Rib Fixation for Severe Chest Deformity due to Multiple Rib Fractures

Hitoshi Igai, MD, PhD, Mitsuhiro Kamiyoshihara, MD, PhD, Toshiteru Nagashima, MD, and Yoichi Ohtaki, MD

The operative indications for rib fracture repair have been a matter of debate. However, several reports have suggested that flail chest, pain on respiration, and chest deformity/defect are potential conditions for rib fracture repair. We describe our experience of rib fixation in a patient with severe chest deformity due to multiple rib fractures.

A 70-year-old woman was admitted with right-sided multiple rib fractures (2nd to 7th) and marked chest wall deformity without flailing caused by an automobile accident. Collapse of the chest wall was observed along the middle anterior axillary line. At 11 days after the injury, surgery was performed to repair the chest deformity, as it was considered to pose a risk of restrictive impairment of pulmonary function or chronic intercostal pain in the future.

Operative findings revealed marked displacement of the superior 4 ribs, from the 2nd to the 5th, and collapse of the osseous chest wall towards the thoracic cavity. After exposure of the fracture regions, ribs fixations were performed using rib staplers. The total operation time was 90 minutes, and the collapsed portion of the chest wall along the middle anterior axillary line was reconstructed successfully.

Keywords: rib fixation, chest deformity, multiple rib fracture

Introduction

The operative indications for rib fracture repair have not been established and are considered to be an issue of debate. However, several reports have suggested that flail chest, pain on respiration, and chest deformity/defect are potential conditions for rib fracture repair if the patient’s post-traumatic cardiopulmonary status is stable and the trauma does not extend to other organ systems.

In this case report, we describe successful results of rib fixation for severe chest deformity in a patient with multiple rib fractures and a review of relevant literature.

Patient

A 70-year-old woman was admitted with right-sided multiple rib fractures (2nd to 7th) and chest wall deformity without flailing caused by an automobile accident. Chest computed tomography (CT) revealed right-sided multiple ribs fractures, from the 2nd to the 7th, with especially marked displacement of the superior 4 ribs, 2nd to 5th, from the normal position (Fig. 1). Collapse of the chest wall was evident along the middle anterior axillary line. Chest X-ray also demonstrated the rise of the density in the right side thorax due to the chest wall collapse (Fig. 2A). At 11 days after the injury, surgery was performed to reconstruct the chest deformity, because it was considered to pose a risk of restrictive pulmonary function impairment or chronic intercostal pain in the future.

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Fig. 1  Chest computed tomography revealed right-sided 2nd to 7th multiple rib fractures, affecting especially the superior 4 ribs, from 2nd to 5th, which were severely displaced from the normal position (arrows).

Fig. 2  A: Chest X-ray demonstrated the rise of the density (arrows) in right side thorax due to the chest wall collapse.  
          B: Postoperative chest X-ray demonstrated that improvement of this density rising in right side thorax.
After double-lumen endotracheal intubation, the patient was placed in the lateral decubitus position. An 8-cm anteroaxillary skin incision was made, and with the latissimus dorsi muscle in traction toward the back side, the serratus anterior muscle was split along the muscle bundles. A wound retractor (Alexis Wound Retractor, Applied Medical, CA, USA) was then placed through the incision to prevent postoperative wound infection and provide a good operative view. As had been shown by preoperative CT, the superior 4 ribs, from the 2nd to the 5th, were markedly displaced, and the osseous chest wall had collapsed towards the thoracic cavity. After exposure of the fracture regions, fixation of the superior 4 ribs was performed using rib staplers (Matsuda Ika Kogyo Co., Ltd., Tokyo, Japan), which provided sufficient chest stabilization (Fig. 3). Then, the wound retractor was removed, and the operation was completed. The total operation time was 90 minutes, and blood loss was 20g. The collapsed area of the chest wall along the middle anterior axillary line was reconstructed successfully. Postoperative chest X-ray demonstrated that improvement of the density rising in the right side thorax due to the chest wall collapse (Fig. 2B). Chest X-ray 2 months after the surgery showed no displacement of treated ribs using rib staplers.

Discussion

Surgeons sometimes encounter cases of rib fracture due to chest trauma requiring surgical repair. In recent years, many authors have insisted their own opinion for operative indications of rib fracture, and the issue has been a matter of debate.1–4

Although not observed in the present case, several authors have suggested that flail chest, which does not improve in spite of positive pressure ventilator support, is a condition for which surgery is required.1–4 In a randomized controlled study, Tanaka et al.1 reported that surgical repair for flail chest had a beneficial effect with respect to a reduced need for mechanical ventilation, was associated with a lower incidence of pneumonia, and allowed a shorter stay in the trauma intensive care unit, thus reducing medical costs, in comparison with internal fixation of ribs. In the present case, the surgical objective was to repair severe chest deformity that was considered to pose a risk of future chronic chest pain, which is a common long-term problem, and restrictive impairment of pulmonary function.2 Because the deformity in this case was particularly severe, we considered that the risk of these post-traumatic sequelae was comparatively high.

When surgical treatment is performed for patients with rib fracture, general anesthesia is problematic because the patient’s post-traumatic cardiopulmonary status is sometimes unstable or the trauma frequently extends to other organ systems. Therefore, many authors have suggested exclusion criteria for surgical rib fracture repair, even though fundamentally recommending this invasive treatment.2–3 According to the randomized trial of Granetzy et al. suggested the following exclusion criteria2): 1. Head trauma with disturbance of consciousness. 2. Associated
injuries such as myocardial contusion, which might be adversely affected by general anesthesia. 3. Severe associated trauma to other systems. Fortunately, in our patient, the general condition including cardiopulmonary status was comparatively good. Therefore, we were able to perform rib fixation under general anesthesia safely and successfully.

Among other postoperative complications, surgical site infection has been reported. Patients whose general condition is unstable due to multiple and severe trauma are comparatively compromised. In addition, foreign body reaction induced by implantation of metal rib staples can increase the probability of wound infection. In a literature review, Nirula et al. reported that only 1.2% of all patients with rib repair suffered postoperative wound infection. Thus, the probability of wound infection as a postoperative complication is not high. However, wound infection after rib repair may induce osteomyelitis, which sometimes necessitates plate removal or becomes life-threatening. In the present patient, we placed a wound retractor through the incision to minimize postoperative wound infection.

In our department, either a rib stapler or bioabsorbable rib-connecting pin is frequently used for repair of a rib fracture. In this case, the ribs were fractured along both the long and short axes. In case of the rib fracture along the long axis, reconstruction using rib-connecting pin is difficult. On the contrary, rib stapler can grasp the fractured rib along the long axis; therefore, rib stapler is useful for the repair of rib fractures along the long axis as our case compared with rib-connecting pin.

References