

Chest Wall Reconstruction following Chondrosarcoma Excision: Review and Case report

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ABSTRACT

Chondrosarcoma is a rare tumor with a high recurrence rate, and wide excision is the treatment of choice. In such cases, a good skeletal fixation and soft tissue cover—both local or microvascular flaps are of great importance in reconstructing form and function.

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INTRODUCTION

Primary tumours of the anterior chest wall are rare, of which chondrosarcoma of the sternum occurs with the highest frequency and with a highly locally aggressive behaviour.^{1,2} Radical resection of the anterior chest wall including the sternum, ribs, and clavicle plays a key role in reducing recurrence rates. This however results in an unstable ribcage leading to a flail chest and also a significant overlying soft tissue defect.

A multidisciplinary approach involving thoracic surgeons, pathologists, radiologists, plastic surgeons, and physical therapists is essential in adequate preoperative evaluation, execution, and reconstruction.³

The role of reconstruction in chest wall defects cannot be stressed enough as it is important to establish the stability of the rib cage to prevent a respiratory compromise due to paradoxical breathing and also to protect the underlying important mediastinal structures.

Various skeletal reconstruction methods using alloplastic materials for bone stability and local autologous muscle and musculocutaneous flaps for soft tissue cover can be used to achieve the same.

We describe a case of chondrosarcoma of the chest wall where a local flap was used in chest wall reconstruction after excision.

CASE STUDY

A 50 years old male presented to the surgical specialty with a swelling in the front of the neck extending into the chest and progressively increasing in size, for 7 months (Figure 1). Due to a recent onset of difficulty in breathing while lying down, medical help was sought.

Clinically, it was a hard, fixed, non-tender, lobulated mass of 20x15 cms present in the front of the neck and extending onto the anterior chest wall. The skin was however found to be free. Radiologically it was found to have features suggestive of chondrosarcoma involving the manubrium sterni and the medial aspect of the left clavicle which was histo-pathologically proven by an Image-guided biopsy.

The resection was performed by the thoracic surgeons and the defect was reconstructed by our team of reconstructive surgeons.

The skin was free of tumour and hence preserved by a midline incision and elevation of skin flaps on either side. The manubrium sterni, the upper part of the sternal body, medial end of both clavicles, 1st and 2nd ribs on both sides upto 4 cms were excised respecting oncological margins, thus creating a defect of 7x7 cms. The rest of the sternal body and xiphisternum and the rest of the ribs were left intact (Figure 2).

The role of our plastic surgery team was to provide stability to the anterior chest wall to help in restoring respiratory mechanics and a sturdy soft tissue cover.

Although the skeleton was fairly stable, there was a loss of normal respiratory physiology due to discontinuity.

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Figure 1: Large chondrosarcoma involving the Manubrium Sterni, Clavicle and Upper 2 Ribs



Figure 2: Defect in chest wall following excision of Tumor, Manubrium, medial end of Left Clavicle and Upper 2 Ribs

Two 14-holed titanium plates were used to fix the sternal body to the medial ends of the clavicles with 4 screws each. This established acceptable stability. The use of mesh was refrained from with a fear of creating a rigid chest wall.

The hardware and skeleton were covered by bilateral pectoralis major advancement flaps, based on their thoraco-acromion pedicle. From the same surgical incision, the pectoralis major muscles were elevated from medial to lateral taking care to achieve proper hemostasis of the internal mammary perforators. The tendinous insertion on one side was released and both the muscle flaps were sutured in the midline to cover the plated, mediastinal structures and the skeleton. The intact skin flaps were then approximated over the flaps with drains placed in the submuscular and subcutaneous planes.

The overlying skin, being nondeficient and uninvolved, could be approximated over the advanced muscle flaps.

Post-operative chest strapping was maintained for 1-week, and breathing exercises were initiated within 48 hours. The drains were removed by day 10 and there were no signs of surgical site infection.

DISCUSSION

The mainstay treatment of primary and secondary chest wall tumours has moved from a conservative approach in primitive times to a wide radical resection with the use of various alloplastic materials and autologous tissues for chest wall reconstruction.

A radical approach to such tumours has not only decreased the recurrence rates but has also helped in improving the quality of life of the patients.^{4,5}

These post-oncological clearance chest wall defects are usually complex and full thickness involving deficiencies in the skeleton and also the overlying soft tissue due to their wide excision.⁶

Hence, Reconstructive goals are mainly 2 in such cases. Form and Function - a stable skeleton when the defect is more than 5 cms more than 2 subsequent ribs have been excised, to prevent a flail chest and ventilatory compromise; and a good soft tissue cover to protect the underlying vital structures and an intrathoracic integrity without compromising on the cosmesis and function, all at the same time.⁷

Skeletal stability can be achieved using various alloplastic materials. It is imperative for an ideal alloplastic material to be chemically inert, hypoallergic, resistant to infections, malleable and to provide easy access during re-surgery.

The materials commonly used are tetrafluoro-polyethylene, polypropylene mesh, marlex mesh, polymethylmethacrylate (PMMA), a sandwich technique using polypropylene mesh and PMMA, titanium plates, and custom-made titanium sternal implants.^{8,9}

In our first patient, since only 2 ribs were resected, the rib cage was fairly stable. However, the defect was 7 cms, and the manubrium was excised. Hence extra stability was provided by using two 14-holed titanium plates to fix the sternal body to the clavicles. Various locally available muscles of the thorax, back, and abdomen can be used either as muscle or musculocutaneous flaps with ease depending upon the availability and intact vascular status. Pectoralis major, latissimus dorsi, serratus anterior, rectus abdominis, external oblique muscles, thoracoepigastric flaps,¹⁰ and the omentum can be used as local flaps.

Pectoralis major muscle flaps are the workhorse flaps in the reconstruction of anterior chest wall defects in non-irradiated chest walls owing to the easy accessibility from the same surgical field without resulting in much donor defect. Also, owing to a robust and reliable dual blood supply, it can be used as a standard advancement, turnover or even a rotation flap without impairing the strength.^{11,12} In very large defects there may be no local options available. Preoperative radiotherapy in a few patients makes the use of local options difficult. Such patients may require distant cover in the form of microvascular-free flaps. Free flaps that can be used to cover large chest wall defects are ALT flap, LD flap, parascapular flap, TFL flap, TRAM flap.¹³

In our case, since the overlying skin flaps were intact and the patient had not received any radiation therapy in the past, making pectoralis major muscle flaps the first choice of soft tissue cover. The insertion of the left pectoralis major muscle had to be released with a separate anterior axillary fold incision for the flap to reach the midline. The right pectoralis major muscle did not require a release of its tendinous insertion. Both the muscles were approximated in the midline to cover the hardware and the skeleton.

This advancement of the muscle flaps does produce some amount of chest wall contour deformities and also a loss of the anterior axillary fold definition on tendon release.¹⁴ In our case, although there was mild left-sided chest wall deformity, it was not very significant.

CONCLUSION

Chondrosarcoma is a rare tumour with a high recurrence rate, and wide excision is the treatment of

choice. In such cases, a good skeletal fixation and soft tissue cover- both local or microvascular flaps are of great importance in reconstructing form and function.

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