Use of a myocutaneous latissimus dorsi rotation flap in managing a deep infection of a shoulder arthrodesis after hardware removal

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INTRODUCTION

Shoulder arthrodesis is a salvage procedure for many complex shoulder problems.[1–4] Complications from this procedure have been described and include deep infection.[3] However, our review of the English literature failed to locate a case report in which the management of a deep infection of a healed shoulder arthrodesis included the use of a myocutaneous latissimus dorsi rotation flap. In this report, we describe a patient who after hardware removal from a healed shoulder arthrodesis developed a deep infection from a suture abscess that inoculated one of the drill holes that extended across the fusion mass. After several unsuccessful attempts to cure the infection with serial debridéments and intravenous antibiotics, filling the space with a latissimus dorsi rotation flap was a critical step in eradicating the infection. Novel aspects of this case include 1) the fusion was maintained despite serial debridéments and the final muscle flap, and 2) the use of the latissimus dorsi flap in this setting has not been previously reported in the literature.

CASE REPORT

A 43-year-old, right-hand-dominant man presented to our clinic with chronic right shoulder pain that was attributed to post-traumatic multi-directional instability and end-stage arthritis. He severely injured his shoulder in 2003 while working at a construction site. Five subsequent reconstructive surgeries were performed for instability and progressively worsening arthritis. He continued to have severe pain with attempts to move his shoulder during all activities of daily living. He had previously consulted with two shoulder specialists who independently recommended a shoulder arthrodesis.

Although the patient had not had full-time employment since his work-related injury (about 1.5 years prior), he expressed a strong desire to return to work in home construction or as a painter. He was taking paroxetine hydrochloride for depression, alprazolam for anxiety, and hydrocodone for chronic pain. He also reported occasional alcohol consumption (one or two drinks a week) and he

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smoked one pack of cigarettes per day for 20 years. Additional medical problems included gastroesophageal reflux and rare occurrences of asthma, but he was not on any regular corticosteroid inhalers. The patient did not stop smoking before the arthrodesis.

At the time of the patient's first consultation with us, he guarded his shoulder from any significant motion secondary to the severe pain that this would cause. Results of the American Society of Shoulder and Elbow Surgeons (ASES) shoulder score[5] was 30 (maximum possible is 100), and his pain level was 10 cm on a 10 cm visual analogue scale (10 = worst pain).

In June of 2005, a right shoulder arthrodesis was performed by JGS according to the description of Richards et al.,[6] which included using iliac crest bone graft and a contoured dynamic compression (DC) plate and screws (Figure 1A).[6] The surgical wound healed uneventfully and by 4 months after surgery the fusion appeared healed by clinical and radiographic evaluations. Although the patient reported some mild improvement in his function and average pain level, he described the persistence of moderate pain, which we speculated was from the metal plate impinging on the posterolateral edge of the distal clavicle.[7] As a result, all hardware was removed at 15 months after surgery (Figure 1B).

Thirteen days after the hardware removal, a small amount of purulent drainage was seen from upper portion of the incision. The patient went to an urgent care facility in his home town (40 miles from our clinic) where he was treated with oral cephalexin; no incisional irrigation or debridément was performed. He then returned to our clinic 21 days after the hardware removal. At that time the source of the continuing drainage was determined to be a suture abscess, which was then lanced, irrigated, and packed open with iodine-impregnated gauze tape (Iodoform Nu Gauze®, Johnson & Johnson Medical, Arlington, Texas, USA). Oral cephalexin, 500 mg every 6 hours, was continued for empirical antibacterial treatment. Moist-to-dry sterile gauze dressing changes were done daily by a home nurse. The patient also was seen in clinic every 5 to 7 days for examination and repeat irrigation and dressing changes. Cultures showed scant growth of coagulase-negative Staphylococcus. This was thought to be a contaminant because it did not grow in any of the subsequent cultures.

