



ORIGINAL RESEARCH PAPER

General Surgery

A COMPARATIVE STUDY OF OPERATIVE FIXATION VERSUS CONSERVATIVE MANAGEMENT OF RIB FRACTURE IN TRAUMA PATIENTS

KEY WORDS: Rib fractures; Surgical stabilization; Conservative management; Thoracic trauma; Visual Analogue Scale.

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ABSTRACT

Background: Multiple rib fractures are a common consequence of blunt thoracic trauma and are associated with significant morbidity due to pain, impaired respiratory function, prolonged hospitalisation, and pulmonary complications. This study compared operative fixation with conservative management in patients with rib fractures. **Materials and Methods:** A prospective cohort study was conducted over two years in the Department of General Surgery, Government Medical College and Rajindra Hospital, Patiala. Sixty patients with displaced rib fractures were equally allocated to conservative (n=30) and surgical fixation (n=30) groups. Outcomes assessed included hospital and ICU stay, mechanical ventilation, pain using the Visual Analogue Scale (VAS), analgesic requirements, radiological union, complications, and functional recovery. Patients were followed for up to three months, and data were analysed using SPSS version 26.0. **Results:** The mean age was 51.07 ± 12.05 years, and 65% of participants were male. Road traffic accidents accounted for 51.67% of injuries. Compared with conservative management, surgical fixation significantly reduced hospital stay (7.57 ± 0.50 vs. 9.13 ± 0.78 days), ICU stay (2.00 ± 0.00 vs. 3.46 ± 1.33 days), mechanical ventilation (3.3% vs. 26.7%), and recovery time (31.13 ± 6.51 vs. 40.60 ± 8.09 days) ($p < 0.05$). Surgically managed patients demonstrated earlier reduction in VAS pain scores and analgesic requirements, higher complete radiological union (93.33% vs. 50%), earlier return to normal activities, and fewer complications. **Conclusion:** Operative fixation of rib fractures provides superior clinical and functional outcomes compared with conservative management.

INTRODUCTION

Trauma has emerged as a major public health problem worldwide, with an increasing incidence of polytrauma due to the growing number of motor vehicles and road traffic accidents. Thoracic trauma represents a significant proportion of traumatic injuries and contributes substantially to morbidity and mortality, particularly in developing countries. Multiple rib fractures are among the most common injuries associated with chest trauma and frequently result from high-energy mechanisms such as road traffic accidents, falls, and sports injuries. Since ribs play an important role in maintaining respiratory mechanics and protecting vital thoracic organs, fractures involving multiple ribs can lead to significant physiological and functional impairment. Complications associated with rib fractures include severe pain, reduced tidal volume, paradoxical chest wall movement, respiratory distress, pneumonia, acute respiratory distress syndrome, and prolonged disability, all of which contribute to increased morbidity and delayed recovery (1,2).

Management of multiple rib fractures remains controversial. Although most patients continue to receive conservative treatment consisting of analgesia, ventilatory support, chest physiotherapy, and other supportive measures, prolonged immobilization and inadequate chest wall stabilization may result in poor outcomes. Surgical stabilization of rib fractures has emerged as an alternative treatment approach to restore thoracic stability, reducing pain, improving respiratory mechanics, and facilitating earlier functional recovery. With advances in biomedical engineering, several modern fixation systems have become available for internal stabilization of rib fractures (2).

However, limited evidence exists comparing operative fixation with conservative management, particularly regarding their impact on pulmonary function, complications, pain reduction, quality of life, and overall patient outcomes. (3) Therefore, the present study was undertaken to compare

operative fixation and conservative management of rib fractures in trauma patients with respect to clinical outcomes, functional recovery, complications, and patient-centred outcomes.

METHODOLOGY

Study Design, Site, and Duration: The present study was designed as a prospective cohort study conducted in the Department of General Surgery, Government Medical College and Rajindra Hospital, Patiala. The study was carried out over a period of two years during the postgraduate training period as part of thesis work.

Study Population and Sample Size: The study population consisted of trauma patients presenting with blunt chest trauma associated with one or more displaced rib fractures. Patients of all age groups fulfilling the inclusion criteria were enrolled in the study. Patients with severe head injury (Glasgow Coma Scale < 13), spinal injury, severe lung contusion, persistent coagulopathy, pneumonia, septicemia, or associated injuries requiring emergency surgical intervention were excluded from the study.

