J Shoulder Elbow Surg (2020) 29, e443–e449

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

# Arthroscopic treatment for septic arthritis of the shoulder in a 1-month-old infant: a case report

**Akihiko Hasegawa, MD, PhD*, Teruhisa Mihata, MD, PhD, Kenta Fujiwara, MD, PhD, Yusuke Noguchi, MD, Masashi Neo, MD, PhD**

*Department of Orthopedic Surgery, Osaka Medical College, Takatsuki, Osaka, Japan*

**Keywords:** Arthroscopic treatment; group B Streptococcus; infant; osteomyelitis; septic arthritis; shoulder

Septic arthritis of the shoulder in infancy and childhood is a rare condition. Prompt diagnosis and treatment are required because delayed diagnosis and inadequate treatment may result in osteomyelitis, chondrolysis, recurrent septic arthritis, and systemic sepsis.[27] Treatment options include needle aspiration, open arthrotomy, or arthroscopic débridement.[6,8,11,21] Previous studies have reported long-term outcome after arthrotomy or needle aspiration.[4,25] The shortening of the humerus and/or deformity of the humeral head sometimes appear more than 1 year after arthrotomy or needle aspiration. As for arthroscopic treatment, there has been no report that completed more than 1 year of follow-up after arthroscopic surgery for septic arthritis of the shoulder in infancy. To our knowledge, we report the first case of septic arthritis of the shoulder in an infant who was treated arthroscopically and completed a 2-year follow-up. Our patient had a good clinical and radiographic outcome at 2 years after arthroscopic débridement and synovectomy.

## Report of the case

A 31-day-old female infant was brought to the pediatric clinic of our institution with a history of not using her left arm for a week although she had no history of trauma or injury. At the initial visit, her body temperature was 37.5°C. On the same day, the patient was introduced to our orthopedic clinic because there were no abnormal findings except for the disuse of her left arm. The initial finding of the plain radiograph was widening and inferior subluxation of the left glenohumeral joint (Fig. 1). Laboratory tests demonstrated a white blood cell (WBC) count of 7780/mm$^3$, relative percentage of neutrophils of 40.0%, and C-reactive protein (CRP) level of 2.76 mg/dL. Unfortunately, the diagnosis of septic arthritis was not made at the initial evaluation because the WBC count and relative percentage of neutrophils, and her body temperature were within the normal range for a 1-month-old infant.[1,13,14,29] Then, a follow-up examination was planned. The patient was brought to our clinic 6 days after the initial visit, without any signs of improvement. Her body temperature was 37.0°C during the second visit. On physical examination, no swelling or redness of her left shoulder were noted (Fig. 2). The plain radiograph revealed radiolucency of the proximal humerus as well as persistent widening of the left glenohumeral joint (Fig. 3). Laboratory tests demonstrated a WBC count of 5920/mm$^3$, relative percentage of neutrophils of 36.0%, and a CRP level of 5.73 mg/dL. Contrast-enhanced computed tomography (CT) was taken to examine whether there was any focus of infection. The computed tomographic images revealed the ring-enhancing lesion in her left shoulder and osteolysis in the proximal humerus (Fig. 4). Then, needle aspiration was attempted. A cloudy, yellow fluid was aspirated from the left shoulder, and Gram staining and culture evaluation showed group B

Institutional review board approval was not required for this case report.

*Reprint requests: Akihiko Hasegawa, MD, PhD, Department of Orthopedic Surgery, Osaka Medical College, 2-7 Daigaku-machi, Takatsuki, Osaka, 569-8686, Japan.

E-mail address: ort171@osaka-med.ac.jp (A. Hasegawa).


https://doi.org/10.1016/j.jse.2020.05.026

**Figure 1** The initial finding of the plain radiograph. Widening and inferior subluxation of the left glenohumeral joint were noted.