After 2 weeks of treatments with oral antibiotics and dressing changes, turbid serous drainage from the problem region of the incision increased. The patient remained afebrile and
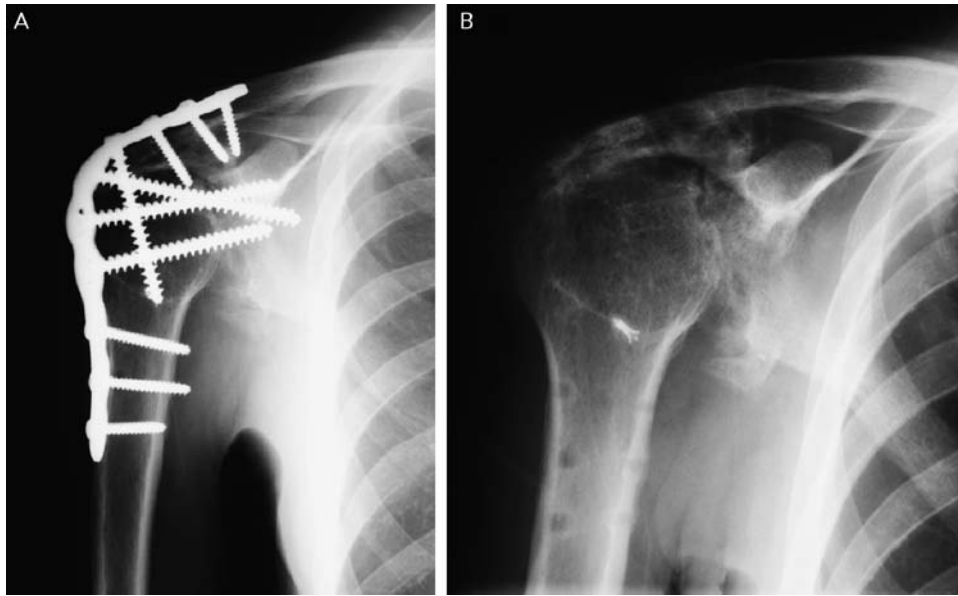
FIGURE 1. (A) Anteroposterior radiograph of the patient's right shoulder arthrodesis within 1 month before the hardware removal. (B) Anteroposterior radiograph of the patient's right shoulder arthrodesis within 1 week after the hardware removal, but before any operative irrigation and debridéments.

his white blood cell count (WBC) was 11,700/μL (normal: 4,000/μL–10,500/μL), erythrocyte sedimentation rate (ESR) was 1.0 mm/hr (normal: <15 mm/hr), and C-reactive protein (CRP) was 0.36 mg/dL (normal: <0.80 mg/L). Irrigation and debridément was performed in the operating room. It was then recognized that the suture abscess was overlying one of the drill holes where a screw had been removed. The drill hole was over-drilled with a large-bore drill bit, and the wound was packed with iodine-impregnated gauze tape and left open for daily sterile dressing changes. Four days later, the wound was closed over drains, including one that was placed down the drill hole. The fluid and tissue cultures revealed a *Propionibacter* species. The microbiology laboratory, however, did not have the technology to determine the species of these bacteria. By the time that this was realized by the surgeon and infectious disease consultant, the cultures had been discarded. Consequently, the sensitivities of this organism to antibiotics could not be ascertained. As recommended by the infectious disease specialist, antibiotic treatment was changed to oral levofloxacin, 750 mg per day, and intravenous vancomycin. This double antibiotic treatment was designed for broader coverage of bacteria, including coverage for the theoretical possibilities that the coagulase-negative *Staphylococcus* species (i.e., *Staphylococcus epidermidis*) or the *Propionibacter* species were not contaminants, or methicillin-resistant *Staphylococcus* was present but not grown in culture. This double antibiotic treatment was continued for several weeks.

Within 3 weeks of the first two operative irrigation and debridéments, turbid/serous drainage again occurred from the incision. Repeat operative irrigation and debridément were done, and this included drilling the path of the previous drill hole and curetting soft bone, and packing with methylmethacrylate beads containing tobramycin sulfate. The wound was left open and covered with a plastic adherent

dressing to allow elution of the tobramycin. Although the patient remained afebrile and his WBC was 9,500/μL (normal: 3,600/μL–10,600/μL), there were elevations in his ESR at 27 mm/hr (normal: <15 mm/hr) and CRP at 5.80 mg/dL (normal: <0.80 mg/dL). The patient was maintained on oral levofloxacin and intravenous vancomycin in accordance with the recommendations of the infectious disease consultant. Six days later another operative irrigation and debridément (the fourth) was performed, the beads were removed, and the skin margins were extensively undermined and closed with retention sutures over several suction drains. However, within 3 weeks of the irrigation and debridément, drainage again occurred from the wound.

The surgeon deemed it reasonable to make one final attempt before considering a muscle flap to solve this problem with irrigation, debridément, and primary wound closure. It was speculated that the infection could be cured with intravenous antibiotics if a distal route for fluid egress could be achieved. During this final procedure before plastic surgery, the relatively large size of the void, which extended to the thoracic wall, was finally recognized when a fluoroscopy machine was used to see the margins of the cavity during curettage. The wound was again closed primarily, but this time one of the four drains was passed through the floor of the axilla under fluoroscopic guidance. Oral levofloxacin and intravenous vancomycin were continued as per the recommendations of the infectious disease consultant. Thirteen days later, the ESR was 10 mm/hr (normal: 0–15 mm/hr) and CRP was 0.42 mg/dL (normal: <0.80 mg/dL). A CT scan was then obtained with this axilla drain in place (Figure 2).

