

## Chest Wall Reconstruction for Chronic Intrathoracic Wounds Using Various Flaps

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### Abstract

The treatment of chronic chest wounds should be focused on eradicating the infection and obliterating the dead space thus providing improved pulmonary function. Chronic chest wounds, although the incidence has decreased over the years, is still associated with high morbidity and prolong hospitalization. In cases where the disease is advanced and conventional measures fail, aggressive approaches achieve adequate resolution or significant improvement. This paper reports four cases of chronic chest wound including bronchopleural fistula and osteomyelitis managed by debridement followed by muscle coverage using latissimus dorsi, rectus abdominis, and omental flap. The intrathoracic reconstruction entails thorough debridement of empyema cavities, bronchopleural fistulas and infection focus. The infection must be completely eradicated prior to or at the time of flap transposition. The flaps used for obliteration of dead spaces provided adequate bulk, abundant blood supply, and minimal donor morbidity. The results were satisfactory with improved respiratory function without complications.

**Key Words :** Intrathoracic reconstruction, Bronchopleural fistula, Latissimus dorsi flap, Rectus abdominis flap, Omental flap

### INTRODUCTION

Common causes leading to intrathoracic wounds are chronic empyema cavities, infected bronchopleural fistula, and purulent mediastinitis. Although various anti-tuberculosis medications has played a major role in reduction of incidence of tuberculosis empyema and bronchopleural fistula, the

incidence still remains high in Korea. Also complications after open-chest surgery are encountered. Most cases of chest empyema can be treated conventionally with drainage, decortication, thoracoplasty, and other methods. But problems such as bronchopleural fistula and empyema are more difficult, requiring long-term treatment and aggressive treatment protocols. Mediastinitis results from various causes including,

**Table 1.** Summary of Cases

	Sex	Age	Diagnosis	Flap used	Follow up	Complications
1	F	17	Bronchopleural fistula due to tuberculosis	Latissimus dorsi	53 weeks	None
2	M	58	Bronchopleural fistula due to tuberculosis	Latissimus dorsi	64 weeks	None
3	M	37	Mediastinitis with osteomyelitis after surgery	Rectus abdominis	32 weeks	Recurred
4	M	37	Mediastinitis after reconstruction with rectus abdominis muscle flap	Omentum	70 weeks	None

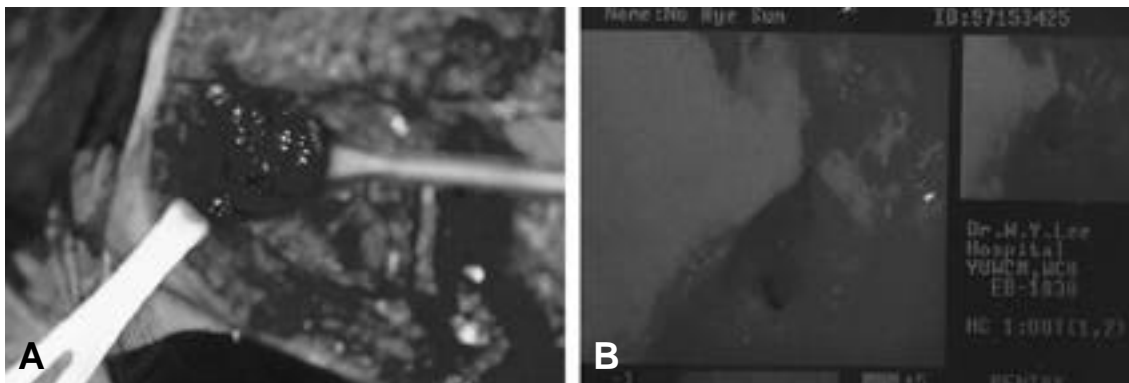
surgery, tumor, radiation and some congenital defects. Various muscle flaps has been used to cover the defects of chest and to reconstruct the intrathoracic cavity. Widely preferred flaps are pectoralis major, latissimus dorsi, serratus anterior, rectus abdominis and omentum<sup>1,4,8,12,15)</sup>. The latissimus dorsi flap was used by Tansini(1906) in reconstruction of chest wall<sup>1)</sup>. Some of the advantage it provides are; location within reach of anterior and posterior sectors of thorax, large and excellent bulk, and pedicle being located in the axilla area prevents the pedicle from possible trauma on the chest. This excessive bulk provides obliteration of dead space in large defects. Microvascular free flaps are reserved for situations when regional options are unavailable or have previously failed. The omental flap for reconstruction of chest wounds were first described by Carberry in 1975 and later by Jurkiewics<sup>9)</sup>. One of the major advantages it supplies is the ability to obliterate large empty space<sup>5)</sup>. These flaps provide abundant bulk and blood supply necessary to obliterate the dead space and augment antibiotics distribution in the lesion.

