



# Pseudomonas osteomyelitis of the proximal humerus after arthroscopic rotator cuff repair

Nuri AYDIN<sup>1</sup>, Evrim ŞİRİN<sup>2</sup>, Ahmet Nadir AYDEMİR<sup>3</sup>, Gökhan ZENGİN<sup>1</sup>

<sup>1</sup>Department of Orthopedics and Traumatology, Cerrahpaşa Medical Faculty, Istanbul University, Istanbul, Turkey;

<sup>2</sup>Department of Orthopedics and Traumatology, Fatih Sultan Mehmet Training and Research Hospital, Istanbul, Turkey;

<sup>3</sup>Department of Orthopedics and Traumatology, Marmara University Training and Research Hospital, Istanbul, Turkey

A 59-year-old male patient was operated arthroscopically due to a rotator cuff tear. An early postoperative *Pseudomonas aeruginosa* infection was treated with early arthroscopic debridement and antibiotic therapy. The patient was lost to follow-up and presented to our clinic with *Pseudomonas aeruginosa* osteomyelitis after two years. Debridement was again performed and antibiotic-impregnated cement beads were filled into the cavity and taken out 6 weeks postoperatively. No findings of infection were observed at the patient's 2nd year follow-up. To our knowledge, this is the first case of *Pseudomonas aeruginosa* osteomyelitis of the shoulder after arthroscopic rotator cuff repair.

**Key words:** Infection; osteomyelitis; shoulder arthroscopy.

Shoulder arthroscopy is a safe procedure with low complication rates. Infection after arthroscopic rotator cuff repair is a very rare condition. Superficial surgical site infection rates after arthroscopic shoulder cases are between 0.16% and 1.9%.<sup>[1-3]</sup> Other complications include deep infections, deep venous thrombosis, peripheral nerve injury and pulmonary embolism.<sup>[3]</sup> Because of the low risk of infection, deep infection after arthroscopic rotator cuff repair can easily be missed as a diagnosis. The frequent pathogens are *S. aureus*, *S. epidermidis* and *Propionibacterium spp.* species.<sup>[4]</sup> *Pseudomonas aeruginosa* is an aerobic, gram-negative bacteria that can cause surgical site infections as a form of healthcare-associated infection. There is limited information about the early and late *P. aeruginosa* infection after arthroscopic procedures.

To our knowledge, there is no report in the litera-

ture regarding late *Pseudomonas* osteomyelitis after arthroscopic rotator cuff repair.

## Case report

A 59-year-old man presented to our outpatient clinic with right shoulder pain and disability that were not associated with trauma. On examination, the patient exhibited a positive Neer's sign and diminished shoulder range of motion compared with the left side. Magnetic resonance images showed complete supraspinatus rupture without fatty degeneration. Arthroscopic rotator cuff repair was planned. There was no skin lesion before surgery on his shoulder and no medical comorbidity.

The operation was performed under general anesthesia with the patient in the beach chair position. Routine arthroscopic portals were used. After arthroscopic ac-

**Correspondence:** Nuri Aydın, MD, Assoc. Prof. İstanbul Üniversitesi Cerrahpaşa Tıp Fakültesi, Ortopedi ve Travmatoloji Anabilim Dalı 34098 Fatih, İstanbul, Turkey.

Tel: +90 532 – 598 62 32 e-mail: nuriaydin@hotmail.com

**Submitted:** December 08, 2013 **Accepted:** November 14, 2013

©2014 Turkish Association of Orthopaedics and Traumatology

Available online at  
www.aott.org.tr  
doi: 10.3944/AOTT.2014.13.0015  
QR (Quick Response) Code

