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André-Lévigne, Dominik; Modarressi Ghavami, Seyed Ali; Karenovics, Wolfram; Joseph, Jean-Marc; Wilde, Jimmy; Pittet Cuenod, Brigitte Maud

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CASE REPORT
Reconstructive

Operative Planning of Chest Wall Reconstructions Illustrated by a Large Defect in a Child

Dominik André-Lévigne, MD–PhD*
Ali Modarressi, MD*
Wolfram Karenovics, MD†
Jean-Marc Joseph, MD‡
Jim C.H. Wilde, MD§
Brigitte Pittet-Cuénod, MD*

Summary: Reconstruction of large chest wall defects is challenging. Here we discuss the process of decision-making in planning chest wall reconstruction, considering the requirements of tumor removal, stabilization of the chest wall, and soft tissue coverage, illustrated by a case of a hemi-chest wall defect in a child. Ewing sarcoma measuring 10×9 × 13cm was resected in a 9-year-old boy, followed by stabilization using a Gore-Tex patch. Due to extension of the oncologic resection far into the superomedial quadrant of the chest, tension-free coverage with a classical latissimus-dorsi flap could not be achieved. Integrating the serratus-anterior muscle into the flap creating a chimeric latissimus-dorsi/serratus-anterior flap allowed for excellent soft tissue coverage of the foreign body. As the skin could be preserved, careful incision planning was necessary to allow for best possible exposure during oncologic resection and flap harvest, while ensuring skin vascularization impaired by underlying tumor resection. Two vertical skin incisions were chosen, one presternal and a second in the mid-axillary fold delineating a large bipedicled skin flap. Postoperative recovery was excellent. Solid skin vascularization and adequate soft tissue coverage of the alloplastic material allowed for the patient to receive two cycles of postoperative radiotherapy without developing wound dehiscence. Careful interdisciplinary planning of skin incisions allowed for good exposure for tumor resection and flap harvest while preserving skin vascularization. Choosing a chimeric latissimus-dorsi/serratus-anterior flap provided larger coverage than a classical latissimus-dorsi flap with minimal additional donor site morbidity. Taken together, we here present a pragmatic solution to a complex problem. *(Plast Reconstr Surg Glob Open 2022;10:e4326; doi: 10.1097/GOX.0000000000004326; Published online 13 May 2022.)*

The reconstruction of large chest wall defects is challenging, and careful preoperative planning is warranted.[1] Alloplastic materials are widely used for chest wall stabilization and provide good biomechanical results, but the use of a foreign body requires reliable soft tissue coverage, especially when radiotherapy might be necessary.[2,3] Here we discuss the process of decision-making in planning chest wall reconstruction of large defects, taking into account the requirements of tumor removal, stabilization of the chest wall, and soft tissue coverage, illustrated by a case of an anterior hemi-chest wall defect in a child.

*From the *Division of Plastic, Reconstructive & Aesthetic Surgery, Geneva University Hospitals, Geneva, Switzerland; †Division of Thoracic and Endocrine Surgery, Geneva University Hospitals, Geneva, Switzerland; ‡Unit of Paediatric Surgery, Woman-Mother-Child Department, Lausanne University Hospital (CHUV), Lausanne, Switzerland; and §Division of Pediatric Surgery, Geneva University Hospitals, Geneva, Switzerland.*

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CASE REPORT

Ewing sarcoma originating from the anterior arch of the third left rib, measuring 10×9 × 13cm was identified in a 9-year-old boy (Fig. 1). Neoadjuvant chemotherapy resulted in 43% size reduction, and no metastases were identified. Hemi-left sternotomy and resection of the second to fifth ribs en bloc with the pectoralis minor, major, and the superior half of the serratus anterior muscle were performed. Two vertical skin incisions were chosen: one presternal and a second in the mid-axillary fold (Fig. 2). A folded Gore-Tex Soft Tissue patch (WL Gore & Associates, Flagstaff, Ariz.) was placed onto the defect

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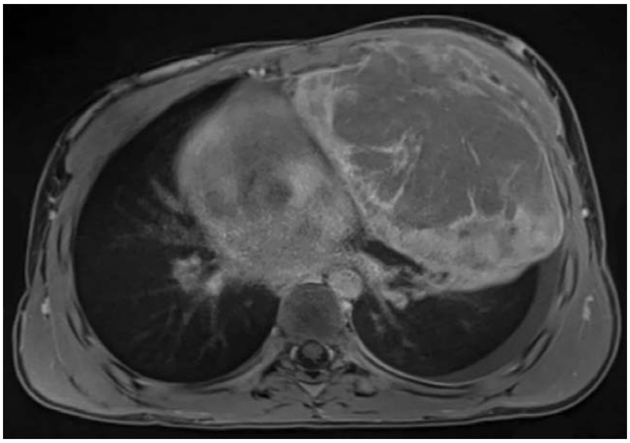