There were 4 cases in our series. Chronic intrathoracic wounds were reconstructed with muscle flaps and the patients were able to obtain full eradication of infection, prompt wound healing, decreased morbidity, gradual improvement of pulmonary function, and a better quality of life.

## PATIENTS AND METHODS

There were 3 patients, 1 female and 2 male, and 4 cases in our series. The ages ranged from 17 to 58 years. All patients had chronic wounds, 2 cases of chronic bronchopleural fistula and 2 cases of mediastinitis with osteomyelitis. One patient had previously undergone local flap coverage with little success leading to reconstruction with omental flap(Table I). Average follow-up period was 55 weeks.

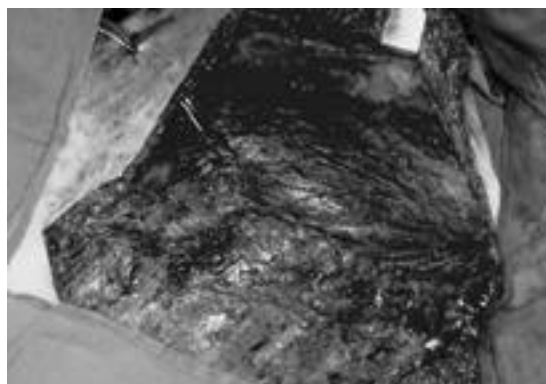
Local muscles are usually preferred for reconstruction of chest and intrathoracic cavity obliteration. The latissimus dorsi was the first choice followed by rectus abdominis. A case where local muscles couldn't be utilized due to trauma, radiation, previous osteotomy incision, omental flap became a good choice. It is imperative to achieve complete debridement. In case of osteomyelitis, rib bone, sternum, or both should be debrided as well. The infections were controlled with systemic antibiotics and anti-tuberculosis medications prior to reconstruction. After surgery, cautious respiratory therapy and proper systemic antibiotics are given. Patient was then given an intensive physiotherapy two to three weeks after surgery.



**Fig. 1.** 58-year-old male patient with tuberculosis empyema and bronchopleural fistula. **A.** Exposed fistula prior to debidement. **B.** Seen through fibrobronchoscope.

### RESULT & CASES

Primary healing was achieved in all 4 cases. But one case had recurrent osteomyelitis 12 weeks after surgery. The residual infection was debrided at second admission and was covered with omental flap without further complications. The patients with bronchopleural fistula were free of tuberculosis and follow-up radiologic findings showed marked improvement. The patients with chronic mediastinitis were cleared from infection. Long-term pulmonary function tests also showed improvement.

