



# Rigid prosthesis removal following chest wall resection and reconstruction for cancer

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**Background:** Composite rigid mesh is one of the most widely used prostheses for chest wall reconstruction after chest wall resection for neoplastic disease, but few data are available on prosthesis stability, dislocation and infections after long-term follow-up. The aim of this study was to assess the indications for chest wall prosthesis removal, technique and postoperative outcome.

**Methods:** A total of 166 consecutive patients underwent chest wall resection and reconstruction by rigid prosthesis over an 18-year period and—among them—10 patients (6.0%) required prosthesis removal.

**Results:** The indications for prosthesis removal were: infection (8 pts: 80%); neoplastic recurrence (2 pts: 20%). Reconstruction following prosthesis removal was: absorbable mesh in three cases (30%), no prosthesis in four patients (40%), other in 2 patients (20%) (1 rigid prosthesis, 1 Gore-tex<sup>®</sup> prosthesis).

**Conclusions:** Composite rigid mesh removal is indicated in case of prosthesis infection or, rarely, to treat chest wall recurrence at the edges of the prosthesis. Reconstruction after prosthesis removal may require soft mesh but very often no new prosthesis is needed due to fibrosis stabilizing the chest wall.

**Keywords:** Chest wall resection; polypropylene mesh; methyl methacrylate; infection

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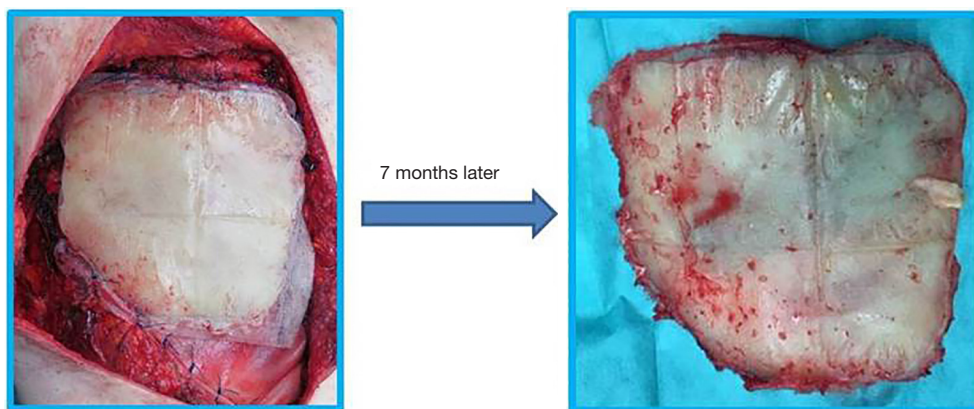
## Introduction

The most common oncologic indications for chest wall resection include primary or secondary chest wall tumours and contiguous involvement from breast or lung cancer (1). The basic principles for effective management of complex post-resectional chest wall defects are rib cage reconstruction and adequate soft tissue coverage.

Small defects, or those located posteriorly under the scapula above the fourth rib can be closed with soft tissue alone, whereas larger anterior or lateral defects need prosthetic reconstruction. A wide spectrum of synthetic mesh can be used to attain skeletal stability, composite methyl methacrylate sandwich being one of the most

commonly used rigid prostheses (2).

According to le Roux and Shama, the ideal prosthetic material should offer rigidity, inertness, malleability and radiolucency (3). Although no material has been found to fulfil all the criteria, synthetic materials like Marlex mesh or Prolene are satisfactory for the reconstruction of medium-sized defects (1). For larger defects, where structural integrity is essential to avoid chest wall collapse, methyl methacrylate sandwich, silicone, Teflon, or acrylic materials have been used with good results (4). Although a plethora of synthetic materials can be utilized to stabilize the resected chest wall, there is no consensus on the most physiologic or effective substance. Wound complications such as infection,



**Figure 1** Resected rigid prosthesis 7 months after implant.

dehiscence, flap loss, and hematoma are reported to occur in up to 20% of cases (5). Nonetheless, prosthesis explants due to infected mesh are seldom reported and few data are available on the indications, technique, timing and outcome of rigid prosthesis removal (*Figure 1*).

This paper aimed to assess the indications for chest wall prosthesis explants, as well as surgical technique and clinical outcomes in the case of mesh infections or colonization by local recurrence.

## Methods

This is an observational retrospective study conducted in accordance with the Declaration of Helsinki (6). Written informed consent was obtained from all subjects before any procedure was done. The investigators explained all the planned procedures verbally to all subjects who received and signed an information sheet to acquaint themselves with details of the planned therapeutic schedule. All patients authorized the investigators to use their data anonymously only for scientific purposes according to Italian legislation (law no. 675/1996). Data were collected prospectively and entered into our institutional general thoracic database at the point of care and reviewed and double-checked retrospectively.

A total of 166 consecutive patients underwent chest wall resection and reconstruction by rigid prosthesis (polypropylene double mesh + methyl methacrylate) over an 18-year period. Among them 10 patients (6.0%) required prosthesis removal, representing the present study population.

Demographic, clinical, pathologic and operative data

and perioperative outcomes were collected: age, sex, type and extent of chest wall resection received, complications, histology of chest wall infiltrating lesion, adjuvant treatments, interval time between first procedure and prosthesis removal, cause of prosthesis removal and—in case of infection—microbiological findings, chest wall reconstruction technique following rigid prosthesis removal, procedure duration, hospital stay and overall postoperative mortality and morbidity were recorded.