Fig. 1. Preoperative findings. Ewing sarcoma originating from the anterior arch of the third left rib, measuring 869ml and 10×9 × 13cm. Marked bossing of the left pectoralis muscle, MRI studies shown.

which extended far into the superomedial quadrant of the chest. A chimeric latissimus dorsi/serratus anterior flap was used (Fig. 3), the serratus anterior muscle was placed in the superomedial quadrant of the chest, and the latissimus dorsi muscle was used to cover the inferior part of the defect (Fig. 4). Postoperative development was uneventful, showing excellent soft tissue coverage and skin vascularization. (**See figure, Supplemental Digital Content 1,** which shows the intraoperative findings at the end of surgery showing no clinical signs of impeded skin vascularization. **http://links.lww.com/PRSGO/C32.**) Shoulder mobility remained complete since recovery from surgery, including during sports in school with a clinical follow-up until 1 year postoperatively. (**See figure, Supplemental Digital Content 2,** which shows the 1-year follow-up. **http://links.lww.com/PRSGO/C33.**)

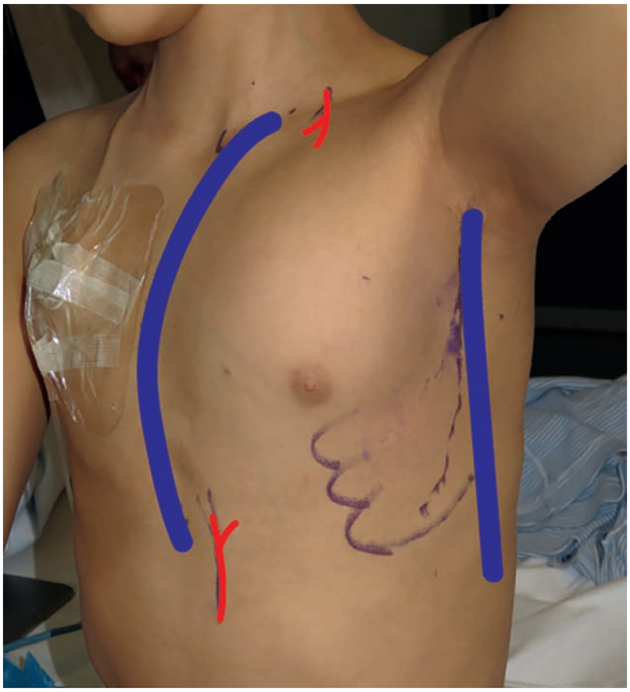

Fig. 2. Planning of skin incisions. Two vertical incisions were planned, one presternal extending over the clavicle and a second in the mid-axillary fold, forming an anterior hemi-thoracic bipedicled skin flap preserving the lateral thoracic artery cranially and the superior epigastric artery caudally. Blue lines indicate skin incision lines; red lines indicate preserved vascular pedicles.

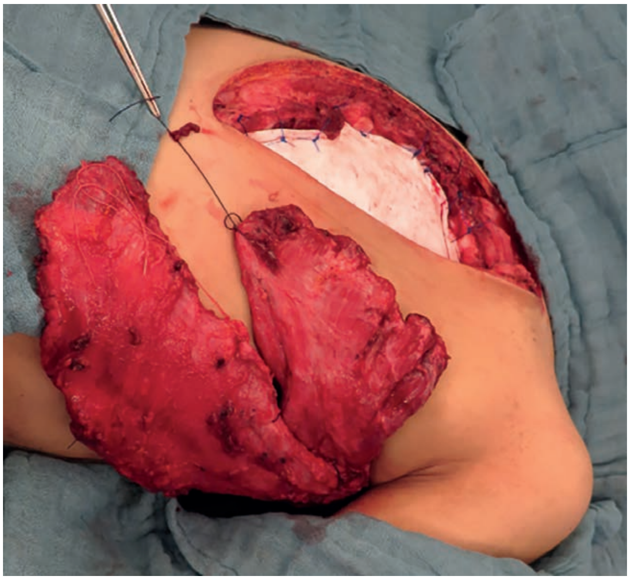

Fig. 3. Flap harvest. A pedicled chimeric serratus anterior/latissimus dorsi muscle flap was used to cover the large defect. Flap shown after harvest.