Within 2 weeks of removing the distal drain (which had remained in place for 2 weeks until all drainage stopped), recurrent drainage occurred even though double antibiotics were continued. Despite firm recommendations to cease smoking cigarettes, the patient continued to smoke one pack
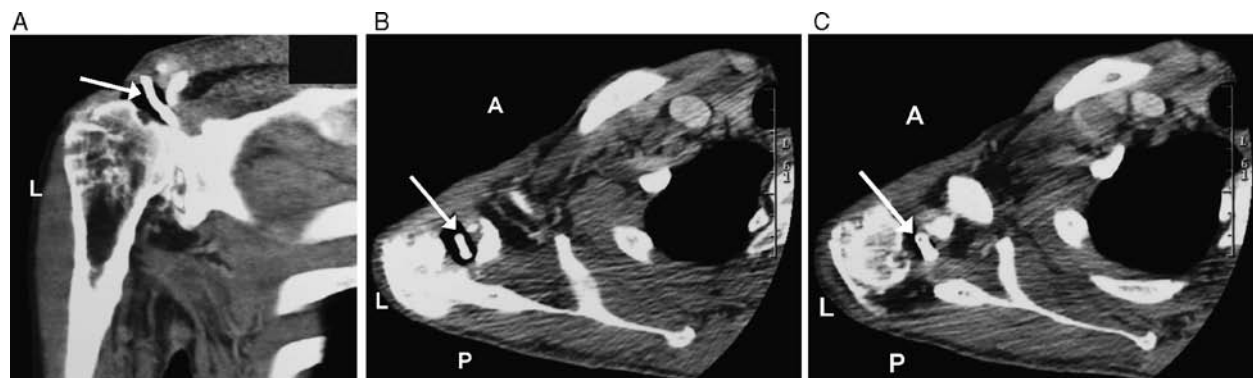
FIGURE 2. CT showing the right shoulder after the hardware removal and after several operative irrigations and debridéments. The latissimus dorsi flap had not yet been performed. The arrow indicates the drain that exited through the floor of the axilla. The drain is adjacent to the fusion site, which, although reduced in size from the debridéments, remained solid. L= lateral; A= anterior; P= posterior. (A) Frontal view. (B) Transverse view.(C) Transverse view.

per day during the entire time that the infection was present. A myocutaneous latissimus dorsi rotation flap was performed; this was 5 months after the hardware removal and 20 months after the original arthrodesis. The sinus tract was excised, and the bone around the margins of the cavity was curetted. The fusion was still solid (no perceptible motion was detected at the fusion site by both palpation and fluoroscopic examination). According to a published description,[8] a latissimus muscle flap, with an overlying skin island measuring 10 x 8 cm was passed through a subcutaneous tunnel into, and completely filling the cavity that was adjacent to the remaining fusion mass. The skin island also completely covered the orifice of the open wound. Antibiotic treatment was continued for 4 weeks after surgery (levofloxacin and vancomycin) and oral levofloxacin for an additional 2 weeks. All cultures showed no growth.

By 4.5 months after the plastic reconstructive surgery, the muscle flap was completely healed and the arthrodesis remained solid. Blood tests showed normal WBC, ESR, and CRP. There were no complications associated with the latissimus dorsi flap, but the results of the patient's shoulder pain/function scores showed that the ASES score remained essentially the same. When the patient was not taking narcotic pain medication, he reported only mild improvement in overall pain when compared to his pre-arthrodesis status (pain ranged from 4–8 on a visual analogue scale). The persistent pain was thought to be neurogenic since it radiated from his neck to his hand. As per the patient's request (lack of health insurance and sufficient funds), further work-up (MRI) for the possibility of cervical radiculopathy was not done.

At 20 months after the muscle flap (38 months after the arthrodesis), the patient returned for clinical evaluation. He reported being free of infection and had returned to working 30 hours per week in a cabinetry shop where he varnished cabinets. Physical and radiographic examinations (Figure 3) confirmed that the fusion remained solid and that there were no signs or symptoms of infection. However, he noted continuing moderate-to-severe pain that radiated from his neck to his hand. Cervical radiculitis also was suggested by an unequivocally positive Spurling's sign and mildly decreased grip strength, and further work-up was again recommended.

The neurogenic pain was adequately treated with the continued use of hydrocodone.