A pilot study involving 10 patients (5 in each group) was initially conducted to assess feasibility, refine the study protocol, and standardize the data collection process. Based on pilot observations, the mean hospital stay in the conservative group was higher compared to the surgical group. Using the formula for comparison of two independent means at 95% confidence level and 80% power, the minimum sample size was calculated to be 16 patients per group. To improve reliability, compensate for attrition, and increase study power, the final sample size was increased to 60 participants. The patients were equally divided into two groups: Group A (Conservative Management) and Group B (Surgical Management), with 30 patients in each group.

Data Collection and Study Procedure: Data were collected

using a structured case record form specifically designed for the study. The proforma included patient demographic details, clinical history, associated comorbidities, injury characteristics, radiological findings, treatment details, operative findings, and outcome measures. A detailed history and thorough clinical examination were performed for each participant, and all baseline investigations and imaging findings were systematically documented. Follow-up observations were also recorded in the same proforma to ensure uniformity and completeness of data collection.

After obtaining informed consent, patients underwent detailed clinical and radiological assessment and were randomly allocated into one of the two treatment groups. Patients in Group A received standard conservative management, including multimodal analgesia, respiratory physiotherapy, incentive spirometry, anti-infective therapy where indicated, maintenance of acid-base balance and haemodynamic stability, thoracic drainage in cases of haemothorax or pneumothorax, and mechanical ventilation when clinically required. Treatment was individualized according to the patient's clinical condition.

Patients in Group B underwent operative rib fixation. Surgical management included appropriate patient positioning, muscle-sparing surgical exposure, anatomical reduction of fractures, and fixation using steel sutures, stainless-steel wires, or reconstruction plates. Preservation of periosteum was attempted whenever feasible, and closed suction drains were placed when required. The choice of ribs for fixation depended on the fracture pattern and surgeon discretion, with the aim of restoring chest wall stability and improving ventilation. Early postoperative mobilization and ambulation were encouraged in all surgically managed patients.

Both treatment groups were compared with respect to length of hospital stay, duration of ICU stay, duration of mechanical ventilation, pulmonary function improvement, reduction in pain score using the Visual Analogue Scale (VAS), duration of analgesic medication use, radiological outcomes, complication rates, mortality, patient satisfaction, and quality of life outcomes.

Patients were followed at 24 hours, 48 hours, 1 week, 2 weeks, and 4 weeks after treatment. Follow-up assessment included fracture healing, pain score reduction, duration of analgesic requirement, and functional recovery. Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, and analysis was performed on an intention-to-treat basis while maintaining confidentiality of patient information throughout the study.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants, and confidentiality of patient information was maintained throughout the study.

RESULTS

The present study included 60 participants with rib fractures secondary to thoracic trauma, equally divided between conservative management (n=30) and surgical management (n=30) groups. The mean age of participants was 51.07 ± 12.05 years, with ages ranging from 31–70 years. The highest proportion of participants belonged to the ≥61 years age group (30%), followed by equal representation in the 31–40 years and 41–50 years groups (25% each). A male predominance was observed, with males constituting 65% of the study population and females 35%.

Road traffic accidents (RTA) were identified as the most common mechanism of injury, accounting for 51.67% of cases, followed by falls from height (23.33%) and assault (21.67%).

The most frequent injury pattern observed was multiple rib fractures associated with haemothorax/pneumothorax (48.33%), followed by flail chest with haemothorax /pneumothorax (25%) and bilateral rib fractures with haemothorax/pneumothorax (16.67%).

Table 1:Major Baseline Characteristics

Variable	Major finding
Mean age	51.07 ± 12.05 years
Male participants	65%
Most common mode of injury	RTA (51.67%)
Commonestfracture pattern	Multiple rib fractures with haemothorax/pneumothorax (48.33)
Surgical group	50%
Conservative group	50%

HRCT chest with 3D reconstruction demonstrated superior identification of complex injury patterns, with 43.33% of patients showing multiple displaced rib fractures with hemopneumothorax. In the surgical arm, ORIF with titanium plates was the preferred intervention and was used in 83.33% of patients, while K-wire and stainless-steel suture fixation were used less frequently, depending upon the type of fractures.

Pain management requirements gradually decreased in both groups over time. NSAID and opioid use were initially similar in both groups; however, the surgical group showed an earlier reduction in analgesic requirements. By the first week, only 10 (33%) patients in the surgical group continued NSAID use compared with 27 (90%) patients in the conservative group. By two weeks, NSAID use had further declined, with only 3 (10%) patients in the surgical group requiring NSAIDs compared with 10 (33%) patients in the conservative group. These findings indicate that surgical fixation was associated with earlier pain relief and a faster reduction in analgesic requirements than conservative management. Opioid use had completely ceased in both groups by two weeks, but the surgical group showed an earlier reduction in opioid needs as compared to the conservative group.