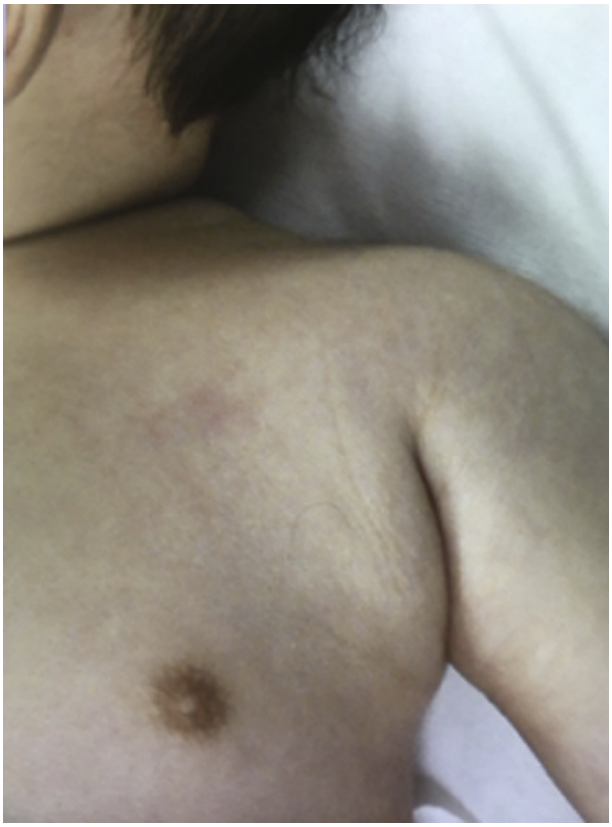

**Figure 2** Preoperative macroscopic findings. No swelling or redness were noted in the left shoulder.

Streptococcus (GBS). Based on the history, symptoms, laboratory data, radiographic images, Gram staining, and culture of the aspirated fluid, we diagnosed septic arthritis of the shoulder due to presence of GBS.

## Surgical technique

At 14 days after onset (38 days after birth), arthroscopic débridement and synovectomy were performed with the patient in the lateral decubitus position under general anesthesia. With the child's left arm held at 30° of shoulder abduction by an assistant, a 23-gauge needle was inserted through the soft spot at the back of the glenoid for joint aspiration (Fig. 5); then, a 2.3-mm 30°-arthroscope was inserted through the posterior portal. The glenoid surface and humeral head were covered by the hypertrophic inflamed synovium (Fig. 6, *A*). Severe synovitis was found at the rotator interval and synovial sheath around the long head of the biceps (Fig. 6, *B*). For the establishment of the anterior portal, a 23-gauge needle was inserted through the rotator interval just lateral to the coracoid process viewing through the posterior portal. After the needle located the appropriate angle and position, the surgeon inserted a blunt-tipped obturator placed parallel to the 23-gauge needle to bluntly tunnel through the soft tissues and enter the joint capsule. Subsequently, a 2.0-mm shaver or radiofrequency wand for wrist arthroscopy was inserted from the anterior portal and synovectomy was performed. We found that the articular surface of the humeral head and glenoid remained intact after arthroscopic débridement and synovectomy (Fig. 6, *C*). After rotator interval release for sufficient synovectomy (Fig. 6, *D*), we closed the skin without inserting drainage tubes.

Ampicillin sodium (600 mg/day) was administered intravenously for 2 weeks, until the laboratory tests

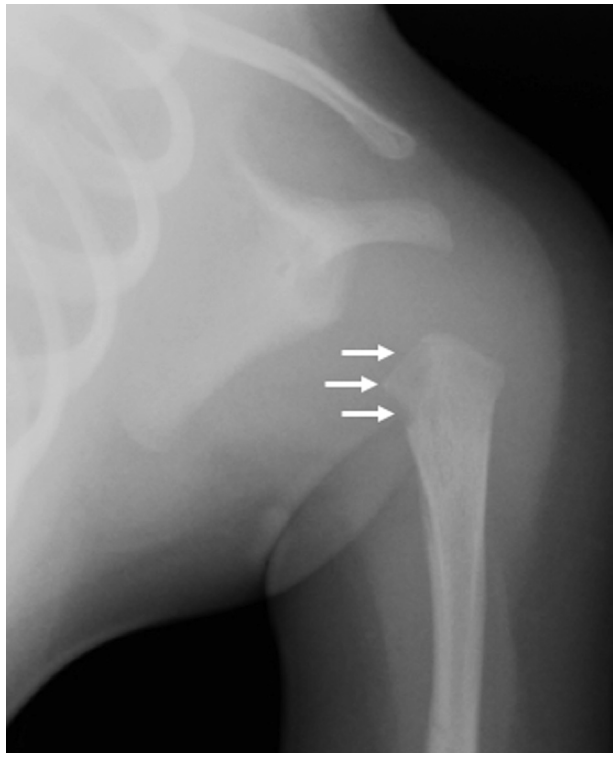

**Figure 3** The preoperative plain radiograph 13 days after onset. Widening and inferior subluxation of the left glenohumeral joint and radiolucency (→) of the medial proximal humerus were noted.