DISCUSSION

The latissimus dorsi muscle, with or without overlying skin, can be detached from its skeletal attachments and rotated on its neurovascular pedicle as an adjunct in the treatment of a variety of problematic wounds or pathological conditions of the shoulder and brachium.[2,8–11] For example, transposition of a pedicled latissimus dorsi flap has been used to restore flexion or extension of the elbow to simultaneously restore flexion of the elbow and replace traumatic loss of soft tissue from the brachium and to provide coverage of defects of the soft tissue about the shoulder and the brachium.[10,12–15] In their review of the use of the pedicled latissimus dorsi flap for upper-extremity reconstruction, Pierce and Tomaino[8] stated that some of the major clinical applications of this flap for upper-extremity reconstruction included its use as a myocutaneous transfer for coverage of nerves, bones, and joints after soft-tissue loss due to trauma, tumors, infection, or irradiation. The usefulness of the pedicled myocutaneous latissimus dorsi flap for filling voids or wound defects of the shoulder region also is well supported by the surgical oncology literature where it is considered an excellent choice for reconstruction of shoulder defects after tumor extirpation.[16]

The proven usefulness of the pedicled myocutaneous latissimus dorsi flap for filling voids in the shoulder region and the high antimicrobial potency of muscle flaps[17] were essential components of the treatment that ultimately achieved the successful eradication of the infected shoulder arthrodesis in our patient. The use of the pedicled latissimus dorsi flap in the specific treatment of deep infections and associated void spaces or tissue defects of the shoulder has been described previously. For example, Goodman and Swartz[18] described its successful use as an interposed graft in a septic neuropathic (Charcot) shoulder joint. Stern and Carey[10] described the transposition of the latissimus dorsi as an adjunct in the treatment of six patients who had chronic osteomyelitis or septic arthritis of the shoulder.[10] At an

FIGURE 3. Anteroposterior view of the patient's right shoulder at 3 years after the initial fusion surgery and 20 months after the latissimus dorsi flap.

average of 2.3 years follow-up none of the patients had drainage. Another case that somewhat resembles the one that we have described is mentioned by Heitmann *et al.*[1] They described the use of a pedicled latissimus dorsi flap in a deep infection that appeared 14 months after shoulder arthrodesis for a shotgun wound in a 49-year-old patient. However, in none of these previous reports did the infection follow a hardware removal, which, in view of our review of English literature, is a novel aspect of our case report. This case also is novel because subsequent bone reconstructive surgery was not needed because a sufficient amount of the fusion mass was maintained.

Although we speculated that worsening cervical radiculitis may have been an important cause of some of our patient's persistent pain at final follow-up, there are alternative explanations for the pain that he experienced after the fusion surgery but before the suture abscess occurred. One possibility is that a low-grade infection was present chronically and was caused by the *Propionibacter* species that had grown in the fluid and tissue cultures. If it is assumed that *Propionibacter acnes* was in fact the species grown in these cultures, then the possibility that this caused a painful low-grade infection is supported by studies that have implicated this organism as the cause of persistent postoperative shoulder pain.[19,20] If this interpretation is correct, then it is plausible that the *Propionibacter* species was present chronically in the vicinity of the fusion site and the *Staphylococcus* species was only subsequently associated with the overlying and relatively acute suture abscess. However, it is difficult to reconcile this

hypothesis with the fact that our patient continued to complain of moderate (occasionally severe) shoulder and neck pain even though the infection was ultimately eradicated and the fusion site had completely healed. We hypothesize that this persistent pain may have more likely been the result of underlying and undiagnosed cervical pathology that worsened during the duration of the follow-up described in this case report. Previous studies have shown that pain relief is not universal following successful glenohumeral arthrodesis.[1-3] For example, out of the 33 patients studied by Richards[2] for functional outcome after shoulder arthrodesis, five patients who had "neurogenic pain" preoperatively continued to have significant pain postoperatively.

In our case report, the surgeon initially failed to recognize the relatively large size of the cavity, which served as a reservoir for the accumulation of contaminated fluid. It was speculated that fluid accumulating in this cavity would eventually flow up through the proximal aspect of the incision. An additional complicating factor in this patient was the delay between recognition of a superficial wound infection and the time that it was examined by the surgeon and lanced and drained in the clinic (21 days after the hardware removal). Nevertheless, if the potential cavity for fluid accumulation had been recognized during the first operative irrigation and debridément, then it might have been possible to eradicate the infection had a distal drainage route been established at that time. When the distal drain was eventually established during the final operative irrigation and debridément, the cavity was then too large for successful closure without plastic surgery intervention. The pedicled myocutaneous latissimus dorsi flap proved to be a good solution for correcting this problem while maintaining a sufficient amount of fused bone, thus eliminating the need for further orthopaedic reconstructive surgery of the arthrodesis site.

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