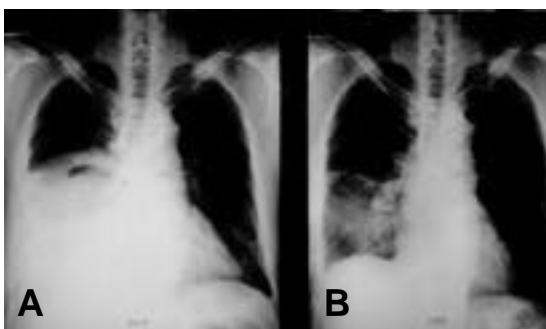


**Fig. 2.** Complete obliteration with latissimus dorsi muscle flap.

### CASE REPORTS

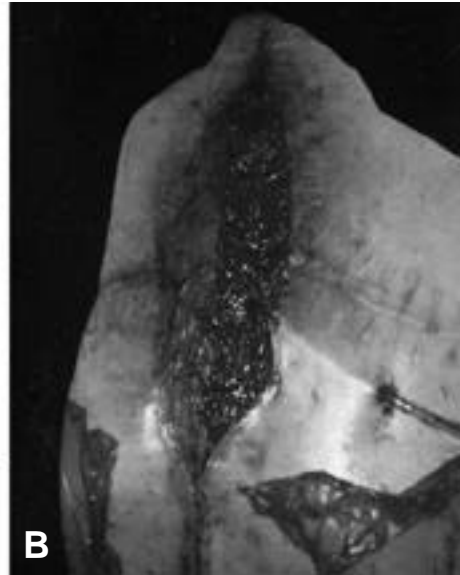
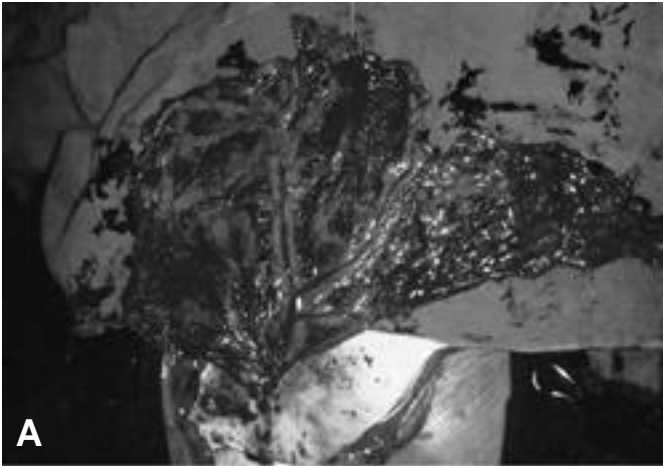
#### Case 1

A fifty-eight-year-old male was consulted to our department for treatment of bronchopleural fistula and empyema due to tuberculosis of the right lung. At the time of diagnosis the patient complained of dyspnea and hemoptysis. The patient was diagnosed in an advanced stage of tuberculosis and closed thoracostomy was performed but failed to achieve further improvement. Debridement was performed once prior to



**Fig. 3.** Roentgen ray seen prior **A** and after surgery **B**.

flap surgery and relative improvement was noted on the follow-up X-rays. On the following operation, debridement and coverage with latissimus dorsi transposition flap was performed(Fig. 1,2). The X-ray



**Fig. 4-A.** 37-year-old male patient with elevated omental flap for reconstruction of chronic mediastinitis. **B.** After inset of the flap.

findings showed homogenous density of the right lower chest clearing after debridement and flap coverage(Fig. 3). Healing process was uneventful. The patient was discharged 17 days after operation. Pulmonary function tests showed improved results.

#### Case 2

A seventeen-year-old female had complaints of severe hemoptysis and dyspnea when diagnosed with tuberculosis. Immediate medication began but symptoms were aggravated thus needing closed thoracostomy 7 months after diagnosis. Cold abscess was formed and removed 3 months after thoracostomy. The patient was consulted for treatment of empyema thoracentesis with bronchopleural fistula of the left chest. 15 months after initial diagnosis, debridement and coverage with latissimus dorsi transposition flap was performed. Healing was uneventful and patient was discharged 24 days after operation. Pulmonary function test showed improved functions.

#### Case 3

A thirty-seven-year-old male was consulted to our department for reconstruction of open sternal wound. The patient showed marked purulent discharge due to mediastinitis 8 weeks after surgical correction of dissecting aneurysm of aorta. After complete debridement, reconstruction of the chest using rectus abdominis muscle was performed. Primary healing was uneventful. Six months after reconstruction, the patient began to show discharge through a draining sinus at the lower margin of the flap. The second surgery consisted of complete debridement of osteomyelitis and coverage was performed with omental flap. The omental flap was based on gastro-epiploic arteries and transposed into the anterior chest defect(Fig. 4). The patient was discharged 6 weeks after surgery. The outcome was uneventful(Fig. 5).