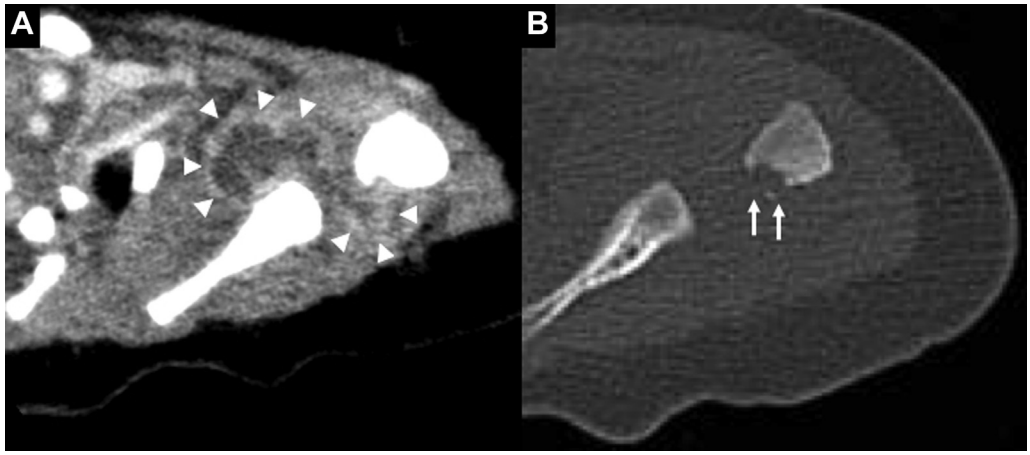


**Figure 4** Preoperative contrast-enhanced computed tomography (CT) images of the left shoulder: (**A**) ring-enhancing lesion (►), (**B**) osteolysis of the proximal humerus (→).

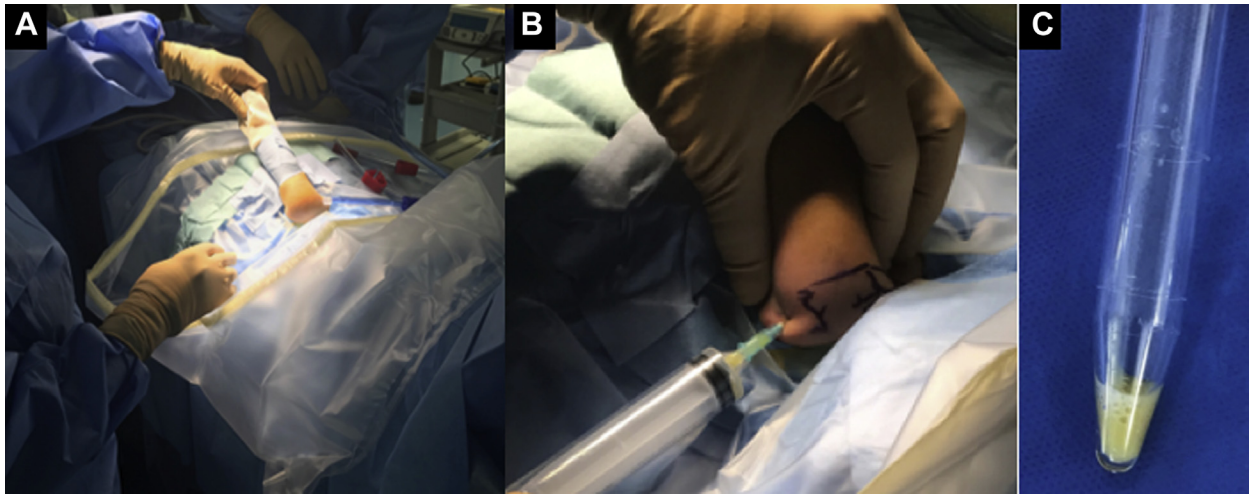


**Figure 5** The position for arthroscopy and joint aspiration. (**A**) The patient's left arm was held at 30°-shoulder abduction with the patient in the lateral decubitus position. (**B**) Joint aspiration with a 23-gauge needle. (**C**) Cloudy, yellow fluid aspirated from the left shoulder.

