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Case Report of a Complex Chest Wall Reconstruction with a Cadaveric Achilles Tendon

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Conflict of interest: None declared

Patient: Female, 46-year-old
Final Diagnosis: Right superior sulcus tumor-squamous cell lung cancer
Symptoms: Right shoulder pain
Medication: —
Clinical Procedure: Right upper lobectomy (lung) • chest wall resection/reconstruction
Specialty: Surgery

Objective: Unusual clinical course

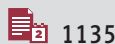
Background: Chest wall reconstruction is sometimes needed after resection of a thoracic malignancy. Various materials and techniques have been utilized to restore stability and integrity to the chest wall. We report what we believe is the first use of a cadaveric Achilles tendon to restore stability and function to the chest wall of a young woman who underwent chest wall resection and right upper lobectomy for a superior sulcus tumor.

Case Report: A 46-year-old woman underwent resection of her first through fourth right ribs in addition to her right upper lobe for a squamous cell superior sulcus tumor. Because it was felt her right scapula provided sufficient coverage of her resultant chest wall defect, her chest wall was not reconstructed post-operatively. The patient experienced 2 episodes of scapular prolapse into her thoracic cavity several months after her resection. After the second episode, her right chest wall was successfully reconstructed with a cadaveric Achilles tendon to prevent further episodes of prolapse.

Conclusions: We believe this is the first description of chest wall reconstruction with a cadaveric Achilles tendon. The use of a cadaveric Achilles tendon should be considered for reconstruction of the chest wall after complex resection due to its strength characteristics, resistance to subsequent infection, and availability.

MeSH Keywords: Allografts • Carcinoma, Non-Small-Cell Lung • Pancoast Syndrome

Full-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/920910>



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Background

The goals of chest wall reconstruction after major resection are to maintain chest wall integrity, prevent lung herniation, provide protection of the underlying lung, optimize respiration, and provide acceptable cosmesis. The materials used for reconstruction should minimize complications, including infection, seroma formation, and future failure due to material reaction with the patient's tissue. Many materials have been used, including methyl methacrylate, and synthetic meshes of polypropylene, including bovine pericardium and polylactic acid [1]. Additionally, evolving technology with three-dimensional printing and the use of polyetheretherketone (PEEK) implants, polytetrafluoroethylene (PTFE), polyglactin 910, and titanium plates, as well as biomaterials, has recently been used to reconstruct large chest wall defects to near-exact anatomical dimensions [2]. Biological materials such as cryopreserved allografts and homografts have also been increasingly utilized, with their major advantage felt to be tissue incorporation with revascularization and cellular repopulation, making them more resistant to infection; an attraction for use with previously irradiated tissue [3]. We present the case of a 46-year-old woman who underwent a right upper lobectomy with chest wall resection for a right superior sulcus squamous cell carcinoma who underwent subsequent reconstruction of her chest wall defect with a cadaveric Achilles tendon homograft. We believe this was the first time a cadaveric Achilles tendon homograft was used for chest wall reconstruction.

Case Report

A 46-year-old woman presented with a 4-month history of right upper back pain radiating down her right upper extremity. She was otherwise healthy, with a 25-pack-year history of cigarette smoking. Physical examination was unremarkable. A computed tomography scan of her chest revealed a large mass, 12 cm in diameter, with invasion and destruction of the right first and second ribs, possible involvement of the right 3rd rib, and suggestion of right brachial plexus invasion located in the superior sulcus of her right pleural space (Figure 1). The patient underwent endobronchial ultrasound evaluation of her mediastinal nodes, which revealed metastatic squamous cell carcinoma in a level-4R node. She was referred to medical and radiation oncology and underwent preoperative concurrent chemoradiation. She was restaged following treatment and was found to have no residual peritracheal nodal metastatic disease, as well as significant volume reduction of her right upper-lobe tumor.

