



Original Article

Use and Versatility of Titanium for the Reconstruction of the Thoracic Wall[☆]



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A B S T R A C T

Introduction: Chest wall deformities/defects and chest wall resections, as well as complex rib fractures require reconstruction with various prosthetic materials to ensure the basic functions of the chest wall. Titanium provides many features that make it an ideal material for this surgery.

The aim is to present our initial results with this material in several diseases.

Material and methods: From 2008 to 2012, 14 patients were operated on and titanium was used for reconstruction of the chest wall. A total of 7 patients had chest wall tumours, 2 with sternal resection, 4 patients with chest wall deformities/defects and 3 patients with severe rib injury due to traffic accident.

Results: The reconstruction was successful in all cases, with early extubation without detecting problems in the functionality of the chest wall at a respiratory level. Patients with chest wall tumours including sternal resections and with chest wall deformities were extubated in the operating room. Chest trauma cases were extubated within 24 h from internal rib fixation. There were no complications related to the material used and the method of implementation.

Conclusions: Titanium is an ideal material for reconstruction of the chest wall in several clinical situations allowing for great versatility and adaptability in different chest wall reconstructions.

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Utilidad y versatilidad del titanio para la reconstrucción de la pared torácica

R E S U M E N

Introducción: La resección y las deformidades/defectos de la pared torácica así como las fracturas costales complejas requieren de reconstrucción con diversos materiales protésicos para garantizar las funciones básicas de dicha pared. El titanio aporta múltiples características que lo hacen un material idóneo para esta cirugía.

Palabras clave:

Reconstrucción pared torácica

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El objetivo es presentar nuestros resultados iniciales con este material en diversas afecciones.

Material y métodos: De 2008 a 2012 se ha intervenido a 14 pacientes en los que se ha empleado el titanio para la reconstrucción de la pared torácica. Un total de 7 pacientes presentaban tumores de pared torácica, 2 de ellos con resección esternal, 4 con deformidades/defectos de la pared torácica y 3 pacientes con traumatismo costal severo por accidente de tráfico.

Resultados: La reconstrucción fue satisfactoria en todos los casos, con extubación temprana y sin detectar problemas en la funcionalidad de la pared torácica a nivel respiratorio. Los pacientes con tumores de pared torácica, incluyendo las resecciones esternales, se extubaron en quirófano, así como las deformidades de pared torácica. Los casos de traumatismo torácico se extubaron en menos de 24 h desde la fijación costal interna. No hubo complicaciones en relación con el material utilizado ni con el método de implantación.

Conclusiones: El titanio es un material ideal para la reconstrucción de la pared torácica en diversas situaciones clínicas, al permitir una gran versatilidad y adaptabilidad en las diferentes reconstrucciones de pared torácica en que se quiera emplear.

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Introduction

Chest wall resections or deformities sometimes require complicated reconstruction for which several prosthetic¹ materials are used with the necessary traits to ensure maintenance of the basic functions of the chest^{1,2} (protection of thoracic organs, mechanical ventilation). Titanium prostheses^{3,4} are highly advantageous compared with traditional rigid prostheses due to the characteristics of the material (malleability, ductility, toughness, tensile strength, shape memory capacity, hypoallergenic properties). This results in relatively simple insertion and excellent final results.⁴

Its versatility promotes use in many different interventions including chest wall resection, repair of chest wall deformities and surgical rib fracture repair.⁵

Material and Methods

From September 2008 to August 2012 a prospective record of consecutive patients was made for whom the Strasbourg Thoracic Osteosyntheses System ([STRATOS] MedXpert, Heitersheim, Germany) titanium connecting bar system and the Strasbourg Costal Osteosynthese System ([STRACOS] MedXpert, Heitersheim, Germany) titanium clip system were used for chest wall reconstruction or repair. The database included clinical data, daily follow-up, a record of complications and, in the case of oncology patients, long-term outpatient neoplasia follow-up.

14 patients were operated on (8 men and 6 women, with an age range from 17 to 78 and mean age of 58) for diverse disorders which were divided into 3 groups: chest wall tumours, chest wall defects/deformities and rib fractures with unstable thorax (Table 1).

Chest Wall Tumour Patients

The criteria for STRATOS usage in patients with chest wall tumours (7) were: extended resection which included several anterolateral ribs or sternal resection. Reconstruction in the

case of chest tumours was always accompanied by a flexible prosthesis to protect the intrathoracic content from the titanium connecting bar system (4 polyester prosthesis covered with resorbable collagen and 3 Gore-tex prostheses), depending on the size of the overall defect. Muscle flap closure was used for the defects (in 5 cases latissimus dorsi flaps and in 1 case chest flap), with the exception of one case of primary closure. In one of the sternal resection cases with previous radiotherapy (Fig. 1), the greater omentum was used to protect the organs and provide better adaptation of the prosthetic material. Only in the case of one patient (with upper thoracic wall leiomyosarcoma) was en bloc resection combined with an atypical resection of the upper right pulmonary lobe due to tumour infiltration.

One bar was used in one patient, 2 in 3 patients and 3 in 3 patients. Chest drainage insertion was used for the soft tissues between the bars and the muscle flap.

Choice of type and number of bars was always made in the operating theatre following surgical extraction, after taking the measurements of the defect and discovering the position of the rib tips and their spatial orientation, with an anatomical (parallel) or crossed over positioning (2 patients).

Chest Wall Deformities and Defect Patients

In this patient group of 4 patients, 3 had deformities from previous trauma and presented with pulmonary hernia (Fig. 2) and 1 patient presented with pectus excavatum for whom the Nuss procedure had failed and who was reoperated by sternochondroplasty (Ravitch technique) with support from a retrosternal titanium bar (Fig. 3) which was placed after osteotomy and sternal anatomical replacement. Indications were to prevent recurrence in all cases, prevent collapse of the sternum in the pectus excavatum and restore normal anatomy. In the 3 pulmonary hernia cases a flexible prosthesis was inserted (Gore-tex in all cases).

Patients with Severe Rib Injury

Surgery was performed on 3 patients with severe rib injury (Fig. 4). Indication in all cases was the impossibility of

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