Does surgical stabilization improve outcomes in patients with isolated multiple distracted and painful non-flail rib fractures?

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Abstract

A best evidence topic was constructed according to a structured protocol. The question addressed was whether surgical stabilization is effective in improving the outcomes of patients with isolated multiple distracted and painful non-flail rib fractures. Of the 356 papers found using a report search, nine presented the best evidence to answer the clinical question. The authors, journal, date and country of publication, study type, group studied, relevant outcomes and results of these papers are given. We conclude that, on the whole, the nine retrieved studies clearly support the use of surgical stabilization in the management of isolated multiple non-flail and painful rib fractures for improving patient outcomes. The interest and benefit was shown not only in terms of pain (McGill pain questionnaire) and respiratory function (forced vital capacity, forced expiratory volume in 1 s and carbon monoxide diffusing capacity), but also in improved quality of life (RAND 36-Item Health Survey) and reduced socio-professional disability. Indeed, most of the authors justified surgical management based on the fact that the results of surgical stabilization showed improvement in short- and long-term patient outcomes, with fast reduction in pain and disability, as well as lower average wait before recommencing normal activities. Hence, the current evidence shows surgical stabilization to be safe and effective in alleviating post-operative pain and in improving patient recovery, thus enhancing the outcome after isolated multiple rib fractures. However, given the little published evidence, prospective trials are necessary to confirm these encouraging results.

Keywords: Chest wall • Trauma • Rib fractures • Surgical stabilization • Pain • Disability

INTRODUCTION

A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

THREE-PART QUESTION

In [patients over 45 years old with isolated, movable and painful rib fractures without true flail chest] is [surgical stabilization] superior to [non-operative management] in improving outcomes [pain, disability, respiratory function, number of days lost from work]?

CLINICAL SCENARIO

A 52-year-old man involved in a motor vehicle accident is transferred to your department. He complains of shortness of breath and spontaneous right chest wall pain. Clinical examination reveals 92% of oxygen saturation in free air, a right chest wall haematoma and aggravated pain on deep palpation over the lateral aspect of the fifth to seventh ribs. There is discernible mobility of the fractured ribs but no true flail chest or other extra-thoracic injury. Chest radiograph reveals obvious displaced fractures of said ribs. As an active businessman, the patient asks for the best available treatment in order to return to work as soon as possible with no pain or disability. Since you have just read two randomized studies [2, 3], indicating that surgical stabilization improved outcomes in patients with severe flail chest injuries, you wonder if surgical stabilization of multiple isolated non-flail, painful and movable rib fractures is superior to non-operative management in improving outcomes. You, therefore, decide to look up the evidence in the literature.

SEARCH STRATEGY

Medline 1948-June 2011, using the OVID interface, with results limited to human subjects and English language articles: (surgery.mp. or exp General Surgery/ OR (stabilization or fixation or repair).mp.) AND (rib fractures or exp Rib Fractures/). Finally, a manual search—from which flail chest injury was excluded—was used to follow up the references from the retrieved studies.

SEARCH OUTCOME

A total of 356 abstracts were found, from which nine papers were selected for providing the best evidence on the topic. These papers are documented in Table 1.
### Table 1: Overview of the studies

