

Pectoralis Major Flap for Chest Wall Reconstruction: Anatomical Reliability, Technical Variants, And Contemporary Indications

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ABSTRACT

Chest wall reconstruction requires restoration of stable coverage, protection of intrathoracic structures, control of infection or dead space, and preservation of respiratory mechanics. The pectoralis major flap remains one of the principal regional options for anterior and upper chest wall reconstruction because of its proximity, reliable vascular anatomy, broad arc of rotation, and ability to provide well-vascularized tissue in contaminated, irradiated, or oncologic wounds. Classically based on the thoracoacromial pedicle, the flap can be advanced, rotated, split, islanded, transposed bilaterally, or designed as a musculocutaneous flap depending on the defect. Internal mammary perforator-based designs further expand its versatility. The pectoralis major is particularly useful for sternal wound infection, anterior chest wall defects, sternoclavicular defects, manubrial reconstruction, supraclavicular coverage, and selected oncologic or radiation-related defects. Although free tissue transfer is increasingly used for large or complex defects, pedicled pectoralis major flaps remain highly relevant because they provide rapid, dependable reconstruction without microvascular anastomosis. Current evidence supports their reliability, but comparative data remain limited, and long-term functional outcomes, donor-site morbidity, shoulder function, quality of life, and cost-effectiveness require further study.

KEYWORDS: pectoralis major flap; chest wall reconstruction; pectoralis major myocutaneous flap; sternal wound infection; thoracoacromial artery; pedicled flap; anterior chest wall defect.

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INTRODUCTION

Chest wall defects may result from tumor resection, deep sternal wound infection, osteomyelitis, radiation injury, trauma, congenital deformity, or failure of previous reconstruction. The reconstructive objective is not simply skin closure. A successful operation must provide durable soft-tissue coverage, obliterate dead space, protect exposed vessels or mediastinal structures, contribute to infection control, and preserve respiratory and shoulder function whenever possible.

The pectoralis major myocutaneous flap became a foundational regional flap for anterior chest wall reconstruction after early descriptions of pectoralis major muscle transposition for anterior thoracic defects. Arnold and Pairolero demonstrated its clinical feasibility in the late 1970s, and later anatomical and reconstructive reviews established the pectoralis major, latissimus dorsi, and rectus abdominis as major workhorse flaps for chest wall reconstruction [1–3]. Despite the growth of microsurgical

reconstruction, the pectoralis major flap remains essential because many anterior chest defects are close to its donor site and can be covered quickly with vascularized regional tissue. Anatomical Basis and Flap Design

The pectoralis major is supplied primarily by the pectoral branch of the thoracoacromial artery, with additional segmental contributions from perforators of the internal mammary and lateral thoracic systems. This vascular consistency explains why the muscle can be used in several configurations, including advancement, turnover, rotation, split-muscle, island, and musculocutaneous designs [2,4]. The thoracoacromial axis supports a broad arc of rotation toward the sternum, manubrium, supraclavicular region, axilla, and upper anterior chest wall. Internal mammary perforator-based designs may be useful when regional vascular anatomy or defect orientation favors a different axis. The muscle can be harvested as a whole unit or divided segmentally to preserve part of its function and contour. Split-muscle and partial turnover designs attempt to deliver

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vascularized tissue to the defect while limiting donor-site morbidity. For sternoclavicular defects, Opoku-Agyeman and colleagues proposed a classification that includes whole-muscle advancement, split-muscle medial advancement or rotation, and islandized clavicular-portion flaps based on thoracoacromial or deltoid branches [5]. Other modifications include the pectoral kite flap, which salvages the caudal non-infiltrated portion of the muscle when the cranial segment has been resected or compromised by tumor [6], and bilateral pectoralis major myocutaneous V-Y advancement flaps for very large central defects [7].

Clinical Indications

The strongest indication for the pectoralis major flap is reconstruction of anterior or upper central chest wall defects, particularly after infected sternotomy or sternal osteomyelitis. In this setting, the flap provides vascularized muscle directly over the sternum, mediastinum, or exposed hardware, improving dead-space control and delivering tissue into a contaminated field. In oncologic reconstruction, it is useful after resection of tumors involving the sternum, manubrium, clavicular region, or anterior chest wall, especially when local tissue is inadequate but microsurgical reconstruction is not necessary or not feasible [3,8].

The flap is also useful for sternoclavicular joint defects, supraclavicular defects, selected axillary or upper lateral thoracic wounds, and radiation-associated defects. Extended or islanded designs can increase reach when standard advancement is insufficient. For very large defects, bilateral pectoralis major flaps or combination with other regional flaps may be required. When the defect is extensive, posterior, lower thoracic, or beyond the arc of the pectoralis, latissimus dorsi, rectus abdominis, omental, perforator, or free flaps may be more appropriate [3,9].

