A prospective single center study to assess the impact of surgical stabilization in patients with rib fracture

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ABSTRACT

Objective: To compare the intensity of pain and duration of return to normal activity in patients with rib fractures treated with surgical stabilization with plating versus conventional treatment modalities.

Patients and methods: This study was conducted over a 12 month period. Patients with rib fractures were assessed by numerical pain scale. Patients having pain scale less than 5 were excluded from study. Patients having pain scale of 5 or more than 5 were treated with conventional treatment for next 10 days. On 11th day patients were again assessed by numerical pain scale and patients having score less than 5 were excluded from study. Patients having pain scale of 5, 6, and 7 were treated with conventional treatment and patients having pain scale of 8, 9, and 10 were selected for operative management. Operative and control group were compared on basis of intensity of pain and duration of return to normal activity. Follow up was done on 5, 15, and 30 post operative day.

Results: There was less pain in operative group as compared to control group. Mean rib fracture pain in operative group was 9.15, 2.31, 1.12 as compared to 6.25, 5.96, 4.50 in control group on 5, 15 and 30 post operative days. Also there was early return to normal activity in operative group.

Conclusion: Surgical stabilization of rib fracture, an underutilized intervention is better than conventional conservative management in terms of both, decrease in intensity of pain and early return to normal activity.

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1. Introduction

Rib fractures are a painful and disabling injury found in thoracic trauma patients. Most simple rib fractures heal with minimal intervention or consequence. As the number of fractured ribs increases, there is an exponential increase in morbidity and mortality.1,2 Rib fracture patients are, on the whole, significantly more disabled at 30 days than are patients with chronic medical illness and lose on average 70 days of work or usual activity.3

The objective of management for rib fractures is to provide adequate analgesia to the patients. Rib fractures are dealt with operative and non-operative strategies. Non-operative management has shifted from conventional chest strapping and use of analgesics (both oral and intravenous) to only analgesic without strapping. Operative management, though being performed at selected centers around the world has still not been utilized to its full potential. Our study aims to fill this void by bringing forth a systematic surgical management of rib fracture patients within the available resources and minimum infrastructure, so as to be able to further propagate this for use in a wide variety of setting worldwide.

2. Patients and methods

This prospective, study was conducted in our institute over a 12 month period. Total of 118 patients (age above 18 year) with rib fractures were admitted between July 2009 to June 2010. Patients having Glasgow Coma Scale of less than seven at presentation were excluded from study. The Thesis Ethics Committee of the Hospital approved our study protocol.

All patients admitted with rib fractures were assessed by numerical pain scale.4 A numerical pain scale allows us to describe the intensity of discomfort in numbers ranging from 0 to 10. Patients having pain scale less than 5 were excluded from study. Patients having pain scale of 5 or more than 5 were treated with conventional treatment modality for next 10 days. Also during this period any associated co morbid condition was corrected and all pre anesthetic workup was done. On 11th day patients were again assessed by numerical pain scale and patients having score less than 5 were excluded from study.
Patients having pain scale of 5, 6, and 7 were treated with conventional treatment and patients having pain scale of 8, 9, and 10 were chosen for operative management (Fig. 1).

Operative and control groups were compared on the basis of intensity of pain and duration of return to normal activity. Pain was graded by patients on days 5, 15, 30, post operative day and was assessed by us using the same numerical pain scale varying from 0 (no pain) to 10 (the worst pain). The type and amount of analgesics or narcotics received by in patients or self administered by outpatients were determined from the nursing/pharmacy record or by patient self-report.

To know the duration of return to normal activity we simply asked when the patient was able to return to usual daily activities.

Data were considered valid if obtained within 1 day of day 5, within 2 days of day 15, within 3 days of day 30. All measurements were calculated by trained research assistants blinded to the patients’ allocation.

Radiologic confirmation of rib fracture by chest radiography and computed tomographic scan was done. Tube thoracostomy was performed if they had pneumothorax or hemothorax. The patients in the outpatient clinic were followed with chest X ray.

Out of 38 patients of operative group 6 patients were excluded from study for having fracture at non accessible site such as behind the scapula or close to spine, and not willing for operation.

Three-dimensional computed tomographic reconstructions were used to better identify all rib fractures and to delineate the surgical incision (Fig. 2). We used titanium made mandible reconstruction plates in our study. These plates are less expensive and readily available in our institute (Fig. 3).

Patients were operated on 12th day of presentation and followed on 5, 15 and 30 post operative day. Patients of control group were followed (starting from 12 day of presentation) on 5, 15, and 30 day.

3. Results

Participants included 40 males (65.57%) and 21 females (34.42%) ranging in age between 22 and 64 years.

Mean age of presentation in operative and conservative group was 47.38 and 45.30 respectively. One patient was lost to follow up in control group.

The leading cause of trauma was road traffic accidents (57.69%). The second most common cause of trauma was fall (26.9%) followed by assault (15.38%).

