Chest wall reconstruction with MatrixRib system: avoiding pitfalls

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Received 27 August 2013; received in revised form 5 November 2013; accepted 12 November 2013

Abstract

Reconstructions of the chest wall using commercially available artificial metallic rib systems are gaining in popularity. The MatrixRib system involves use of plates and screws to bridge any defect and provide support for the chest wall following resection. So far, there has been no publication focusing on describing the use of this new technology in a step-by-step approach. We describe our technique and discuss potential pitfalls and difficulties of using the system.

Keywords: Artificial ribs • Chest wall • MatrixRib • Methyl methacrylate

INTRODUCTION

Chest wall tumour resection can result in large defects requiring complex reconstruction to maintain chest wall integrity. Previously, methyl methacrylate was the popular choice to reconstruct parts of the sternum, ribs and chest wall [1]. Recent advances in rib fixation devices have simplified the reconstruction process, in particular the Synthes\textsuperscript{	extregistered} MatrixRib Precontoured Plate system [2]. The new devices are more ergonomic and can avoid certain complications associated with traditional reconstruction methods such as prosthesis fracture. The successful implantation of prosthetic ribs requires knowledge of certain tips and tricks to avoid pitfalls, which we discuss in detail for MatrixRib system.

TECHNIQUE

A 24-year old gentleman with a 10 cm right chest wall osteosarcoma involving lateral fourth to seventh ribs underwent en bloc resection of the tumour with four involved segments of ribs resulting in a 14 cm × 16 cm chest wall defect (Fig. 1A and B). Pneumostasis and haemostasis were secured followed by placement of a 28-Fr chest drain through a separate inferior port towards the apex. Three pieces of Gortex\textsuperscript{	extregistered} mesh were united in a ‘clover’ configuration by Covidien TA\textsuperscript{	extregistered} 90 mm staples to allow sufficient coverage of the defect (Fig. 1C). The mesh was trimmed to 2 cm larger than the defect in all directions. Interrupted horizontal mattress Ethibond 2/0 sutures were placed circumferentially 3 cm apart on the mesh and then sutured to the chest wall fascia internally (Fig. 1D). Before tying all the sutures and closing off the pleural space, the lung was re-expanded under direct vision and 2-lung ventilation resumed. Rib reconstruction with MatrixRib plates to the sixth and seventh rib defects was performed by choosing a plate of appropriate length such that there are at least two screws on either side of the rib, and fashioning of the plate to the contour of the rib. Through a drill guide, two holes are created at each end and locking screws firmly secure the plate to the resected rib ends (Fig. 2A). A Redivac drain was placed superficial to the mesh and secured with 2/0 silk. The thoracotomy was closed routinely and both drains placed on suction. In the follow-up at 16 months the plates remained intact with no signs of loosening or infection and no local recurrence on positron emission tomography-computed tomography scan.

DISCUSSION

Methyl methacrylate is widely used to reconstruct the rigid structures of the chest wall. However, the material can be difficult to use in inexperienced hands. Other potential problems that are uncommonly encountered include: methyl methacrylate toxicity, poor anchorage and fixation difficulties, fracture of the material and associated chronic pain and prosthesis infection. More recently, a rib fixation systems like Synthes\textsuperscript{	extregistered} MatrixRib is increasingly becoming a popular alternative. Despite reports of chest wall reconstruction with similar rib fixation devices, none discusses the tips and tricks as well as pitfalls of the system [2].

Preoperatively, imaging should be studied and the size of the post-resection defect estimated bearing in mind that there is limitation to the length of the artificial ribs. The longest MatrixRib is an 18-hole plate, after allowing for insertion of two screws for securing the plate onto the rib at both ends, the maximum breachable rib–rib defect is 14 cm. If the defect is slightly too wide for even the longest plate, a trick is to push the ends of the rib closer together to narrow the gap before fixation of the plate. In addition, adequately sized Gortex mesh should be sourced. If the mesh is too small to cover the defect, several pieces can be joined together efficiently by the Covidien TA\textsuperscript{	extregistered} 90 mm stapler.

Prior to ‘closing off’ the pleural cavity with the Gortex mesh, it is important to place intrathoracic drains, achieve haemostasis and pneumostatis and to re-expand the lung. We place the mesh deep...
to the artificial ribs to prevent lung herniation between the ribs. In addition, the mesh should be trimmed to a slightly larger size, usually 2 cm larger than the defect circumferentially, to avoid tension and detachment.

Another pitfall concerns mismatch between screw length and measured rib thickness. The measurement of rib thickness by parallel gauge records the thickest aspect of the rib (Fig. 2b). The surgeon must ensure that the drilling, plates and screws are placed over this thickest aspect of the rib to correspond to the measured screw length to prevent screw protrusion and loosening. If the length of the plate is sufficiently long, to further improve plate security the screws should be placed into the last and third from last holes of each plate end. Furthermore, to avoid screw back-out or loosening, special care should be taken during drilling to avoid ‘double-tap’ (re-drilling the same hole), which can destroy the bone threads that lock the screw securely in place.

In conclusion, artificial rib systems such as Synthes® MatrixRib is a convenient way to reconstruct chest wall defects. Special attention to preoperative planning and important technical considerations can avoid certain pitfalls and reduce the risk of screw loosening or plate fracture. In the future, more structured training in the use of these systems may increase their popularity and improve outcomes.

Conflict of interest: none declared.

REFERENCES