<table>
<thead>
<tr>
<th>Author, date and country; study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments/weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nirula and Mayberry, 2010, USA [4]</td>
<td>Identifying surgical indications and quantifying the potential short- and long-term individual benefits of repair</td>
<td>Potential indications for operative stabilization</td>
<td>(1) Reduction of pain and disability (2) Chest wall deformity/defect (3) Symptomatic rib fracture non-union (4) Thoracotomy for other indication ('on the way out')</td>
<td>Non-systematic review with no further statistical analysis</td>
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<td>Non-systematic review (level 5)</td>
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<td>Mayberry et al., 2009, USA [5]</td>
<td>46 patients with severe chest wall injury: - 18 flail chest with failure to wean from the ventilator - 15 intractable pain associated with severely displaced rib fractures - 5 acute chest wall deformity/defect - 3 acute pulmonary herniation - 5 thoracotomy for other indication</td>
<td>Long-term pain assessed by the MPQ Long-term disability assessed by RAND-36 survey</td>
<td>Mean long-term MPQ pain rating index was 6.7 ± 2.1 RAND-36 indices indicated equivalent or better health status compared with the general population</td>
<td>Low response rate to the survey, lack of control group, small population size, variety of surgical techniques and indications used</td>
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<tr>
<td>Retrospective study (1996–2005) (level 3)</td>
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<td>Moreno De La Santa Barajas et al., 2010, Spain [7]</td>
<td>22 patients with rib fractures: - 13 flail chest - 6 intractable pain or disability - 3 chest wall deformity</td>
<td>Length of hospitalization Long-term disability Socioprofessional rehabilitation Respiratory function</td>
<td>Mean hospital stay: 8 days Excellent pain relief Total socioprofessional rehabilitation FVC% at 3 months: 78 FEV1% at 3 months: 77</td>
<td>Unknown preoperative respiratory function, unknown tool for pain assessment and small population size</td>
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<tr>
<td>Retrospective study (2008–09) (level 3)</td>
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<tr>
<td>Nirula et al., 2006, USA [8]</td>
<td>30 patients undergoing surgical stabilization were matched with 30 controls</td>
<td>Length of: - ICU and hospital stay - Mechanical ventilation</td>
<td>Length of Intensive care unit and total hospital stay was similar Trend towards fewer total ventilator days (P = 0.12) and fewer ventilator days from the time of stabilization (P = 0.02)</td>
<td>Case-matched study, no long-term follow-up and no standardized protocol for pain management</td>
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<td>Case control study (1996–2000) (level 3)</td>
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<td>Campbell et al., 2009, Australia [9]</td>
<td>Surgical management of 32 patients using union orthopaedic trauma plating system wraps</td>
<td>Pain level (visual pain scale) Chest stiffness and movement Shortness of breath Employment status Quality of life</td>
<td>Low levels of pain at rest (1.0/10) and when coughing (1.3/10) Chest wall stiffness: 60% of patients Dyspnoea: 20% of patients Socioprofessional rehabilitation Complete overall satisfaction</td>
<td>Low response rate to the survey and mean time between surgery and the questionnaire is 1.039 days (±480 days)</td>
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<tr>
<td>Retrospective study (2004–08) (level 3)</td>
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<td>Gasparri et al., 2003, USA [10]</td>
<td>Surgical management of multiple rib fractures on a 49-year-old man involved in a motorcycle accident presenting with persistent pain and shortness of breath</td>
<td>Pain control Respiratory function (FVC, FEV1, DLCO) Socioprofessional disability</td>
<td>Complete pain relief achieved at POD 14 Normalization of pulmonary function Resumption of normal activity at POD 10</td>
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<tr>
<td>Case report (level 4)</td>
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<td>Cacchione et al., 2000, USA [11]</td>
<td>Non-union of multiple rib fractures managed by operative stabilization on a 46-year-old patient involved in a vehicle crash 2 years before and presenting with chest wall deformity, chronic pain and shortness of breath</td>
<td>Pain control Respiratory function Disability</td>
<td>Disclosed minimal pain Improved shortness of breath Socioprofessional rehabilitation</td>
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<tr>
<td>Case report (level 4)</td>
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Continued
RESULTS

Nirula and Mayberry [4] performed a review of rib fracture repair, summarizing clinical presentations and potential indications of stabilization. Excluding flail chest, they defined the operative indications as painful, movable rib fractures, failure of narcotics or epidural pain catheter, fracture movements exacerbating pain and minimal associated injuries (abbreviated injury scale ≤2). They added chest wall deformity/defect, symptomatic rib fracture non-union and thoracotomy ‘on the way out’ as other surgical indications.