Operative Principles

Reconstruction begins with complete debridement of nonviable tissue, control of infection, assessment of skeletal stability, and identification of exposed vital structures. In infected sternotomy wounds, all necrotic bone, infected tissue, and unstable foreign material should be addressed before flap inset. The pectoralis major is then mobilized according to the required arc of movement, preserving the dominant pedicle unless an alternative vascular basis is deliberately selected. For midline sternal defects, unilateral advancement may be sufficient; larger central defects often require bilateral advancement or turnover.

The flap should be inset without excessive tension, and dead space should be minimized. Closed suction drainage is commonly used. When skeletal reconstruction is required, soft-tissue coverage may be combined with prosthetic mesh, rigid fixation, autologous tissue, or osteomyocutaneous variants. A recently described pectoralis major flap with rib illustrates how the flap can be adapted when both soft-tissue and skeletal components are required [10]. In contaminated

wounds, reconstructive choices must balance infection control, stability, and long-term durability.

Outcomes and Complications

Clinical series support the reliability of the pectoralis major flap, but complication rates vary according to indication, patient condition, flap design, and wound contamination. In a 43-patient series of unilateral pectoralis major advancement flaps for sternal defects after sternotomy-associated osteomyelitis, three complete flap failures were reported, and additional complications required reoperation in several patients [11]. A bilateral partial pectoralis major turnover technique for deep sternal wound infection achieved healing without recurrence in most patients at short follow-up [12]. These data support the flap's role in infected anterior chest wounds, while also emphasizing that these patients are high-risk and outcomes depend on systemic condition, debridement, and postoperative care.

Complications include partial or total flap loss, hematoma, seroma, wound dehiscence, recurrent infection, contour deformity, nipple-areolar asymmetry, chest wall depression, and shoulder weakness. Donor-site morbidity is underreported, especially long-term shoulder strength, range of motion, and patient-reported quality of life. Cosmetic chest deformity after pectoralis harvest may be significant, particularly in male patients, and isolated reports describe correction using pectoral implants and lipofilling [13].

Comparisons with free flaps are complex. In head and neck reconstruction, free flaps may have lower infection and necrosis rates than pectoralis major myocutaneous flaps, but these data do not translate directly to chest wall reconstruction [14,15]. In large chest wall series, pedicled and free flaps can both achieve successful reconstruction, with free flaps often selected for larger or more complex defects [16]. Thus, the pectoralis major should not be viewed as inferior to microsurgery, but as a regional option whose value depends on defect location, vascular reliability, operative urgency, and patient risk.

DISCUSSION

The pectoralis major flap remains a cornerstone of anterior chest wall reconstruction because it combines anatomical reliability with technical efficiency. Its proximity to sternal and upper thoracic defects allows rapid transfer of vascularized tissue without the logistical demands of microsurgery. This is especially valuable in infected wounds, frail patients, and situations requiring dependable coverage of exposed mediastinal structures.

The major limitation is reach. A unilateral pectoralis flap is best suited to anterior, central, and upper defects. Large, inferior, posterior, or circumferential defects often require alternative regional or free flaps. Donor-site morbidity is another important consideration. Although muscle-sparing, split, and partial turnover designs may preserve function

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better than whole-muscle transfer, high-quality long-term functional data remain limited.

The evidence base is also uneven. Much of the literature consists of retrospective series, technical reports, and case-based innovations. The uploaded synthesis highlights important gaps in comparative trials, long-term functional outcomes, quality-of-life measures, and cost-effectiveness. Future studies should report not only flap survival and wound closure, but also shoulder function, chest contour, patient satisfaction, respiratory impact, and reconstructive durability.

CONCLUSION

The pectoralis major flap is a reliable and versatile regional flap for anterior and upper chest wall reconstruction. Its

consistent thoracoacromial vascular supply, proximity to common defect sites, and ability to provide well-vascularized muscle make it particularly useful for infected sternotomy wounds, sternal osteomyelitis, sternoclavicular defects, manubrial defects, and selected oncologic or radiation-related reconstructions. Technical variants such as bilateral advancement, split-muscle turnover, islanded designs, pectoral kite flap, and osteomyocutaneous configurations extend its utility. Free flaps remain important for larger or more complex defects, but the pectoralis major flap continues to offer a durable, efficient, and anatomically dependable solution when matched appropriately to the defect.

Clinical setting	Preferred role of pectoralis major flap	Main consideration
Sternal wound infection or osteomyelitis	Vascularized muscle coverage and dead-space obliteration	Requires aggressive debridement and infection control
Anterior chest wall defect	Regional pedicled coverage based on thoracoacromial axis	Best for central or upper anterior defects
Large central defect	Bilateral pectoralis advancement or combined regional flap strategy	Unilateral reach may be insufficient
Sternoclavicular defect	Whole-muscle, split-muscle, or islandized configuration	Technique depends on defect size and vascular status
Oncologic chest wall defect	Soft-tissue coverage after tumor resection	Must coordinate with skeletal reconstruction if needed
Radiation-related defect	Introduction of vascularized nonirradiated tissue	Local tissue quality may limit inset
Very large or posterior defect	Alternative regional or free flap may be preferable	Pectoralis arc of rotation may be inadequate

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