**Fig. 5.** Follow-up after 4 months without recurrence.

## DISCUSSION

The treatment of intrathoracic cavity with muscle flap is not new but once occurred, the proper treatment should be offered due to its severity and sometimes fatal outcome. The formation of fistula usually manifests prolong intrathoracic infection and post-sternotomy infections are noted after aggravation of wound site has occurred. Although the incidence for such complications is decreasing, it is imperative to make pertinent diagnosis and treatment. The principles for chest reconstruction are; complete resection and debridement of all necrotic tissue and infection, obliteration of intrathoracic dead space, skeletal stabilization if more than four rib segments

or more than 5cm of chest wall is resected en bloc, and adequate soft tissue coverage. Replacement must be found to restore the rigid chest wall in order to prevent physiologic flail and healthy soft tissue coverage is essential to seal the pleural space, to protect the viscera, and to prevent infection. This principle needs to be fully sufficed in order to control the bronchopleural fistula, empyema and chest infection with success.

It should be recognized that most cases of chest empyema can be controlled with conservative methods<sup>11</sup>). Whereas the closed thoracostomy can provide conventional care or cure in some cases, the possibility of progression to a chronic status always remains. Some reports even show that adequate drainage alone will not be sufficient to resolve bronchopleural fistula<sup>10,14</sup>). In thoracoplasty, multiple ribs are resected to allow collapse of the chest wall and to obliterate a cavity. Thoracoplasty is rarely reported in modern literature but can still be useful in certain settings<sup>6</sup>). Once the wound of the chest becomes chronic and difficult to resolve by conventional methods, complete obliteration of the defect within the intrathoracic cavity can be achieved by flap utilization. Muscle or omental flaps are considered in patients who have developed severe pleural thickening due to chronic inflammation and persistent discharge. The fibrotic pleura restricts lung expansion and must be corrected to improve pulmonary function. Muscle flaps are used to close the airway fistula and obliterate the dead space. The flaps also provides abundant blood supply to the chest wound conveying antibiotics thus augmenting wound healing. The preferred muscle are latissimus dorsi, rectus

abdominis, serratus anterior, and pectoralis major muscles<sup>1,4,8,9,12,15</sup>. The reconstructive choice for the region of the chest is the pectoralis major muscle transposed based on the thoracoacromial vessels. The musculocutaneous flaps including paddle flaps, that use the pectoralis major are readily designed and transposed to all area of the chest<sup>2,13</sup>. The cases reported in this paper encountered compromised vascular supply for local muscle structure due to previous thorocotomy incision and infection to this region. Pectoralis major and latissimus dorsi muscle can be often injured by surgical procedures prior to flap coverage. The rectus abdominis has its limits in covering the defects of the upper chest. These cases require a large bulk to obliterate the dead space and cover the wound. Omental flap, the security blanket for chest wall reconstruction, can be transposed to any area of the anterior chest and supports skin graft. Its primary advantage is the fact that brings reliable blood supply of undamaged tissue<sup>3</sup>. This flap was used after failure to achieve healing in a case where rectus abdominis muscle covered the open chest wound. The reason of failure was most likely chronic osteomyelitis of the rib bone which was drained through a sinus tract. The omentum was molded into the defect and obliterated the dead space.

Through use of muscle flaps for chronic chest wounds, there are advantages of faster resolution compared to the conventional methods in treating empyema and bronchopleural fistula. Reports have shown muscle flap coverage of intrathoracic wounds to have higher rate of success and lower mortality rate<sup>7</sup>. Chronic chest wounds are challenging with strict guidelines to

achieve proper healing. Flap reconstruction for chest wounds can be expected to give good long-term results including improvement in its function. Aggressive debridement and obliteration of dead space with healthy viable tissues is mandatory.

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