DISCUSSION

The presented case illustrates the various challenges encountered when planning and performing the reconstruction of large chest wall defects. As it was necessary to

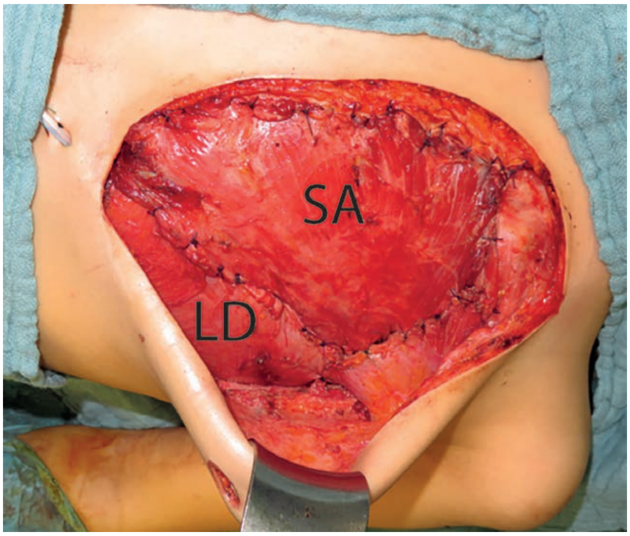

Fig. 4. Flap inset. Flap sutured in place easily covering the Gore-Tex patch. Integrating the serratus anterior muscle into the flap allowed for a tension-free coverage far into the superomedial quadrant. LD, latissimus dorsi; SA, serratus anterior.

stabilize the chest wall with alloplastic material, reliable soft tissue coverage was required, especially because postoperative radiotherapy was expected to be necessary. The extension of the oncologic resection far into the superomedial quadrant represented a challenge because a tension-free coverage with a classical pedicled latissimus dorsi flap could not be achieved. A latissimus dorsi muscle-thoracolumbar fascia composite flap might have reached the superomedial end of the defect, as recently described for a similar large anterior chest wall defect.[4] However, it would have provided a thin fascia-only coverage of the GoreTex patch at the distal end of the flap that could have proven insufficient in covering the foreign body in case of wound dehiscence. Integrating the four inferior slips of the serratus anterior muscle into the latissimus dorsi flap allowed for excellent soft tissue coverage. The chimeric latissimus dorsi/serratus anterior flap was first described in 1989 by Collini and Wood[5] for reconstruction of a large defect of the hand and is considered to be a robust and one of the largest, and most generous flaps.[6] It remains, however, rarely used and it should be considered when planning chest wall reconstructions because it provides extensive soft tissue coverage with minimal additional donor site morbidity compared with a classical latissimus dorsi flap, provided the inferior angle of the scapula is appropriately fixated after flap harvest.[7] In the present case, this fixation allowed for an excellent stability and mobility of the scapula.

When the skin can be preserved, multidisciplinary preoperative incision planning is crucial. Classical oncological approaches for large tumor resections of the anterior thoracic wall include L-shaped incisions according to Dartevelle or hemi-clamshell or U-shaped approaches according to Masoka's trans-sternal incision.[8] These approaches would not allow for the harvest of the latissimus dorsi muscle, and additional incision in the mid-axillary line would be necessary to adequately expose the superior third of the latissimus dorsi flap and its pedicle. This additional incision would have compromised skin vascularization of the anterior chest wall. The challenge was thus to design skin incisions long enough to allow large exposure of the anterior chest wall for oncological removal and flap harvesting, while preserving the vascularization of the anterior hemithorax skin flap. Taking into account the angiosomes of the main cutaneous vascular pedicles,[9] while considering the resection of internal mammary pedicle and all the perforators along with the underlying tumor, two vertical skin incisions were chosen: one presternal and a second in the mid-axillary fold. Thus an anterior hemi-thoracic bipedicled skin flap was formed, preserving the lateral thoracic artery cranially and the superficial superior epigastric artery caudally (Fig. 2). This approach allowed us to maintain the skin vascularization of the entire anterior hemi-chest while providing sufficient exposure for large intrathoracic tumor resection and flap harvest.

Postoperative radiotherapy was necessary in the reported case. Solid skin vascularization and adequate soft tissue coverage of the alloplastic material with a chimeric muscle flap allowed for the patient to receive two cycles of radiotherapy without developing wound dehiscence or implant exposure, which might have required additional invasive procedures with limited success rates.

CONCLUSIONS

Taken together, we here present a pragmatic solution to a complex problem. Pedicled muscular flaps are safe, relatively simple, and fast. Choosing a chimeric latissimus dorsi/serratus-anterior flap allows for much larger coverage than a classical latissimus-dorsi flap. The conservation of the muscle innervation and the appropriate fixation of the mobilized muscles to adjacent remaining muscles and the scapula resulted in an excellent functional outcome.

Dominik André-Lévigne, MD–PhD
Division of Plastic, Reconstructive & Aesthetic Surgery
University Hospitals of Geneva
Rue Gabrielle-Perret-Gentil 4
CH-1211 Geneva 14
Switzerland
E-mail: dominik@levigne.ch

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