demonstrated recovery of WBC count and CRP level within the normal range. Laboratory tests demonstrated a WBC count of 7090/mm$^3$ and CRP level of 0.09 mg/dL at 14 days after surgery. We prescribed an oral suspension containing amoxicillin trihydrate (170 mg/day) after intravenous administration for an additional week. She was discharged from the hospital 17 days after surgery. At 10 weeks after surgery (3 months old), her physical examination revealed symmetrical movements and the postoperative radiograph showed remodeling of the proximal humerus where radiolucent changes had been observed preoperatively (Fig. 7, *A*). Laboratory tests demonstrated that the WBC count and CRP level remained within the normal range. At 8 months after surgery (9 months old), 2 separate epiphyseal ossification centers were observed in the proximal humeral epiphysis (Fig. 7, *B*). At 2 years after surgery (25 months old), the plain radiograph showed no abnormality in the appearance of ossification centers or arm length discrepancy (Fig. 7, *C*). The patient was asymptomatic and showed active elevation without discomfort (Fig. 8). Passive range of motion in her left shoulder was not restricted. We evaluated magnetic resonance imaging (MRI) findings obtained after a 2-year follow-up (Fig. 9). A radiologist and an experienced pediatric orthopedic surgeon confirmed that there was no abnormality of the glenohumeral joint, growth plate, and proximal humerus in the MRIs.

The patient's parents were informed that the data and photograph from the case would be submitted for publication and gave their consent.

## Discussion

The incidence rate of septic arthritis is between 5.5 and 12 cases per 100,000 children[10,12]; the shoulder is affected in 3%-5% of all cases.[11,21] Septic arthritis of the shoulder in

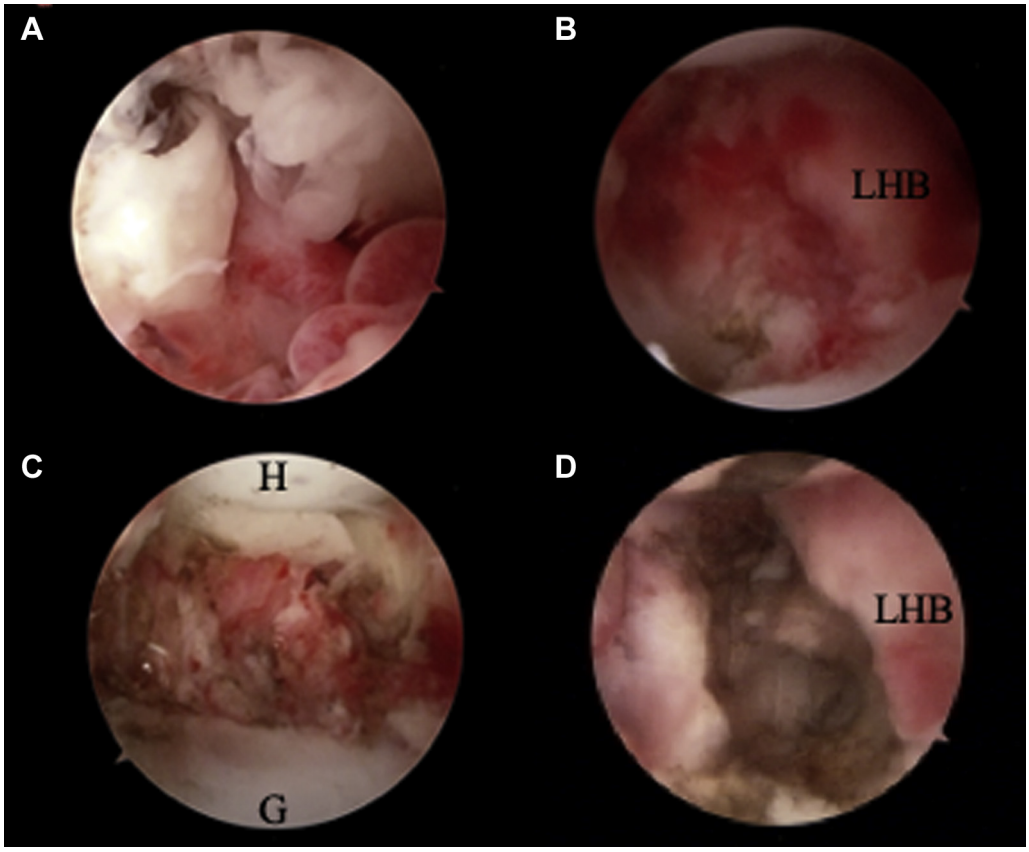


**Figure 6** Arthroscopic findings of the left shoulder: (**A**) Humeral head and glenoid were covered by inflammatory synovium. (**B**) Severe synovitis can be seen at the rotator interval and around the LHB. (**C**) The humeral head and glenoid surface remained intact. (**D**) The rotator interval was released. *LHB*, long head of biceps; *H*, humeral head; *G*, glenoid.

