Surgical Treatment of Flail Chest and Rib Fractures. JAAOS. 2014;22: 751-760.