

Operative Management versus Non-operative Management of Multiple Rib Fractures and Flail Chest after Blunt Trauma Chest: A Prospective Analysis

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Abstract

Introduction: Thoracic traumas are one of the most common causes of mortality due to trauma, multiple rib fractures, and flail chest being the most lethal among them.

Purpose: The purpose of this study was to find out the best treatment modality in patients with rib fractures.

Materials and Methods: This was a prospective study, in which out of 40 patients, 20 underwent operative, and 20 underwent conservative procedures.

Results: Through the cases performed in this study, we have tried to prove that patients, who were managed operatively for multiple rib fractures, especially flail chest, required a shorter duration of ventilatory support, were less likely to require tracheostomy and were less likely to develop septicaemia than patients managed conservatively. The other inferences made from this study were that males were affected with chest trauma more than females and the mean age was 45 years in both genders. The most common cause of chest trauma was road traffic accidents, followed by fall from height and assault.

Conclusion: This study demonstrates reduction in both intensity of pain and duration of disability through operative repair which has been established by other studies too.

Key words: Fixator plates, Flail chest, Rib fractures, Thoracic trauma, Thoracotomy

INTRODUCTION

Approximately 10–15% of all traumas are thoracic traumas and they cause death in 25% of all mortalities due to trauma. The wide range of thoracic trauma ranges from an undisplaced/minimally displaced rib fracture with minimal lung injury to multiple displaced rib fractures with severe lung contusion and hemorrhage. Patients with multiple rib fractures are predisposed to pulmonary insufficiency and

compromised ventilation causing hypoxemia, hypercarbia, and pH disturbances. Furthermore, paradoxical chest wall motion noted in flail chest injuries and the rib fracture pain can cause significantly low tidal volumes, alveolar collapse, and hypoxemia.

Non-operative management includes extensive use of analgesics, intercostal drainage, and mechanical ventilation. Operative intervention involves reduction and internal stabilization of the fractured ribs using fixator plates, intramedullary nails or wires, and struts.

Operative versus non-operative management for rib fractures in 40 patients of thoracic trauma was compared in this study, out of which 20 were subjected for conservative management and 20 were operated. Conclusions were drawn on the basis of reduction of

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pain and days required to return to normal activity in both the groups.

MATERIALS AND METHODS

In this randomized study, 40 patients with multiple rib fractures were studied; 20 were managed conservatively and 20 operatively. Comparisons between the cases and controls were made on the following basis:

- Duration of disability or return to work
- Intensity of pain.

Self-assessment of pain was done by patients at days 5, 10, 30, and 45 post-injury using Wong Baker Faces Pain Assessment Scale [Figure 1]. Patients with 2 or more rib fractures or with flail chest were included in the study.

Following patients were excluded from the study:

- Patients having fractures at non accessible sites
- Vitrally unstable patients requiring mechanical ventilation or ones which are comatose
- Patients having fracture in floating ribs
- Patients who did not give consent to be a part of the study.
- Figure 2 is an example of a patient with left sided multiple rib fractures showing intraoperative image of rib fixation and Figure 3 is the postoperative Xray of the same patient.

Indications and Technique of Rib Repair

Indications

- Management of pain
- Chest wall defect and deformity
- Non-union of ribs
- Flail chest
- “On the way out” for thoracotomies.

Technique of rib repair^[1-4]

1. Extramedullary fixation
 - Anterior plating with wire cerclage or bicortical screws.
 - Judet Strut
 - U-Plate
 - Absorbable plates.
2. Intramedullary fixation^[5,6]
 - Kirschner wire fixation
 - Wire cut out
 - Rehbein intramedullary splint.

Complications

There are various complications reported such as superficial wound infections, wound drainage without infections, empyema, wound hematoma, and persistent

pleural effusion. Fixation failure (due to plate loosening or wire migration) and chest wall stiffness and pain requiring plate removal have been reported in some patients. A few patients have also reported osteomyelitis, and the most common cause for that was infection from *Staphylococcus aureus* which was due to the contamination from a pre-operative chest tube.

RESULTS

The mean age of the patients in this study was 36 years and there was a male predominance.

Distribution according to age		
Age	Number	Percentage
18–40 years	28	70.0
41–60 years	11	27.5
>60 years	1	2.5
Total	40	100.0

Twenty-eight (70%) patients were in the age group 18–40 years, 11 (27.5%) were in the age group 41–60 years, and 1 (2.5%) patient was of age more than 60 years. The mean age of the patients was 35.98 ± 8.95 years (range: 18–62 years). Majority of patients sustained thoracic injury due to road traffic accidents, followed by fall from height and assault.