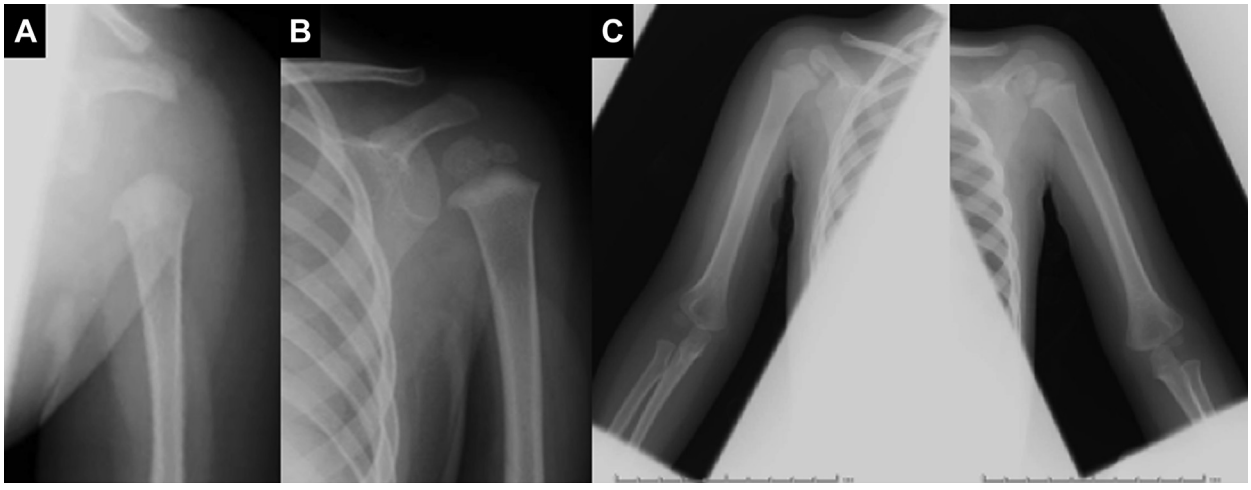


**Figure 7** Radiographic findings after surgery: (**A**) Ten weeks after surgery, remodeling of the proximal humerus was observed. (**B**) Eight months after surgery, 2 separate epiphyseal ossification centers were observed in the proximal humeral epiphysis. (**C**) Two years after surgery, there was no abnormality in the appearance of ossification centers or arm length discrepancy.

young children is less common than that of the lower extremities, such as of the hip or knee.[10,12,30] Osteomyelitis is highly associated with septic arthritis of the shoulder as the capsule envelops the metaphysis, facilitating hematogenous spread between the bone and joint space.[3,22] Therefore, delayed diagnosis of septic arthritis of the shoulder causes damage to the growth plate and growth of the secondary ossification centers of the

**Figure 8** Active shoulder elevation at 2 years after surgery.

proximal humerus, resulting in a shortened humerus with a deformed head.[4,25] Kawashima et al[15] reported that in some cases, more than 10 days after onset, infection and inflammation had already affected the articular cartilage and bone, resulting in a shortened humerus with a deformed head in the upper arm and/or deformity of the humeral head.

In our patient, the radiograph showed widening of the joint space and inferior subluxation of the affected shoulder joint when she was initially brought to the outpatient clinic with a history of not using her left arm for a week. At the second visit, which was 13 days after onset, the radiograph showed medial metaphyseal radiolucency, which suggested adjacent osteomyelitis as well as persistent widening and subluxation of the joint space of the affected shoulder. These radiographic changes were consistent with those observed in previous reports.[15,25]

The causative organism in this case report was *Streptococcus agalactiae*, which is also known as GBS; GBS is a common commensal bacterium of the bowel and genital tract flora. It is recognized as a cause of sepsis, septic arthritis, and meningitis in newborns and pregnant women.[2,24] Known transmission routes include sexual contact with colonized individuals as well as vertical transmission from mother to neonate.[9] Invasive neonatal GBS infection has either early (usually within 24 hours of birth) or late (7 days after birth) onset. Septic arthritis has been well described as a clinical manifestation of late-onset GBS infection in neonates.[7,17] Our patient's parents noticed that the patient did not use her left arm at 24 days after birth, without any traumatic events or injuries. Thus, we suspected that GBS was vertically transmitted from the patient's mother to the patient.