## Results

Five patients in the study population were male (50%); mean age was 59 years (range, 27–73 years); 3 patients (30%) received a two-rib resection; 4 patients (40%) received a three-rib resection; 3 patients (30%) received a four-rib resection; 5 cases (50%) had an associated partial sternal resection. Neoplastic disease of the chest wall was: sarcoma (4 pts: 40%); breast cancer (2 pts: 20%); other (4 pts: 40%, mesothelioma, lung cancer, thymic carcinoma, single site colonic metastasis). All 10 patients (100%) received methyl methacrylate sandwich; prosthesis coverage was obtained by muscular rotational flap in 6 patients (60%) and by direct soft tissue coverage in 4 (40%).

Three patients (30%) received postoperative radiotherapy; 1 patient (10%) received postoperative chemotherapy; 1 patient (10%) received postoperative combined radio-chemotherapy; 1 patient received preoperative combined radio-chemotherapy (10%); 4 patients (40%) did not receive any adjuvant or neoadjuvant treatments.

Mean interval time between the first procedure and

**Table 1** Clinicopathological features of the study population

Patient	Age	Sex	Treatments after 1st implant	Indication for removal	Interval time (months)	Reconstruction	Length of hospital stay (days)
1	35	Male	Radio	Recurrence	37.1	Gore-tex <sup>®</sup>	6
2	27	Male	Radio	Infection	21.2	None	7
3	42	Female	Chemoradiation	Infection	9.1	Vicryl	6
4	65	Male	None	Infection	1.0	Vicryl	17
5	64	Female	None	Infection	9.5	None	1
6	62	Female	None	Infection	7.4	None	7
7	43	Female	Radio	Recurrence	161.3	Rigid	8
8	71	Male	Chemoradiation	Infection	32.9	None	6
9	73	Male	Chemo	Infection	80.0	Vicryl	9
10	57	Female	None	Infection	7.5	None	7

prosthesis removal was 15.4 months (range, 1–161 months). Indications for prosthesis removal were infection (8 pts: 80%) or neoplastic recurrence (2 pts: 20%). In the group of infected prostheses, *Staphylococcus aureus* was isolated in three cases; *Staphylococcus aureus* and *Streptococcus agalactiae* in one case; *Staphylococcus epidermidis* in one case; *Streptococcus mitis* in one case; *Staphylococcus* not otherwise specified in one case; no isolation in one case. Reconstruction following prosthesis removal was: absorbable mesh in 3 cases (30%), no prosthesis in 4 patients (40%), other in 2 patients (20%) (1 rigid prosthesis, 1 Gore-tex<sup>®</sup> prosthesis). Mean procedure duration was 149.5 minutes (range, 39–446 minutes). The postoperative course was uneventful in 9 cases whereas 1 patient (10%) had flap dehiscence requiring reoperation. Mean total length of hospital stay was 7 days (range, 1–17 days) (Table 1).

## Discussion

Although there is some controversy as to which chest wall resections should be reconstructed, posterior defects close to the tip of the scapula, demolitions larger than 5 cm in size in any location, and most anterior defects usually require reconstruction (7). Methyl methacrylate—usually sandwiched between two layers of mesh—is one of the most widely used prostheses to provide rigidity after chest wall resection for cancer, thus avoiding flail segments which move in a paradoxical pattern with respiration, causing inefficient ventilation (8).

Although rigid prostheses provide excellent chest wall stability and a low risk of pulmonary complications, they have been associated with a greater number of wound complications. However, it is not clear whether these were related to the prosthesis itself or to the size of the chest wall defects or other factors such as the length of the operation or form of soft tissue reconstruction (5). Only 8 patients (4.8%) in our series of 166 consecutive patients treated by rigid prosthesis presented mesh infections requiring explants. In fact, chest wall infections arising in the presence of synthetic materials can be managed with appropriate incision and drainage and intravenous antibiotic therapy (9). Negative-pressure wound therapy—also called vacuum-assisted closure—may serve as a temporary measure in several cases if definitive closure or flap coverage needs to be delayed or to manage external wounds when rib cage stability has been obtained (10,11). However, vacuum-assisted closure is contraindicated over exposed blood vessels or organs and some concerns exist about its use in wounds containing malignant tumours, untreated osteomyelitis, necrotic tissue, or non-enteric and unexplored fistulae (8). The indications for prosthesis explant in our series included infected mesh exposure not amenable to sterilization, and adequate new soft tissue coverage. In any case, vacuum-assisted closure was attempted in selected cases to minimize the microbacterial load before surgical explant. Only in two cases was mesh removal due to oncologic disease recurrence incorporating the edge of the prosthesis: in one case it was a thymic carcinoma recurring 37.1 months after resection

and postoperative radiotherapy; the second case was a chondrosarcoma recurring 161.3 months after resection and postoperative radiotherapy.

If the foreign material is removed at least six to eight weeks after first implant, a thick strong fibrous layer will be formed that is rigid enough to furnish chest wall stability (8,12-14): only in one of our patients did we use a new rigid prosthesis, due to an extended re-do chest wall resection for local recurrence whereas soft mesh or no mesh were used in all other cases.

In conclusion, composite rigid mesh removal is indicated in case of prosthetic infection, or rarely in case of chest wall recurrence at the edges of the prosthesis. Reconstruction after prosthesis removal may require soft mesh but very often no new prosthesis is needed due to fibrosis stabilizing the chest wall. This is a safe and effective procedure, generally with an uneventful postoperative course.

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### Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/shc.2018.08.02>). LS serves as an unpaid editorial board member of *Shanghai Chest* from Jul 2017 to Jun 2019. The other authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained; being a retrospective study on patients already allowing the use of their data, no formal ethical approval was needed but formal authorization was obtained by each patient.

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