Sternal Dehiscence After Clamshell Incision in Lung Transplantation Treated With the STRAsbourg Thoracic Osteosyntheses System (STRATOS)

Bastien Orsini, MD, Xavier Benoit D’Journo, MD, PhD, Martine Reynaud-Gaubert, MD, PhD, and Pascal Alexandre Thomas, MD

Departments of Thoracic Surgery, and Pulmonary Disease and Lung Transplantation, North Hospital, Aix-Marseille University, Marseille, France

Clamshell incision with transverse sternotomy is the approach of choice for bilateral lung transplantation when cardiopulmonary bypass becomes necessary or to improve exposure. Sternal dehiscence is a well-known complication of this approach. This results in chronic thoracic pain and contributes to a delayed pulmonary rehabilitation. Sternal dehiscence can be treated with conservative therapy, but severe dehiscence requires secondary surgical closure. Several techniques of osteosynthesis have been reported with conflicting results. We describe the first use of the STRAsbourg Thoracic Osteosyntheses System (STRATOS) devices in three cases of secondary sternal closure without infection after bilateral lung transplantation.

Clamshell incision with transverse sternotomy is the approach of choice for bilateral lung transplantation (BLTx) when cardiopulmonary bypass becomes necessary or to improve exposure. Sternal dehiscence is a well-known complication of the clamshell approach [1]. Sternal wires can break, and one edge of the sternum can be displaced over the other. This dehiscence results in chronic thoracic pain and contributes to a delayed pulmonary rehabilitation. Osteoporosis, diabetes, malnutrition, emphysema, chronic steroid therapy, prolonged mechanical ventilation, and immunosuppressive drugs are various risks factors for sternal dehiscence. When sternal dehiscence is moderate, it can be easily treated with conservative therapy [2]. When sternal dehiscence is severe, it requires surgical correction with secondary closure of the sternum. Iterative use of sternal wires could be impossible because of important osteoporosis. Several techniques have been described to prevent [3, 4] or obtain complete closure of the pseudarthrosis with conflicting results [1, 5, 6]. Herein, we describe a technique of immobilization and dynamic compression with indirect osteosynthesis using the STRAsbourg Thoracic Osteosyntheses System (STRATOS) device in three patients.

Technique

Case Report

In 18 months, 61 lung transplantations were performed in our center. Fifty-one (83.6%) were BLTx with clamshell incision in 20 patients (39.2%). Sternal dehiscence occurred in 3 patients (15%).

PATIENT 1. A 57-year-old man underwent BLTx for emphysema. A clamshell incision was performed because of pulmonary hypertension requiring cardiopulmonary bypass. Two months later, the patient presented with thoracic pain with sternal dehiscence. We decided to remove the sternal steel wires and to use a direct osteosynthesis with a titanium fixation system device as a first treatment. Unfortunately the material was removed 2 months later because of recurrence of sternal dehiscence caused by severe sternal osteoporosis. As a second line of treatment, we decided to use STRATOS to create an immobilization with dynamic compression using indirect fixation of the device on a healthy rib bone (Fig 1). Complete sternal consolidation was obtained 2 months later. Material was removed after this period because of recurrence of thoracic pain.

PATIENT 2. A 47-year-old man underwent BLTx for cystic fibrosis. A clamshell incision was performed because of pulmonary hypertension requiring cardiopulmonary bypass. Two months later, the patient presented with thoracic pain with sternal dehiscence. We decided to use STRATOS to create an immobilization with dynamic compression using indirect fixation of the device on a healthy rib bone (Fig 1). Complete sternal consolidation was obtained 2 months later. Material was removed after this period because of recurrence of thoracic pain.

PATIENT 3. A 39-year-old woman underwent a repeat BLTx for rapid worsening of a chronic lung allograft dysfunction associated with an antibody-mediated rejection 6 months after a first transplantation for a nonamyloid immunoglobulin deposition disease. A clamshell incision
was performed to enable use of cardiopulmonary bypass and to facilitate exposure. The patient experienced a sternal dehiscence 3 months after transplantation. Osteosynthesis was performed 6 months later using the technique of immobilization with dynamic compression provided with the STRATOS device. Consolidation was obtained 2 months later, and the material is still in place.

**Surgical Procedure**

Under general anesthesia, the patient is placed in a supine position with a block under the shoulders, and the existing cutaneous incision is opened. Existing wires are removed. Removal of all devitalized tissue without mediastinal or pleural dissection is performed to release the distal and proximal edges of the sternum. Rib clips are clamped with rib clip fixation pliers on the ribs just above and below the sternal dehiscence without prior intercostal pedicle dissection. The STRATOS device is fixed on each side of the chest wall to create a cross with two connecting bars just in front of the sternal dehiscence. Connecting bars are fixed under sternal compression, reducing the sternal gap and favoring consolidation. Some isolated sutures with absorbable suture can be added between the implanted material and the chest wall stabilizing device and soft tissue. A solid immobilization with dynamic compression is created without direct osteosynthesis onto the fragile and osteoporotic bone. The material can be easily extracted after 3 months if needed and when chest roentgenograph and clinical examination appear to show a bone consolidation. On the other hand, the material can be safely left in place for longer.

**Comment**

The STRATOS device has been previously used in surgical treatment of chest wall deformation, in stabilization of flailed chest after blunt chest trauma, and in chest wall reconstruction after tumoral resection [7, 8]. The system has been also used with success to treat sternal dehiscence in a case of median sternotomy [6]. To our knowledge, this system has never been used in case of sternal dehiscence after a clamshell incision for BLTx. On the basis of our 3 patients, we believe that this device presents two major advantages:

1. The system avoids the use of plates, cables, or screws directly in the osteoporotic sternal bone. The system creates a strong stabilization favoring bone consolidation with strong fixation on the ribs instead of the sternum. With this technique, mechanical constraints are not directly applied on the sternum but on the implanted material. This creates a strong immobilization with dynamic compression, allowing bone consolidation without foreign material on fragile bone. Moreover, mediastinal or pleural retrosternal dissections are not necessary to obtain fixation. Stabilization is obtained with rib fixation, requiring an anterior chest wall exposure. In our experience, bone consolidation is obtained in 2 or 3 months. It can be confirmed by chest roentgenograph and clinical examination.

2. The material is composed mainly of titanium. This composition provides an important resistance to mechanical constraints. The risk of infection is clearly
decreased. Thus, this titanium device can be left in place or can be removed if needed. As a comparison with other titanium devices, the STRATOS device is the only one without screws providing risk of subcostal tissue perforation. At least because of its non-ferromagnetic properties, the material is compatible with magnetic resonance imaging.

Our experience suggests that indirect stabilization with the STRATOS device provides an effective and reliable method for immobilization of sternal dehiscence after clamshell incision in case of lung transplantation. The preventive use of this material in patients undergoing BLTx with sternotomy could be considered.

References