Risk factors for poor outcomes after septic arthritis include delayed diagnosis as well as nonoperative management and increased virulence of the organism.[3,4,19] Previous studies have demonstrated a delay in treatment for shoulder infection as compared to hip infections.[3] With the availability of a validated clinical prediction rule for septic arthritis of the hip and advanced imaging modalities such as MRI, most hip infections are diagnosed early.[5,12,16] However, validated guidelines for the diagnosis of septic arthritis of the shoulder in children do not exist. Instead, diagnosis is often made based on the clinical history, clinical course, fever, elevated serum markers (ie, white blood cell count, neutrophil count, erythrocyte sedimentation rate, CRP level, and blood culture), joint fluid aspiration (ie, cell count, Gram stain, and culture), and imaging studies (ie, plain radiograph, ultrasonography, and MRI).[20] Our patient had a history of not using her left arm for a week, the abnormally high serum CRP level (2.76 mg/dL, reference range: 0.09-1.58 mg/dL for a 0-90-day-old infant),[29] and the widening and subluxation of the joint space of the affected shoulder on the plain radiograph at the initial visit. Unfortunately, however, there was a delay in the diagnosis and treatment of our patient because of the rarity of septic arthritis of the shoulder in infancy, along with a normal WBC count (7780/$mm^3$, reference range: 5000-19,500/$mm^3$ for a 1-month-old infant)[1] and body temperature as a 1-month-old infant. Caird et al reported that although a fever of $>38.5°C$ and a CRP level of $>2.0$ mg/dL were strong predictors of septic arthritis, they were still negative for 56% and 15% of children with septic arthritis, respectively. Based on findings of our case and previous literature, septic arthritis of the shoulder should be considered in infants who present with abnormal use of the arm even if laboratory values and other clinical factors are not present. In addition, we recommend to consider the additional examination such as contrast-enhanced computed tomography, MRI, or joint aspiration for a prompt diagnosis if septic arthritis is suspected from a physical examination, plain radiograph, and laboratory tests.

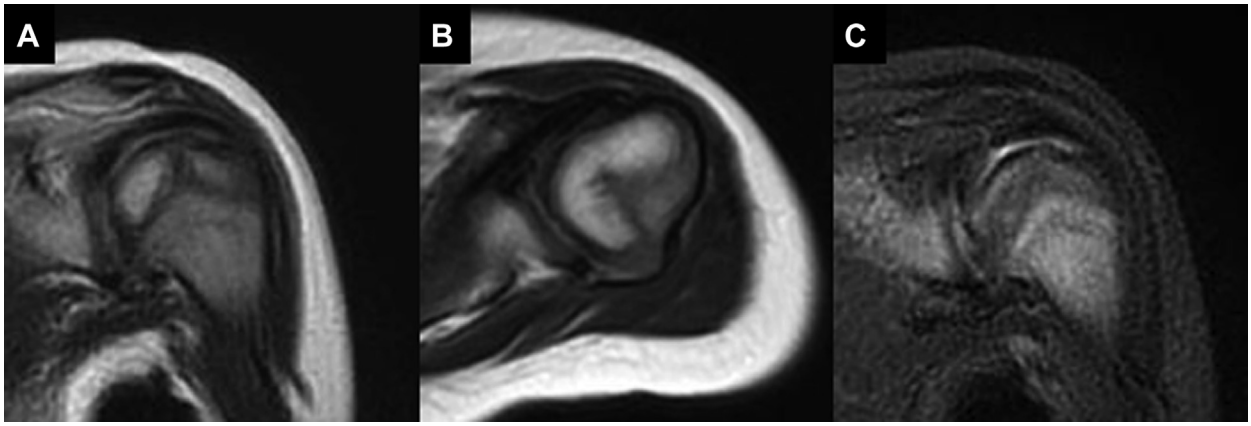


**Figure 9** Magnetic resonance imaging at 2 years after surgery, There was no abnormality of the glenohumeral joint, growth plate, and proximal humerus. (**A**) Oblique coronal T2-weighted image of the left shoulder. (**B**) Axial T2-weighted image of the left shoulder. (**C**) Oblique coronal short-term inversion recovery image of the left shoulder.