Distribution according to mode of trauma		
Mode of Trauma	Number	Percentage
Assault	4	10.0
Fall from height	6	15.0
Road traffic accident	30	75.0
Total	40	100.0

Four (10%) patients sustained injury due to assault, 6 (15%) patients sustained injury due to fall from height, and 30 (75%) patients sustained injury due to road traffic accident. The mean number of days of work lost was significantly higher in conservative group (57 days) compared to operative group (37 days).

Comparison of mean number of days of work lost in relation to type of management

Type of management	Number	Mean±SD	t-value	P-value
Conservative	20	57.15±11.60	6.603,	0.001*
Operative	20	36.90±7.31	df=38	
Total	40			

Unpaired “t” test applied. $P=0.001$, Significant

In conservative group, the mean number of days of work lost was 57.15 ± 11.60 days and in operative group, it was 36.90 ± 7.31 days. The mean number of days of work lost was significantly higher in conservative group compared to operative group ($P = 0.001$). The mean visual analog scale

Comparison of VAS between the types of management

VAS	Conservative (Mean±SD)	Operative (Mean±SD)	t-value	P-value
Day 0	5.30±1.56	6.80±1.06	-3.562, df=38	0.001*
Day 5	5.60±1.39	7.70±0.57	-6.243, df=38	0.001*
Day 15	6.05±1.28	8.35±0.49	-7.525, df=38	0.001*
Day 30	6.70±1.22	8.75±0.72	-6.487, df=38	0.001*
Day 45	7.30±1.22	9.25±0.64	-6.340, df=38	0.001*

Unpaired t-test applied. $P < 0.05$ was taken as statistically significant, VAS: Visual analog scale

(VAS) score in conservative group was significantly lower than operative group at all-time intervals.

- At Day 0, the mean VAS in conservative group was 5.30 ± 1.56 and in operative group was 6.80 ± 1.06 . The difference was found to be statistically significant ($P = 0.001$), showing a significantly higher VAS in operative group
- At Day 5, the mean VAS in conservative group was 5.60 ± 1.39 and in operative group was 7.70 ± 0.57 . The difference was found to be statistically significant ($P = 0.001$), showing a significantly higher VAS in operative group
- At Day 15, the mean VAS in conservative group was 6.05 ± 1.28 and in operative group was 8.35 ± 0.49 . The difference was found to be statistically significant ($P = 0.001$), showing a significantly higher VAS in operative group
- At Day 30, the mean VAS in conservative group was 6.70 ± 1.22 and in operative group was 8.75 ± 0.72 . The difference was found to be statistically significant ($P = 0.001$), showing a significantly higher VAS in operative group
- At Day 45, the mean VAS in conservative group was 7.30 ± 1.22 and in operative group was 9.25 ± 0.64 . The difference was found to be statistically significant ($P = 0.001$), showing a significantly higher VAS in operative group
- The mean VAS score in conservative group was significantly lower than operative group at all the time intervals ($P < 0.05$) [Figure 4]
- In patients with flail chest, VAS score showed a better value with operative management than conservatively managed patients. As the patients in operative group were able to regain their daily activities sooner, it was found that the use of analgesics was for lesser number of days in operative group than the conservative group. [Figures 1-4].

DISCUSSION

A number of case series and research articles have been published which support the trends observed in this study.^[7] In general, all of the studies favored operative fixation

