

Conference paper

## Long-Term Results of Chest Wall Reconstruction After Tumor Resection Using TiNi Implants

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### 1 Introduction

Reconstructive surgery of the chest wall seems to be a rather complicated and serious field of modern medical practice. Radical operations in tumors, traumatic injuries, cardiosurgery intervention sequences lead to the necessity of replacing defects of the rib bar [1, 2, 3]. A variety of available reconstructive techniques, first of all, testifies to the lack of a multipurpose effective method of the chest rib replacement [4, 5, 6, 7]. The main demands for the implants are the following: biocompatibility, corrosion stability, ability to maintain the fixed form for a long time [8, 9, 10]. One of the variants of solving the given problems is represented in the report. The nickelid titanium (NiTi) alloy was taken as a basis. This material widely used in abdominal surgery, traumatology, maxillofacial surgery. It is characterized by a high biocompatibility and additional properties defined by the form and structure of the material. Unit-coast devices have the shape memory effect, high strength and elasticity, they are porous and actively germinate with the fibrous tissue [11].

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## 2 Experimental

In the period of 2007–2016 - 34 reconstructive operations (26 patients) using the titanium-nickelide were made. Among the morphologic variants there are primary bones (9) and soft tissue sarcoma (5), skin cancer (1) and metastatic processes (6), breast cancer (2), desmoid tumor (1), fibrous dysplasia (1), giant cell tumor (1). The age of patients was 34-68 years old, the mean age made up 51 years. The majority of patients (11/26) had local recurrence after combined treatment. Localization – anterosuperior parts of the chest wall. Resection included the ribs, the sternum, the clavicle, the lung, pericardium, jugular and subclavian veins. The defect area of the chest made up 40-323 cm<sup>2</sup>, on average 127 cm<sup>2</sup>. Skin infiltration with ulceration, were present in 5 (19,2%) cases. All patients were operated with one-stage (24 patients) or delayed reconstruction (2 patients) with the use of titanium-nickelide implants. Re-operation was performed in 8 patients, regarding tumor recurrence or complications. In these cases, also used titanium-nickelide. The elements of the device are the following: fabric made of the thread of 50 μm in thickness, the cell size is 120 μm, the rib implants are made up of the unit-cast core and porous plates. The size and form of a fabric implant is designed intraoperatively, Fabric may be cut with scissors, the ribs prepared in advance taking into account the individual defect parameters – curvature and extension. The peculiarity of the given technique is a possibility to connect the device elements fix them to the bar using sutural material. The reconstruction scheme looks as follows: first of all, fixation of the tissue by the defect perimeter with ligatures is performed. Then the rigidity ribs are installed, fixed using a sutural material to the titanium nickelide fabric, soft tissues of the chest wall. A number of plates corresponds to the amount of the removed ribs or it is installed with a maximal distance of 3-4,5 cm (Fig. 1). We apply the atraumatic absorbable ligatures. A primary fixation of the rib implants with a stable spatial orientation is achieved. In 2-3 weeks after operation there is a final fixation of a device due to growing of the fibrous tissue. In the first day after the surgery performed x-rays to evaluate positioning rib implants. Four weeks later a CT scan was performed. The study of respiratory function was evaluated after 3 weeks and 3 months after surgery. Term observation of patients from 1 to 6 years.

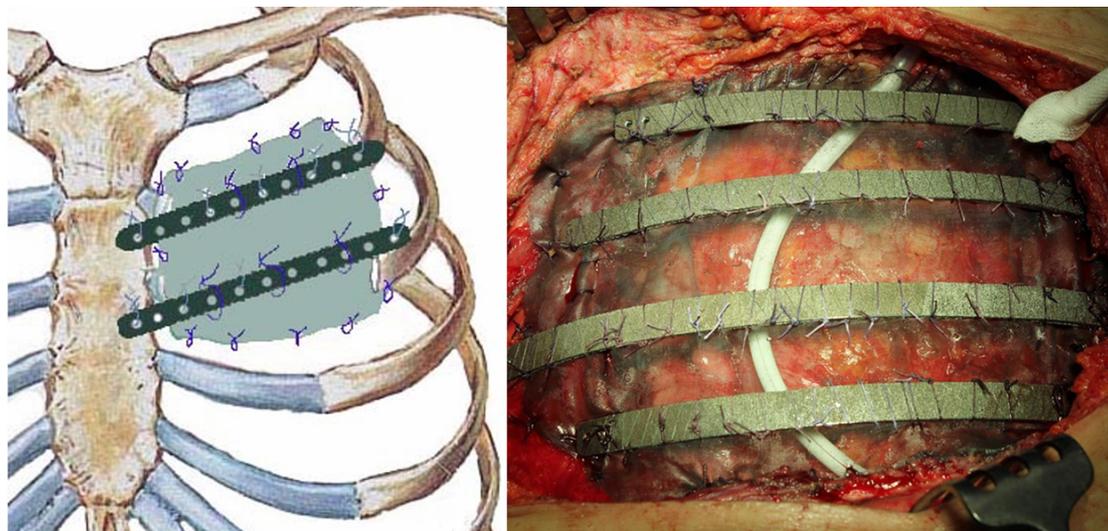


Fig. 1. Reconstruction of the chest wall using nickelide-titanium implants: a – scheme of reconstruction, b – in operating room

### 3 Results and discussion

We used nickelid titanium for chest wall reconstruction, including: porous plates, a fabric of filaments 60 microns with a cell size of 100–120 microns and a rib implants. The replacement of soft tissue defects was performed with local skin and fascial flaps or skin muscle flaps with axial blood supply (thoraco-dorsal flap - 10). Spontaneous breathing was restored on the day of surgery, and patients were extubated (32/34). All patients in the postoperative period, retained the ability to self-care and performing usual physical activity. Examination of the respiration function was performed in 3 weeks and 3 months after surgery. According to spirometry data, the restrictive disturbances of grade I-II were noted in the early postoperative period, VC indices made up  $67,3 \pm 2,6\%$ . Regression of the ventilation disturbances was observed in 3 months after operation, VC was  $83,6 \pm 2,9\%$ . The total number of postoperative complications was 8 of 34 (23,5%). Inflammatory complications were presented in the early postoperative period. The pleuropneumonia was registered in two cases (7%). The most significant complications that required surgical correction recorded in 4 cases (11.7 per cent). Additional installation of implants to the ribs was required in one case. Removal of the implants in the long term was performed in two cases. Total necrosis of the musculo-cutaneous free flap in one case. All complications were not associated with implants. Local recurrences were detected in 11 of 26 patients (42%).

Morphological structure of recurrent tumors: SMT (4/4), Osteosarcoma (2/2), Chondrosarcoma (3/6), skin cancer (1/1), desmoids (1/1). All recurrences were identified in terms 5-12 months, average 9 months. Surgical treatment for local recurrence was performed in 5 patients. Fourteen of 26 (53,8%) patients alive. The position of the endoprosthesis ribs with a porous shell and tissue implants were stable throughout the observation period.

## 4 Summary

This method of nickelide titanium reconstruction of the chest wall can be applied in cancer patients with large extension of local disease. The method allows to achieve good long-term functional result.

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