Surgical treatment for septic arthritis of the shoulder in infants and children by multiple aspirations and open arthrotomy has been well established.[6,11,21,31] A randomized prospective study has compared the clinical and radiographic outcome of septic arthritis of the shoulder treated by either needle aspiration or arthrotomy and found no statistical difference in the clinical outcome for the 2 treatments.[28] Recently, arthroscopic surgery has evolved, and arthroscopic treatment for septic arthritis in infants and children was introduced. Forward et al[8] reported 3 cases of septic arthritis of the shoulder in infants treated by arthroscopic washout; the patients recovered fully 3 months after surgery. Morihara et al[18] reported a case of septic arthritis of the shoulder in a 2-year-old infant treated by arthroscopic débridement and synovectomy and showed a good clinical outcome at the 1-year follow-up. To date, however, there has been no report that completed more than 1-year follow-up after arthroscopic treatment for septic arthritis of the shoulder in infancy. Some previous studies have reported that humeral shortening, humeral head irregularity, or deformity appeared between 12 and 18 months after the treatment,[11,25,26] although Saisu et al[25] reported that 10 of 16 patients showed radiographic abnormalities within a year after the arthrotomy or nonoperative treatment. Thus, longer follow-up is recommended in children with septic arthritis. Here, we reported the first case of septic arthritis of the shoulder in an infant who was treated arthroscopically and completed a 2-year follow-up. In our case, we found no abnormalities in the appearance of ossification centers or arm length discrepancy during a 2-year follow-up. In addition, we evaluated the MRI findings and confirmed that there were no abnormalities in the shoulder joint, growth plate, and proximal humerus at the 2-year follow-up. The best technique available to evaluate changes in the bone marrow/water content of a bone with a high sensitivity and specificity for the diagnosis of osteomyelitis is MRI.[22,23] Therefore, we believe that our patient achieved a favorable outcome without recurrent arthritis or osteomyelitis 2 years after arthroscopic treatment, although there was a delay in diagnosis. Given the excellent visualization, sufficient débridement, synovectomy, irrigation, and reduced soft tissue disruption, arthroscopic treatment might have an advantage in the treatment of septic arthritis.

## Conclusion

We report a case of arthroscopic treatment for septic arthritis of the shoulder in a 1-month-old infant. Our patient showed excellent clinical and radiographic outcomes without any sign of recurrent arthritis, osteomyelitis, or growth disturbance in the shoulder, 2 years after arthroscopic treatment. Arthroscopic débridement and synovectomy may be a viable alternative to surgical treatment for septic arthritis of the shoulder, even in infants.

## Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

## References

1. Andropoulos D. Appendix B: pediatric normal laboratory values. In: Gregory GA, Andropoulos DB, editors. Gregory's pediatric anesthesia. Oxford, UK: Wiley-Blackwell; 2012. p. 1300-14.
2. Baker CJ. Group B streptococcal infections. Clin Perinatol 1997;24:59-70.