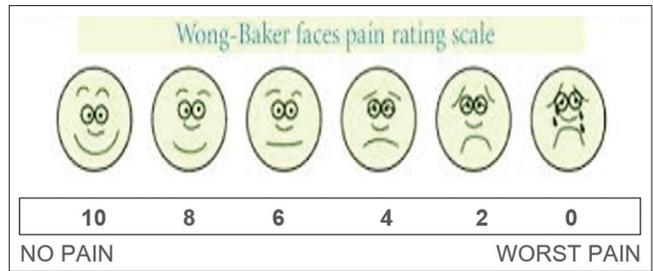


Figure 1: Wong-baker pain assessment scale

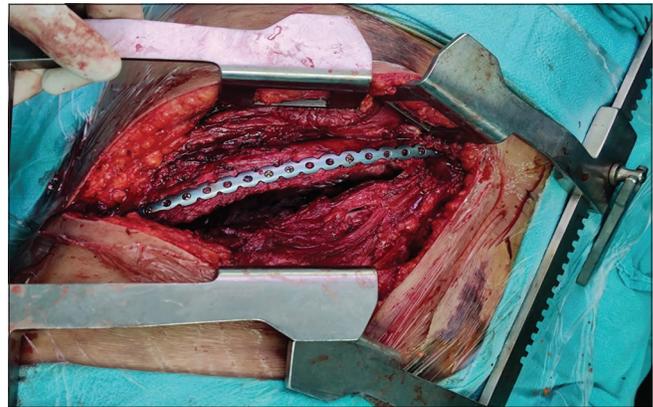


Figure 2: Intraoperative image of rib fixation



Figure 3: Post-operative X-ray

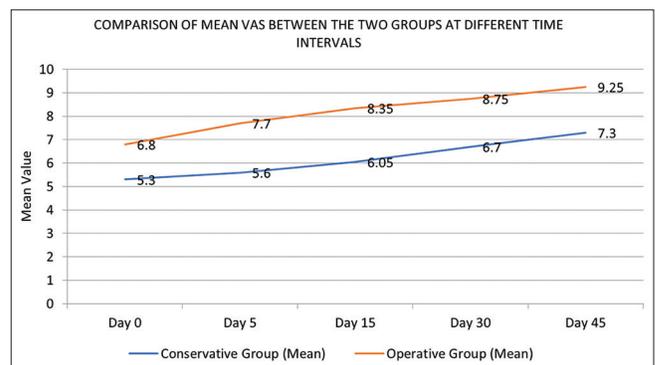


Figure 4: Mean visual analog scale between the two groups

of fractured ribs, there was a significant decrease in the number of days requiring mechanical ventilation, number of days in intensive care unit (ICU), and other pulmonary complications.^[8]

Lardinois *et al.*^[9] did a prospective evaluation of 66 patients who required surgery for flail chest out of a total of 732 patients. There were anterolateral flail segments in all of these patients. Reconstruction plates (made of stainless steel) were used for fixation. The mean ventilator time was significantly reduced to 2.1 days and immediate extubation was possible in 47% patients. Approximately 100% of the patients returned to their work within 2 months of surgery. Few patients required plate removal due to hardware related pain.

Nirula *et al.*^[10] did a retrospective study which compared flail chest patients, half of which underwent surgery and the other half managed conservatively. Adkins Struts were used for fixation of flail segments. The operative group showed a significantly lower number of ventilator days measured from the time of surgery to extubation. This study also determined the complication rates associated with surgical fixation. Various complications were noted such as superficial wound infections, draining wounds without infections, wound hematoma, empyema, persistent pleural effusion, and hardware failures and removal.

Tanaka *et al.*^[11] randomized 37 flail chest patients which were managed conservatively or operatively and compared them on the basis of requirement of mechanical ventilation. The surgically repaired group exhibited fewer days in the ICU and on ventilator and showed lower pulmonary complications than non-operative group.

Ahmed and Mohyuddin^[12] compared 38 patients that were treated non surgically using positive pressure ventilation with 26 patients, in which k-wire fixation of one rib of the flail segment was done. Other related complications such as hemothorax or a major air leak, and associated abdominal and orthopedic injuries were treated surgically. Groups were not matched or randomized and no statistical analysis was performed. They reported better outcomes in number of ventilator days, number of ICU days, number of patients requiring tracheostomy, chest infection rate, sepsis rate, and mortality rate, in patients that were managed operatively.

Granetzny *et al.*^[13] reported a randomized trial of 40 patients, in which the operative group exhibited considerably less mechanical ventilation, ICU and admission days, and pneumonia compared to patients managed conservatively. In the operative group, forced vital capacity and total lung capacity were extensively higher, and chest wall deformity or persistent flail chest were significantly less.

This study was different than the other studies as the above-mentioned studies address mainly to flail chest. Most of the patients included in our study had multiple rib fractures, and these are the major portion of all thoracic trauma patients appearing in Outpatient department and emergency rather than flail chest.

Limitations

Several limitations of this study must be addressed:

- First, the sample size of this study was very small. This was due to limitations of admission of patients in COVID Pandemic and due to short duration of the study. Still, this study was unique in comparing on intensity of pain and duration of disability
- Second, very limited parameters of the patients were assessed. No comparison on ICU days or admission days of patients was made. There are various parameters which affect the healing of wound and recovery like socioeconomic factors or nutrition status, which were not evaluated in this study
- Third, there was no long-term follow-up of the patients and as a result pulmonary complications were not satisfactorily evaluated. Due to this, the effect of stabilization on functional outcome of the patients that were operated was not assessed with their counterparts
- Finally, there was no standardized protocol for pain management in the control group.

CONCLUSION

Out of the 40 patients with rib fractures, 20 underwent an operative procedure for rib fracture stabilization (cases) and 20 were managed conservatively (controls) and comparisons were made between the two. This study demonstrates reduction in both intensity of pain and duration of disability through operative repair which has been established by other studies too. Both the criteria were evaluated by patients themselves.

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