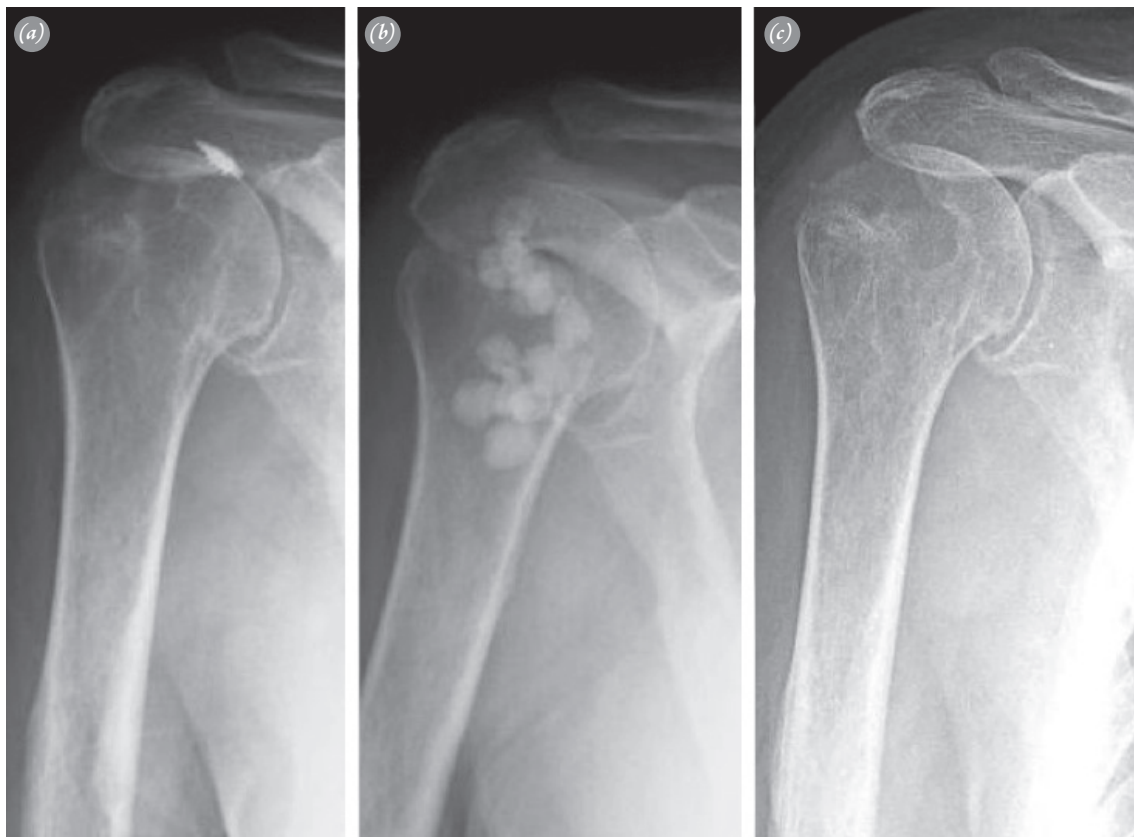


romioplasty and subacromial decompression, a double-row rotator cuff repair was performed. Two titanium anchors (Twinfix 5.0 mm; Smith & Nephew plc, Memphis, TN, USA) were placed at the medial row and two PEEK knotless anchors (Footprint PK 5.5 mm; Smith & Nephew plc, Memphis, TN, USA) were placed at the lateral row. The pendulum exercises and passive movements were started and the patient was discharged from the hospital with an arm sling on the 2nd postoperative day.