Mayberry et al. [5] studied long-term morbidity, pain and disability after repair of severe chest wall injury in 46 patients. Indications included the flail chest with failure to wean from the ventilator (n = 18), intractable pain associated with severely displaced rib fractures (n = 15), acute chest wall defect/deformity (n = 5), acute pulmonary hernia (n = 3) and thoracotomy for other traumatic indications (n = 5). Pain was assessed by the McGill pain questionnaire (MPQ) and disability using a RAND 36-Item Health Survey. Mean long-term MPQ pain rating was 6.7 ± 2.1. RAND-36 indices indicated equivalent or better health status with the exception of role limitations due to physical problems, when compared with the general population. They concluded that repair of severe chest wall injuries in selected patients may diminish their expected long-term pain and disability.

Richardson et al. [6] analysed 3844 patients with rib fractures from 1993 to 2005. They performed open reduction and internal fixation (ORIF) on seven patients with multiple rib fractures. All of these patients had significant pain relief and both ventilator-dependent patients were rapidly weaned. Long-term results indicated that there was no post-operative infection, non-union or disability. They concluded that operative fixation, while underused, is a useful modality for patients with multiple rib fractures.

Moreno De La Santa Barajas et al. [7] analysed 22 patients with rib fractures who underwent ORIF using the STRATOS system (Strasbourg Thoracic Osteosyntheses System, MedXpert, Germany). All patients recovered and returned to work after an average of 2 months. They concluded that stabilization could be recommended in patients with chest wall lesions to improve outcomes.

Nirula et al. [8] performed a case–control study of patients undergoing rib fracture stabilization. They concluded that surgical stabilization seemed to reduce ventilator requirements for severe thoracic injuries.

Campbell et al. [9] analysed 32 patients who underwent ORIF of fractured ribs. All patients were followed up with a questionnaire assessing pain, chest stiffness and movement, shortness of breath, exercise tolerance, employment status, quality of life and overall satisfaction with the operation. They concluded that a surgical approach for the treatment of displaced rib fractures may be appropriate.

Gasparri et al. [10] reported a case of surgical management of multiple rib fractures, using plates, on a 49-year-old man exhibiting persistent pain and shortness of breath. The patient had complete pain relief achieved at POD 14, and resumption of normal activity at POD 10.

Cacchione et al. [11] reported a case of non-union multiple rib fractures managed by operative stabilization on a 46-year-old patient involved in a vehicle crash 2 years prior, presenting with chest wall deformity and chronic pain. All pain-reducing therapy failed. Post-operative results showed that the patient was discharged on the fifth day with minimal pain, improved shortness of breath and socio-professional rehabilitation.

Kerr-Valentic et al. [12] determined the magnitude and duration of pain and disability in patients with rib fractures treated by a conservative medical method. Forty injured patients with ≥1 rib fracture on chest radiograph were asked...
to participate. Pain was assessed using a visual pain scale. Mean rib fracture pain was 3.5 ± 2.1 at day 30 and 1.0 ± 1.4 at day 120. Disability was assessed by comparing the patients to the chronically ill population reference of the RAND Medical Outcome Study. The patients were more disabled at day 30 ($P < 0.001$) in all categories except emotional stability and general health. They concluded that rib fractures are a significant cause of pain and disability in patients with thoracic injury and that the development of new therapies—including surgery—to accelerate pain relief and healing would substantially improve the outcomes.

**CLINICAL BOTTOM LINE**

In general, of the nine studies presented, all indicated that surgical stabilization in the management of isolated multiple non-flail and painful rib fractures improved outcomes. Indeed, the interest and benefit was shown not only in terms of pain and respiratory function but also in improved quality of life and reduced socio-professional disability. Hence, the current evidence shows surgical stabilization to be safe and effective in alleviating postoperative pain and improving patient recovery, thus enhancing the outcome of the procedure. However, retrieved studies provided a low level of evidence (small studies with few numbers of patients and short-term follow-up or case reports). Large prospective controlled trials are thus necessary to confirm these encouraging results.

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**REFERENCES**