3. Belthur MV, Palazzi DL, Miller JA, Phillips WA, Weinberg J. A clinical analysis of shoulder and hip joint infections in children. J Pediatr Orthop 2009;29:828-33. https://doi.org/10.1097/BPO.0b013e3181b76a91
4. Bos CF, Mol LJ, Obermann WR, Tjin a Ton ER. Late sequelae of neonatal septic arthritis of the shoulder. J Bone Joint Surg Br 1998;80:645-50.
5. Caird MS, Flynn JM, Leung YL, Millman JE, D'Italia JG, Dormans JP. Factors distinguishing septic arthritis from transient synovitis of the hip in children. A prospective study. J Bone Joint Surg Am 2006;88:1251-7. https://doi.org/10.2106/JBJS.E.00216
6. Caksen H, Ozturk MK, Uzum K, Yuksel S, Ustunbas HB, Per H. Septic arthritis in childhood. Pediatr Int 2000;42:534-40.
7. Dan M. Neonatal septic arthritis. Isr J Med Sci 1983;19:967-71.
8. Forward DP, Hunter JB. Arthroscopic washout of the shoulder for septic arthritis in infants. A new technique. J Bone Joint Surg Br 2002;84:1173-5. https://doi.org/10.1302/0301-620x.84b8.12560
9. Foxman B, Gillespie BW, Manning SD, Marrs CF. Risk factors for group B streptococcal colonization: potential for different transmission systems by capsular type. Ann Epidemiol 2007;17:854-62. https://doi.org/10.1016/j.annepidem.2007.05.014
10. Frank G, Mahoney HM, Eppes SC. Musculoskeletal infections in children. Pediatr Clin North Am 2005;52:1083-1106. ix. https://doi.org/10.1016/j.pcl.2005.04.003
11. Gillespie R. Septic arthritis of childhood. Clin Orthop Relat Res 1973:152-9.
12. Gutierrez K. Bone and joint infections in children. Pediatr Clin North Am 2005;52:779-794. vi. https://doi.org/10.1016/j.pcl.2005.02.005
13. Hamiel U, Bahat H, Kozer E, Hamiel Y, Ziv-Baran T, Goldman M. Diagnostic markers of acute infections in infants aged 1 week to 3 months: a retrospective cohort study. BMJ Open 2018;8:e018092. https://doi.org/10.1136/bmjopen-2017-018092
14. Herzog LW, Coyne LJ. What is fever? Normal temperature in infants less than 3 months old. Clin Pediatr (Phila) 1993;32:142-6.
15. Kawashima A, Toyama Y, Mikasa M. Septic arthritis of the shoulder in infants and children: a long-term follow-up. Shoulder Joint 1987;11:174-8.
16. Kocher MS, Mandiga R, Murphy JM, Goldmann D, Harper M, Sundel R, et al. A clinical practice guideline for treatment of septic arthritis in children: efficacy in improving process of care and effect on outcome of septic arthritis of the hip. J Bone Joint Surg Am 2003;85:994-9.
17. Memon IA, Jacobs NM, Yeh TF, Lilien LD. Group B streptococcal osteomyelitis and septic arthritis. Its occurrence in infants less than 2 months old. Am J Dis Child 1979;133:921-3.
18. Morihara T, Arai Y, Horii M, Chatani K, Fujita S, Tokunaga D, et al. Arthroscopic treatment for septic arthritis of the shoulder in an infant. J Orthop Sci 2005;10:95-8. https://doi.org/10.1007/s00776-004-0861-9
19. Nade S. Acute septic arthritis in infancy and childhood. J Bone Joint Surg Br 1983;65:234-41.
20. Pandya NK, Namdari S. Shoulder arthroscopy in children and adolescents. J Am Acad Orthop Surg 2013;21:389-97. https://doi.org/10.5435/JAAOS-21-07-389
21. Paterson DC. Acute suppurative arthritis in infancy and childhood. J Bone Joint Surg Br 1970;52:474-82.
22. Perlman MH, Patzakis MJ, Kumar PJ, Holtom P. The incidence of joint involvement with adjacent osteomyelitis in pediatric patients. J Pediatr Orthop 2000;20:40-3.
23. Pineda C, Vargas A, Rodriguez AV. Imaging of osteomyelitis: current concepts. Infect Dis Clin North Am 2006;20:789-825. https://doi.org/10.1016/j.idc.2006.09.009
24. Regan JA, Klebanoff MA, Nugent RP. The epidemiology of group B streptococcal colonization in pregnancy. Vaginal Infections and Prematurity Study Group. Obstet Gynecol 1991;77:604-10.
25. Saisu T, Kawashima A, Kamegaya M, Mikasa M, Moriishi J, Moriya H. Humeral shortening and inferior subluxation as sequelae of septic arthritis of the shoulder in neonates and infants. J Bone Joint Surg Am 2007;89:1784-93. https://doi.org/10.2106/JBJS.E.01021
26. Schmidt D, Mubarak S, Gelberman R. Septic shoulders in children. J Pediatr Orthop 1981;1:67-72.
27. Shaw BA, Kasser JR. Acute septic arthritis in infancy and childhood. Clin Orthop Relat Res 1990:212-25.
28. Smith SP, Thyoka M, Lavy CB, Pitani A. Septic arthritis of the shoulder in children in Malawi. A randomised, prospective study of aspiration versus arthrotomy and washout. J Bone Joint Surg Br 2002;84:1167-72. https://doi.org/10.1302/0301-620x.84b8.13080
29. Soldin OP, Bierbower LH, Choi JJ, Choi JJ, Thompson-Hoffman S, Soldin SJ. Serum iron, ferritin, transferrin, total iron binding capacity, hs-CRP, LDL cholesterol and magnesium in children; new reference intervals using the Dade Dimension Clinical Chemistry System. Clin Chim Acta 2004;342:211-7. https://doi.org/10.1016/j.cccn.2004.01.002
30. Thompson RM, Gourineni P. Arthroscopic treatment of septic arthritis in very young children. J Pediatr Orthop 2017;37:e53-7. https://doi.org/10.1097/BPO.0000000000000659
31. Welkon CJ, Long SS, Fisher MC, Alburger PD. Pyogenic arthritis in infants and children: a review of 95 cases. Pediatr Infect Dis 1986;5:669-76.