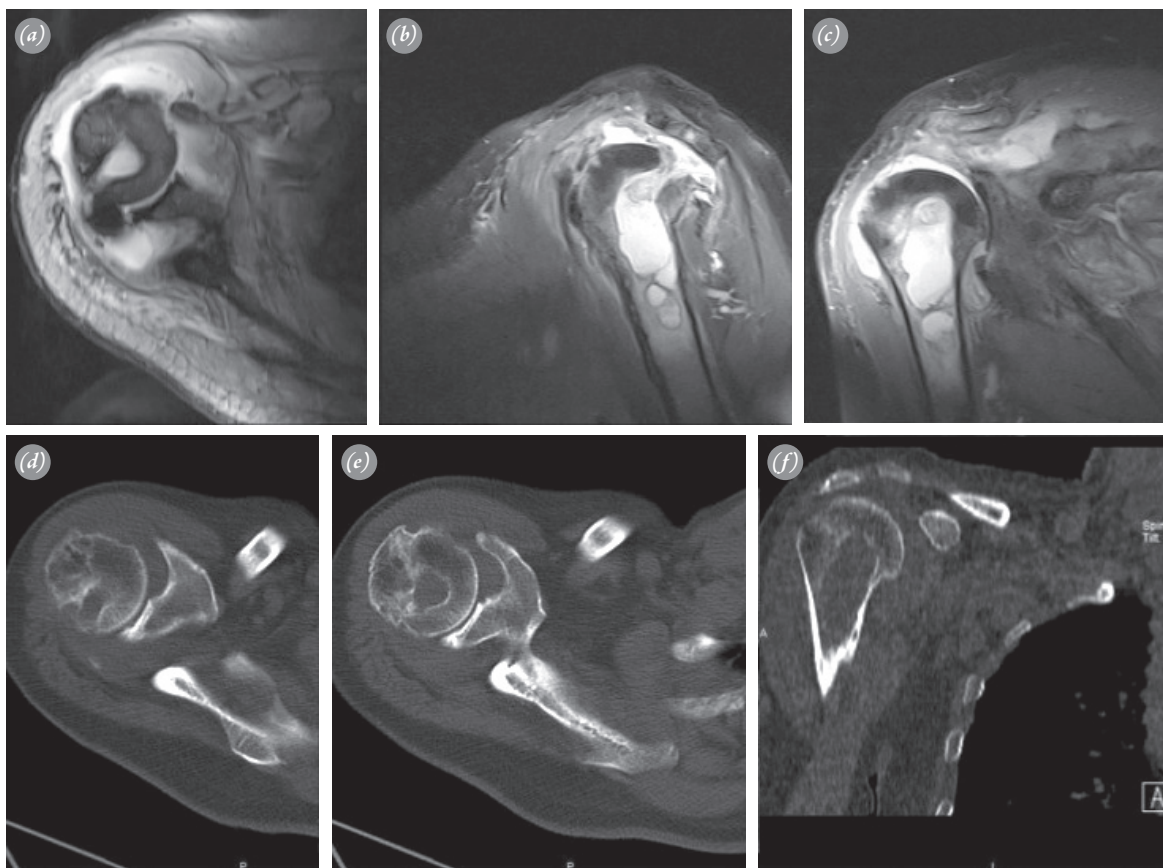
The patient presented to our outpatient clinic two weeks after the operation with fatigue, fever, increased temperature, edema around the operation area, and a loss of shoulder range of motion. There was minimal drainage from the anterolateral portal. Swab cultures from which *P. aeruginosa* was isolated were taken. Laboratory tests showed elevated serum CRP (30 mg/L) and erythrocyte sedimentation rate (ESR) (60 mm/h). A diagnosis of acute shoulder joint infection was made. Arthroscopic debridement was performed to remove the anchors. While 1 titanium anchor and 1 PEEK anchor could be removed, the remaining 2 anchors could not. No

attempt was made to fix disrupted rotator cuff repairs at the first irrigation and debridement. The arthroscopic debridement was completed after irrigation with 12000 ml isotonic saline solution. The portals were alternated on an in-flow and out-flow basis. Further cultures taken during the procedure also grew *P. aeruginosa*. Consultation with infectious diseases was undertaken and antibiotic therapy was started with oral ciprofloxacin (Ciproxin; Bayer AG, Leverkusen, Germany) 750 mg twice daily and piperacillin/tazobactam (Tazocin; Pfizer, Inc., New York, NY, USA) 4.5 g IV four times daily. After serum CRP and ESR levels turned to normal, the patient was discharged on oral ciprofloxacin 750 mg twice daily for three months. The patient was then lost to follow-up.

Two years after his first surgery, he returned to our outpatient department with pain and limited motion on his shoulder. There was some swelling on the anterior side of the shoulder joint. He had fatigue but no fever. In his laboratory examination, serum CRP and ESR levels were elevated (60 mg/L and 80 mm/h, respectively) and bony destruction was observed on anteroposterior radiography (Fig. 1a). Magnetic resonance and CT im-



**Fig. 1.** Plain film radiographs of the right shoulder. **(a)** There is a visible cavity at the proximal humerus. The anchor is floating in the subacromial space. **(b)** The cavity is filled with antibiotic-impregnated cement beads. **(c)** View after the removal of the cement beads in the 6th week.