Radiological outcomes were more favourable in surgically treated patients. Complete union was observed in 93.33% of surgically managed patients compared with 50% in the conservative group. Delayed union was observed only in conservatively managed patients (26.67%), while malunion was also more frequent in the conservative group (23.33%) than in the surgical group (6.67%).

Table 2: Comparison of Clinical Outcomes Between Groups

Outcome	Conservative	Surgical	P value
Hospital stay (days)	9.13 ± 0.78	7.57 ± 0.50	<0.05
ICU stay (days)	3.46 ± 1.33	2.00 ± 0.00	<0.05
Recovery time (days)	40.60 ± 8.09	31.13 ± 6.51	<0.05
Return to normal activity (days)	18.30 ± 4.13	14.30 ± 4.81	<0.05
Mechanical ventilation	26.7%	3.3%	<0.05
Complete radiological union	50%	93.33%	<0.05

Physiological recovery parameters also demonstrated earlier improvement in surgically treated patients. Pulse rate and respiratory rate decreased more rapidly, while oxygen saturation (SpO₂) improved earlier in the surgical group, reaching near-normal values sooner than in conservatively managed patients. The mean VAS pain score decreased from 6.67 ± 1.69 to 0.00 in the conservative group and from 6.00 ± 1.49 to 0.00 in the surgical group over 6 weeks, with surgically treated patients demonstrating a faster reduction in VAS scores during the early follow-up period.

Complications were more frequent in the conservative group.

Pneumonia (17.86%), prolonged haemothorax (7.14%), abnormal rib movement (3.57%), and chest wall deformity (3.57%) were observed exclusively in conservatively treated patients. The surgical group demonstrated fewer clinically significant complications, although procedure-related events such as numbness (13.3%) and wound infection (3.3%) were noted. No mortality was observed in either treatment group.

DISCUSSION

The findings of the present study were largely comparable with previously published studies evaluating operative fixation versus conservative management of rib fractures. In the present study, a male predominance (65%) was observed, with road traffic accidents being the most common mechanism of injury (51.67%), which is similar to the observations reported by Liu et al. (2), Majeed et al. (1), Bauer et al. (4), and Kao et al. (5), where males constituted the majority of the study population and road traffic accidents represented the predominant cause of injury. Similar to previous studies, surgically treated patients in the present study demonstrated improved clinical outcomes compared to conservatively managed patients. Hospital stay (7.57 ± 0.50 vs. 9.13 ± 0.78 days) and ICU stay (2.00 ± 0.00 vs. 3.46 ± 1.33 days) were shorter in the surgical group, which was consistent with findings reported by Liu et al. (2), Bauer et al. (4), and the meta-analyses by Shiroff et al. (6) and Wijffels et al. (7), all of which demonstrated reduced hospitalization and ICU stay among surgically managed patients. The present study also demonstrated a lower requirement for mechanical ventilation in the surgical group (3.3% vs. 26.7%), supporting findings reported by Majeed et al. (1) and Shiroff et al. (6). Furthermore, faster reduction in pain scores, earlier reduction in analgesic use, and earlier return to normal activities observed in the present study were comparable to the results of Majeed et al. (1) and Kao et al. (5), which reported improved pain outcomes following surgical fixation. Complications such as pneumonia and prolonged haemothorax were more frequently observed in conservatively managed patients in the present study, consistent with Liu et al. (2), Xu et al. (3), and Shiroff et al. (6), who also demonstrated lower complication rates with surgical stabilization. Overall, the findings of the present study support existing evidence suggesting that surgical fixation provides better functional recovery and improved clinical outcomes compared with conservative management.

CONCLUSION

The present study demonstrated that operative fixation of rib fractures was associated with better clinical outcomes compared to conservative management in trauma patients with multiple rib fractures. Surgically managed patients showed faster improvement in respiratory parameters, earlier reduction in pain and analgesic requirements, shorter hospital and ICU stay, earlier return to normal activities, and superior radiological healing. Complications such as pneumonia, prolonged haemothorax, and chest wall deformity were more common in the conservative group, while only minor procedure-related complications were observed in the surgical group. Overall, operative fixation appears to be a safe and effective treatment option that may improve functional recovery and reduce morbidity in appropriately selected patients with rib fractures.

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