She underwent an open resection with right upper lobectomy and en bloc chest wall resection of her right first through fourth ribs. The right brachial plexus and right subclavian artery and

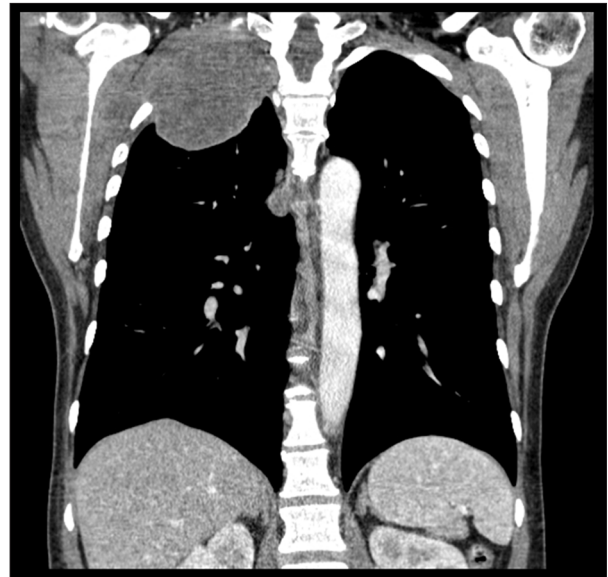


Figure 1. Right superior sulcus tumor. Coronal computed tomographic image of right superior sulcus tumor involving right upper lobe and chest wall at the thoracic inlet.



Figure 2. Right scapular prolapse into thoracic cavity. Sagittal computed tomographic image of right scapula prolapsed into the thoracic cavity after original resection.

vein were not found to have tumor invasion with the exception of the first thoracic nerve, which was resected with the specimen. No attempt at chest wall reconstruction was made at the time of her operation as it was felt her scapula provided adequate coverage of her resultant defect. A viable residual tumor was found in the resected right upper lobe upon pathological review. She subsequently underwent post-resection chemotherapy and boost external beam radiation to the bed of her first thoracic vertebral body due to a close but negative

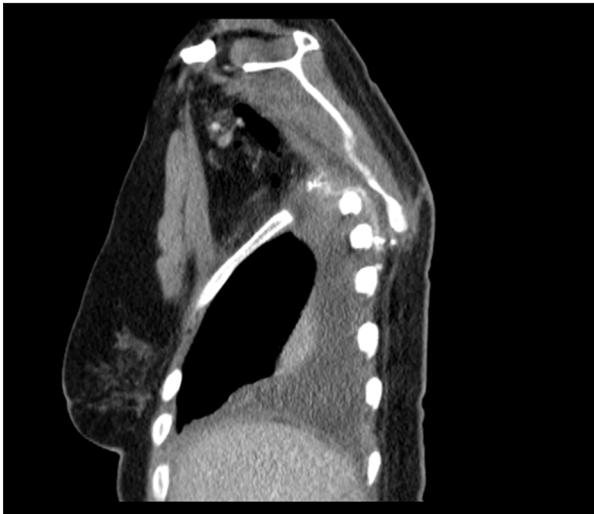


Figure 3. Reduction of right scapula prolapse. Reduction of right scapula after chest wall reconstruction with cadaveric Achilles tendon allograft.

margin. She convalesced from her operation without significant complications.

Three months later, she experienced acute intense pain in her right upper back and shoulder after swinging a softball bat. She was found to have a right scapular prolapse into her right pleural space (Figure 2). She underwent closed reduction under general anesthesia, and her right upper extremity was placed in a sling for 6 weeks. Three months later, she experienced a similar episode. After closed reduction, she was offered chest wall reconstruction. She underwent reconstruction of her right superior chest wall with a cadaveric Achilles tendon placed into the bed of her fourth rib to remove what was believed to be her scapula's intussusception point, and a polytetrafluoroethylene (PTFE) patch (GORE® DUALMESH®) was placed over it to further stabilize the posterior-superior chest wall defect, providing the scapula a linear surface to slide over inferiorly to the fifth and sixth ribs (Figure 3).