**Fig. 2.** Magnetic resonance and computerized tomography images. **(a, b, d, e)** Posterior opening of the cavity at the proximal humerus. **(b)** The cavity connects to the subacromial space. **(c, f)** Localization of the abscess at the proximal humerus.

ages confirmed the diagnosis for osteomyelitis of the proximal humerus (Fig. 2). The patient was operated in beach chair position using a deltopectoral approach. The remaining 1 titanium and 1 PEEK knotless anchor were removed. The bony window opened by the abscess that was located at the posterior side of the humerus was used as access to the debridement site. Multiple culture samples were taken from superficial and deep tissues. The debridement was performed by curette and pressured irrigation was used for the debridement of the wound using 12000 ml isotonic saline solution. The cavity at the proximal humerus was filled with antibiotic bone cement beads (Cemex Genta; Exactech Inc., Verona, Italy). The cement was composed of 0.5 g gentamicin mixed with 1 g of teicoplanin (Targocid; Sanofi S.A., Paris, France) in 40 g of cement. Handmade bone cement beads were prepared and passed around a no.2 suture (ULTRABRAID™; Smith & Nephew plc, Memphis, TN, USA). Routine closure was performed (Fig. 1b). Cultures taken during surgery were again positive for *P. aeruginosa*. Intravenous antibiotic therapy was started with piperacillin/tazobactam (Tazocin). The CRP levels

turned to normal values in the 4th week after debridement. Intravenous antibiotic treatment was continued for a total of 6 weeks. In the 6th week, an additional operation was performed to remove the handmade antibiotic bone cement beads (Fig. 1c). The patient continued on oral antibiotic treatment with ciprofloxacin 750 mg (Ciproxin) twice daily for 2 months. Two months after the final operation, ESR levels returned to normal. The patient had residual limited movement of the shoulder with 40 degrees of elevation, 60 degrees of abduction, 10 degrees of external rotation and 10 degrees of internal rotation at the latest follow-up, and was able to perform his usual activities of daily living.

## Discussion

Although shoulder arthroscopy is a minimally invasive procedure with a low risk of deep infection, we experienced a case of osteomyelitis of *P. aeruginosa* that has not been previously reported as a cause of osteomyelitis after arthroscopic rotator cuff repair. Osteomyelitis is an inflammation of the bone caused by a pyogenic organism. Historically, osteomyelitis has been categorized as acute,

subacute or chronic, with the presentation of each type based on the time of disease onset. Acute osteomyelitis develops within two weeks after disease onset, subacute osteomyelitis within one to two months and chronic osteomyelitis after a few months.<sup>[5]</sup> In the present case, chronic osteomyelitis was categorized by nearly two years of disease duration and bone destruction on X-ray.

Chronic osteomyelitis can generally be eradicated by radical debridement that can leave a large dead space. Several methods have been described to eliminate the dead space to prevent recurrence and bone loss that might result in bone instability.<sup>[6]</sup> In our case, antibiotic bone cement beads were used to pack the dead space after the necrotic bone parts were excised.

There are many causes for infection. The source may be the skin of the patient or airborne particles from operating room personnel.<sup>[7]</sup> Even conversation made in the operating room has been shown to be a potential source.<sup>[7]</sup> Suction tips, light switches, collection bags, blades and high room temperatures may cause bacterial accumulation.<sup>[8]</sup> Armstrong and Bolding<sup>[9]</sup> published 7 cases of infection among 352 arthroscopic procedures with an infection rate of 2%. They found that electrocardiography cables were contaminated with *P. aeruginosa* from an unsterile cleaning solution, which later led to shoulder infections. Inadequate arthroscope disinfection or some remaining tissue particles left in the arthroscopic equipment may also lead to infection. In our case, cultures from the operating theater, electrocardiographic cables and arthroscopic equipment were taken during the first acute presentation but no bacteria could be isolated from the environment. Armstrong and Bolding also showed that the use of intraoperative intra-articular corticosteroids is correlated with the occurrence of infection.<sup>[9]</sup> In our case, no corticosteroid injection was performed pre or postoperatively.