Average number of rib fractures in conservative and operative group was 3.10 and 3.34 respectively (Table 1).

Fig. 1. Overview of study design.

Fig. 2. 3-D computed tomographic chest showing rib fracture marking done with lead wire highlighted with red dots.

Fig. 3. Intra operative photo graph showing fracture being stabilized with titanium plate.
Out of 61 patients, 27 patients (14 of operative group and 13 of conservative group) do not have any co morbid conditions. Most common co morbid condition in both groups was blunt trauma abdomen.

Though control group was initially having less pain (as seen on scale) there is mild pain at 15 days in operative group as compared to severe pain in control group which continues in the same trend at 30 days (Table 2).

For duration of return to normal activity, there is difference of around 28 days in operative and control groups (Table 3).

Mann–Whitney test using SPSS V16 was applied for pain assessment scale and $t$ test for duration of early return to normal activity. Both test proved a statistically difference between operative and control group (Table 3).

### 4. Discussion

Because rib fractures are common, any improvements in pain control and disability would have a proportionately positive effect on the health and economic status of a large number of patients. The indications for fixation remain controversial because of lack of adequate studies. However, several studies suggest benefit to patients. Despite this evidence, the procedure remains mostly underutilized.

This study done at our hospital draws attention to that there is scope for improvement in treatment for patients with rib fractures. There were 32 patients undergoing rib fracture stabilization procedure with 29 kept as controls.

There are sporadic reports in literature of surgical approaches to rib fractures. More specifically Tanaka et al., Granetzny et al., Lar- dinois et al.5–7 all favoring operative fixation. Our study is different from all above study since all studies address flail chest only. In our study only two patients of flail chest were operated. Most of the patients in our study had 2 or 3 rib fractures. And actually these are the major chunk of all thoracic trauma patients attending to OPD rather than flail chest.

In our study we made the use of titanium mandibular reconstruction plates that are similar to anatomical rib plates and provide good strength. These plates were a 2.7 mm in thicknesses used along with 8 mm fixation screws. These plates and screws are readily available in our institute and cost very little around 22 US $.

Rib fracture pain originates at the site of the fractured bone and injured muscle and is usually reported by patients to be exacerbated by any movement of the chest wall (e.g., with respiration and most certainly with deep breathing and coughing). Interventions that have proven effective to provide short-term control of pain include epidural analgesia, intrapleural instillation of local anesthetics, rib blocks, and intravenous narcotics/NSAIDs.8–13 The disadvantage of these interventions is that they cannot be continued for the duration of time that a patient with rib fractures has significant pain. We used NSAIDs as per our institute protocol in different doses according to different thresholds of different person for initial 10 days period. Latter operative group was kept on paracetamol tablets and control group on same analgesic as was on 10 days before.

Nirula et al.14 collected information on 650 rib fracture repairs reported in the literature to determine the complication rates associated with surgical fixation. Complications included eight superficial wound infections (1.2%), four draining wounds without infection, two pleural empyemas, one wound hematoma, one persistent pleural effusion and one case of osteomyelitis. They noted eight hardware failures and nine patients requiring hardware removal. In our study the most common complication was post thoracotomy pain syndrome with no evidence of pleural effusion or fixation failure (Table 4).

Overall it appears that surgical stabilization with plating reduced pain and duration of disability/return to work to a wider extent than conventional treatment alone.

We acknowledge several limitations of our study. First this study was conducted on very small number of patients. Though to our knowledge this is the largest study be conducted in this short duration of time and unique in terms of comparing on intensity of pain and duration of early return to normal activity. Second patients were not matched in terms of age, sex and nutrition status. Third there was no standardized protocol for pain management in control group due to difference in threshold levels of different patients as well as management being done at different levels in the institute.

There are ongoing trials for less-invasive stabilization of rib fractures such as use of intramedullary rib splints.15 Results are still awaited.

Duration of hospital stay needs to be assessed. It is not possible in our study since chest trauma is a part of poly trauma and multiple factors need to be addressed. More studies are required to include all these multiple factors.

### 5. Conclusion

Our study gives an idea that chest trauma patients with rib fracture can be managed surgically with limited resources and low complication rate. Surgical stabilization of rib fractures patients...
with criteria as discussed above should be done and is better than conventional conservative management in terms of both decrease in intensity of pain and early return to normal activity.

Conflicts of interest
Nothing to declare.

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Nothing to declare.

Ethical approval
Yes approval was given by Ethical Committee of the Hospital.

Author contribution
Corresponding author: Dr. Khandelwal Gaurav (M.B.B.S, M.S) - data collection, writing, procedure done.
Co authors: Dr Mathur R.K (M.S, MNAMS, FICS, FAIS) - study design. Dr Shukla Sumit (M.S) - study design, procedure done, data analysis. Dr Maheshwari Ankur (M.S) - study design, data collections, data analysis.

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