She has remained free from recurrence to date, 30 months after her resection. She continues to undergo close follow-up with biannual physical exams and annual surveillance chest computed tomography. She has not experienced scapular prolapse subsequent to her cadaveric Achilles tendon chest wall reconstruction.

Discussion

Scapula prolapse into the intrathoracic space after resection of a superior sulcus tumor is a rare but known complication [4]. It was felt that the patient's scapula would provide adequate coverage of her chest wall and reconstruction was

not necessary after her original surgery. The patient was young and remained active following treatment for her malignancy. She quickly returned to her preoperative activities, including athletics, but that assessment proved incorrect.

Superior sulcus tumors represent less than 5% of all bronchogenic carcinomas, have a 5% operative mortality rate, and have a complication rate of 7–38%; the overall 2-year survival rate after induction chemoradiation and resection varies from 55% to 70% [5]. Our patient's chest wall had previously received 60 Gy of external beam radiation, with another 16 Gy provided as a boost following her resection. Based on recurrence rates and her age, it was felt she may require future chemotherapy due to recurrence. The choice of material for her chest wall reconstruction was strongly influenced by being resistant to infection. Previous studies have shown that biological materials used in chest wall reconstruction are less prone to infectious complications than are prosthetic materials [1,3].

Her previous closed scapula reductions had been performed with the assistance of orthopedic surgery. After careful consideration of the materials available for her chest wall reconstruction, it was felt that a biological material would be best. After collaborating with orthopedics, a cadaveric Achilles tendon homograft was proposed as the optimal material for chest wall reconstruction. This was chosen to minimize further musculoskeletal deformity as would occur with a muscle flap, its properties as a biological material to resist infection, its availability, and its strength properties. We believe this is the first time a cadaveric Achilles tendon was used for chest wall reconstruction. The biomechanics of a cadaveric Achilles tendon, as well as the size and shape of the graft, allowing the entire bed of the resected fourth rib to be filled, provided the incentive for its use [6]. The PTFE was placed overlying the homograft to allow the scapula a longitudinal surface to slide upon.

Conclusions

The Achilles homograft provided strength and form to the chest wall, with the theoretical benefit of increased resistance to infection. It was readily available and straightforward in its placement. It does not appear to have the same complications as the available prosthetic materials, such as fracture failure and migration [7]. It provided excellent cosmesis, with the ability to be molded into the defect, much like a muscle flap. The patient has returned to her baseline activities and has remained free of infection and cancer recurrence 30 months after her initial surgery.

Acknowledgments

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References:

1. Miller DL, Force SD, Pickens A et al: Chest wall reconstruction using biomaterials. *Ann Thorac Surg*, 2013; 95: 1050–56
2. Wang L, Huang L, Li X et al: Three-dimensional printing PEEK implant, a novel choice for the reconstruction of chest wall defect. *Ann Thorac Surg*, 2019; 107: 921–28
3. Sanna, S, Brandolini J, Pardolesi A et al: Material and techniques in chest wall reconstruction: A review. *J Vis Surg*, 2017; 3: 95–110
4. Nishimura M, Suzuki H: Scapular prolapse into the intrathoracic cavity after lobectomy with rib resection. *Ann Thorac Surg*, 2018; 105: e181
5. Foroulis CN, Zarogoulidis P, Darwiche K et al: Superior sulcus (Pancoast) tumors: Current evidence on diagnosis and radical treatment. *J Thorac Dis*, 2013; 5(S4): S342–58
6. Maganaris CN, Narici MV, Maffulli N: Biomechanics of the Achilles tendon. *Disabil Rehabil*, 2009; 30: 1542–47
7. Ng C: Recent and future developments in chest wall reconstruction. *Semin Thoracic Surg*, 2015; 27: 234–39