In the first acute presentation of our case, the debridement was performed arthroscopically. We were unable to remove 2 anchors (1 PEEK and 1 metal). Herrera et al. published good results with leaving the sutures in place and obtained a good result with *P. acne*.<sup>[10]</sup> In another study by Masini, it was shown that there is bacterial adherence to high-tensile strength sutures.<sup>[11]</sup> We believe that the first debridement for this patient was not sufficient to prevent later reactivation of the infection. All implants with sutures should be removed with either an open or arthroscopic method. Cases with good results after arthroscopic debridement have been reported in the literature, but in most of these cases, no material remained in the bone or joint.<sup>[11-14]</sup>

We preferred antibiotic-impregnated cement beads

because chronic osteomyelitis is caused by bacteria growing in a biofilm environment that causes a resistance to systemic antibiotic levels up to 1000 times higher than therapeutic levels.<sup>[6,15]</sup> Local antibiotic delivery after surgical debridement is a crucial component in the long-term resolution of chronic osteomyelitis. The disadvantage of bone cement beads is the need for removal with another operation.<sup>[16]</sup> Because it represents a foreign body, the cement has a potential for recurrent infection after the period of effective antibiotic elution.<sup>[16,17]</sup> In our case, we extracted the cement in the 6th week. We believe that antibiotic cement is an effective method. Our patient was able to manage his daily activities at the final follow-up with minimal pain. We have offered a reverse total shoulder arthroplasty to be undertaken in the future, but the patient has declined a further operation at present.

Martin et al.<sup>[3]</sup> recently published data regarding complications after shoulder arthroscopy in 9,410 cases. Among 9,410 patients, the total complication rate was 0.99%. Patients with a history of smoking, chronic obstructive pulmonary disease, an operative time longer than 1.5 hours, or an American Society of Anesthesia class of 3 or 4 compared with 1 or 2 were in a higher risk group for complications. Parnes et al.<sup>[18]</sup> published their results after revision arthroscopic rotator cuff repair. The review of 94 revision patients resulted in failure to heal (10.6%), stiffness (7.4%), infection (2.1%) and nerve injury (1.1%). The complication rate after revision arthroscopic rotator cuff repair was found to be twice the published rates for primary rotator cuff repairs. The most common complication was failure to heal because of poor tissue quality. Pandey et al. reported a patient who developed a nonfatal air embolism during shoulder arthroscopy which occurred just after the filling of the joint with air for diagnostic arthroscopy.<sup>[19]</sup> Austin et al.<sup>[20]</sup> showed that an air embolism may occur because of the residual air in commercial liquid bags. It is advised to evacuate air from 3L bags prior to use.

As even minor complications are rare after arthroscopic operations, sometimes symptoms can be underestimated postoperatively. Therefore, there should be a high index of infection suspicion if the patients' symptoms do not resolve after a certain time. The appropriate blood tests, aspiration of the joint and imaging studies should be done immediately. It should be remembered that arthroscopic operations are real surgical interventions and all the surgical handpiece tools and equipment should be properly sterilized. On the other hand, there are some mechanisms designed to minimize the risk of infection in arthroscopic surgeries, such as limited incisions, constant irrigation and short surgical time. The

avoidance of infection should start with surgical equipment sterilization and surgical site preparation. Activities such as draping should be done with caution as draping that does not prevent leakage can contaminate the surgical site from the surrounding unsterile areas. Surgical sites should also be cleansed and clippers used for hair removal where appropriate.<sup>[21]</sup>

Isolation of the microorganisms is the primary objective and must be completed prior to debridement and irrigation of the infected site. After debridement and irrigation, eradication of biofilm must also be considered by local antibiotic therapy. Cement beads with antibiotics can be used for local antibiotic therapy and dead space management. After deep culture specimens are taken, advice should be obtained from the infectious diseases department for advanced antibiotic therapy guided by the results of the deep culture specimen in switching to specific antibiotics. After the operation and administration of the specific antibiotics, the patient's inflammatory markers (ESR, CRP and leukocyte count) should be monitored.<sup>[22]</sup>

In conclusion, osteomyelitis due to shoulder arthroscopy can be successfully treated by debridement and application of antibiotic-impregnated cement beads.

**Conflicts of Interest:** No conflicts declared.

## References

- Mansat P, Cofield RH, Kersten TE, Rowland CM. Complications of rotator cuff repair. *Orthop Clin North Am* 1997;28:205-13. [CrossRef](#)
- Settecerri JJ, Pitner MA, Rock MG, Hanssen AD, Cofield RH. Infection following open repair of the rotator cuff. *Orthop Trans* 1997;20:949.
- Martin CT, Gao Y, Pugely AJ, Wolf BR. 30-day morbidity and mortality after elective shoulder arthroscopy: a review of 9410 cases. *J Shoulder Elbow Surg* 2013;22:1667-75.
- Mirzayan R, Itamura JM, Vangness CT Jr, Holtom PD, Sherman R, Patzakis MJ. Management of chronic deep infection following rotator cuff repair. *J Bone Joint Surg Am* 2000;82-A:1115-21.
- Dan M, Siegman-Igra Y, Pitlik S, Raz R. Oral ciprofloxacin treatment of *Pseudomonas aeruginosa* osteomyelitis. *Antimicrob Agents Chemother* 1990;34:849-52. [CrossRef](#)
- Mayberry-Carson KJ, Tober-Meyer B, Smith JK, Lambe DW Jr, Costerton JW. Bacterial adherence and glycocalyx formation in osteomyelitis experimentally induced with *Staphylococcus aureus*. *Infect Immun* 1984;43:825-33.
- Letts RM, Doermer E. Conversation in the operating theater as a cause of airborne bacterial contamination. *J Bone Joint Surg Am* 1983;65:357-62.
- Aydin N, Esemeli T. Sweating: a formidable challenge in orthopaedic surgery. *J Hosp Infect* 2010;75:236-7. [CrossRef](#)
- Armstrong RW, Bolding F. Septic arthritis after arthroscopy: the contributing roles of intraarticular steroids and environmental factors. *Am J Infect Control* 1994;22:16-8.
- Herrera MF, Bauer G, Reynolds F, Wilk RM, Bigliani LU, Levine WN. Infection after mini-open rotator cuff repair. *J Shoulder Elbow Surg* 2002;11:605-8. [CrossRef](#)
- Masini BD, Stinner DJ, Waterman SM, Wenke JC. Bacterial adherence to high-tensile strength sutures. *Arthroscopy* 2011;27:834-8. [CrossRef](#)
- Busfield BT. Glenohumeral joint sepsis after magnetic resonance imaging arthrogram. *Am J Orthop (Belle Mead NJ)* 2012;41:277-8.
- Klinger HM, Baums MH, Freche S, Nusselt T, Spahn G, Steckel H. Septic arthritis of the shoulder joint: an analysis of management and outcome. *Acta Orthop Belg* 2010;76:598-603.
- Duncan SF, Sperling JW. Treatment of primary isolated shoulder sepsis in the adult patient. *Clin Orthop Relat Res* 2008;466:1392-6. [CrossRef](#)
- Harding JW, Braddock GT, Croydon EA. Successful treatment of osteomyelitis caused by *Pseudomonas aeruginosa*. *J Clin Pathol* 1970;23:653-6. [CrossRef](#)
- Kanellakopoulou K, Giamarellos-Bourboulis EJ. Carrier systems for the local delivery of antibiotics in bone infections. *Drugs* 2000;59:1223-32. [CrossRef](#)
- Bowyer GW, Cumberland N. Antibiotic release from impregnated pellets and beads. *J Trauma* 1994;36:331-5.
- Parnes N, DeFranco M, Wells JH, Higgins LD, Warner JJ. Complications after arthroscopic revision rotator cuff repair. *Arthroscopy* 2013;29:1479-86. [CrossRef](#)
- Pandey V, Varghese E, Rao M, Srinivasan NM, Mathew N, Acharya KK, et al. Nonfatal air embolism during shoulder arthroscopy. *Am J Orthop (Belle Mead NJ)* 2013;42:272-4.
- Austin L, Zmistowski B, Tucker B, Hetrick R, Curry P, Williams G Jr. Commercial liquid bags as a potential source of venous air embolism in shoulder arthroscopy. *J Bone Joint Surg Am* 2010;92:2110-4. [CrossRef](#)
- Canale ST, Beaty JH. *Campbell's Operative Orthopaedics*. 12th ed. Philadelphia: Elsevier Mosby; 2013. p. 2374-5.
- Meislin RJ, Halbrecht J. *Complications in Knee and Shoulder Surgery*. London: Springer-Verlag; 2009. p. 238-9. [CrossRef](#)