



The relation between the arthroscopic findings and functional outcomes in patients with septic arthritis of the knee joint, treated with arthroscopic debridement and irrigation

İbrahim YANMIŞ¹, Hüseyin ÖZKAN¹, Kenan KOCA¹, Volkan KILINÇOĞLU², Doğan BEK¹, Servet TUNAY¹

¹Department of Orthopedics and Traumatology, GATA, Ankara, Turkey;

²Department of Orthopedics, Medical Park Hospital, Gaziantep, Turkey

Objective: The aim of this study was to evaluate the relation between arthroscopic findings and functional outcomes in patients with septic arthritis of the knee joint, treated with arthroscopic debridement and irrigation.

Methods: Twenty patients (17 male, 3 female; mean age: 31 years [5-63 years]) with knee septic arthritis treated with arthroscopic debridement and irrigation in our clinic between 2004-2007 were included in the study. The decision for arthroscopic debridement was made based on the clinical findings, erythrocyte sedimentation rate, C-reactive protein level and the aspiration of the affected knee. During the arthroscopic debridement, the joint was staged according to Gachter criteria. Continuous irrigation system was set up for all cases following surgery. After the surgery, the Bussiere functional scale was used for clinical evaluation. The mean follow-up period was 29±11 months (range 13-54 months). The McNemar test was used in comparing the results. The Spearman correlation coefficient was used in the correlation analysis. The level of significance was set at 0.05.

Results: The culture was positive in 3 cases, and negative in 8 cases who exhibited gram (+) cocci in gram stains. In nine cases, cultures were negative and no microorganisms were detected in gram stains. According to the arthroscopic Gachter classification, 4 cases (20%) were Stage 1, 10 cases (50%) were Stage 2, 5 cases (25%) Stage 3 and 1 case (5%) was Stage 4. There was a statistically significant difference between the mean functional score of the knees with differing Gachter stages (McNemar test, p=0.003). There was a statistically significant and strong correlation between Gachter score and functional results (correlation coefficient: 0.780; p<0.001).

Conclusion: Advanced arthroscopic findings are associated with poor functional results in patients with septic arthritis of the knee joint. In addition, the time between the initial symptoms and the surgery directly affects the functional results.

Key words: Arthroscopy; Bussiere; debridement and irrigation; Gachter; knee, septic arthritis.

The incidence of septic arthritis is between 0.034-0.13% and approximately half occur in knee joints.^[1] Septic arthritis causes rapid and permanent joint damages and consequently causes poor functional results, therefore the treatment should begin immedi-

ately once the diagnosis is made. The mortality rate has been reported as 3 to 29%.^[2] The type of the microorganism and the accompanying pathologies have an impact on the results.^[3,4] Septic arthritis diagnosis is made based on clinical findings such as fever,

Correspondence: Volkan Kılınçoğlu, MD. Department of Orthopedics, Medical Park Hospital, Gaziantep, Turkey.
Tel: +90 342 211 16 00 e-mail: v.kilincoglu@hotmail.com

Submitted: April 5, 2009 **Accepted:** August 27, 2010

©2011 Turkish Association of Orthopaedics and Traumatology

local hyperemia, joint effusion, joint fluid analysis, blood tests and imaging studies. After the diagnosis drainage of the joint fluid, irrigation and debridement and appropriate antibiotherapy are compulsory for successful results.^[5] Surgical treatment methods are suggested in addition to the medical treatment methods. In the past, repeated needle aspirations or irrigation and debridement of the joint had been performed with open arthrotomy.^[4] While septic arthritis was successfully treated with these methods, the functional results were not satisfactory.^[6,7]

Arthroscopy, a minimally invasive method, has the advantages of both methods mentioned above. It became very popular for the treatment of septic arthritis.^[8] Additionally, it was reported that most functions of the knee joints were recovered after arthroscopic debridement and irrigation.^[1,9] It was shown that the duration between initial symptoms and surgery had an impact on the outcomes of septic arthritis of the knee.^[10] It was reported that the intraoperatively Gachter staging might have had an impact on postoperative functional classification of Bussiere.^[11]

The aim of this study was to evaluate the relation between arthroscopic findings and functional outcomes in patients with septic arthritis of the knee joint, treated with arthroscopic debridement and irrigation.

Patients and methods

Between 2004-2007, twenty patients (17 men, 3 women; average age 31; distribution 5-63 years), who underwent arthroscopic drainage and irrigation

for the septic arthritis of the knee. One patient, who had been previously diagnosed with distal femur osteomyelitis, was excluded from the study. Patients who had previous trauma or surgical history were not included in the study. During the follow-up, the parameters, such as the age, sex, operated side, risk factors (diabetes mellitus, alcoholism, and systemic diseases), and the mean time between initial symptoms and joint aspiration and the mean time between initial symptoms and surgery were recorded.

The septic arthritis diagnosis was made based on clinical findings, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) levels and the increase of white blood cell (WBC) count in the joint fluid.^[12] Additionally, joint aspiration for direct microbiologic inspection and culture was obtained from all patients before treatment.

During the arthroscopic surgery, standard antero-medial and anterolateral portals were used. First, joint fluid was drained with the arthroscopic cannula (Fig. 1). Afterwards, the joint debridement was performed to remove the fibrin deposits and necrotic tissues. Arthroscopic irrigation was performed with 3000 cc ringer lactate solution, using manual pressured liquid sets. Solutions with antibiotics or antiseptics had not been used during the irrigation. Gram staining, bacterial culture and antibiotics sensitivity tests were performed with the joint fluid and synovial tissue. Two drains were inserted from medial suprapatellar (incoming) and lateral infrapatellar (outgoing) portals for the continuous lavage



Fig. 1. Drainage of the purulent joint fluid by the arthroscopic cannula. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]



Fig. 2. Establishment of the irrigation system postoperatively. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

system (Fig. 2). The irrigation of the knee was continued for 3 days with 3000 cc ringer lactate per day. The medial suprapatellar drain was removed on the third postoperative day. The lateral infrapatellar drain was removed on the fifth postoperative day.

Postoperatively, double antibiotics consisting of first generation cephalosporins and aminoglycosides, were administered intravenously for all patients. While the aminoglycosides was administered for a week, cephalosporin was administered for 6 weeks (1 week intravenously, 5 weeks orally).

Assessment criteria

Cartilage damage, detected during the operation, was classified with Gachter criteria^[13] (Table 1 and Fig. 3). According to these criteria, patients are categorized as Stage 1, 2, 3 or 4. After surgery, patients were assessed with the functional evaluation scale described by Bussiere,^[14] and classified as excellent, good, fair or poor (Table 2). Additionally, the correlation between the results of both evaluation scales was examined statistically. The mean follow-up period was 29 (range, 13 to 54) months.

Bussiere's functional scores and differing Gachter stages of the patients was compared with the McNemar test. The Spearman correlation coefficient was used in the correlation analysis. The level of significance was set at 0.05.

Results

The average follow-up period was 29 months (range 13 to 54 months). Nine patients suffered in the left knee and 11 in the right. There were various risk factors in 7 patients: three had diabetes mellitus, 1 rheumatoid arthritis, 1 respiratory tract infection, 1 arterial septal defect and 1 graft-versus-host disease. Thirteen patients had no predisposing factors. The average time between the initial symptoms and the aspiration was 2 ± 1.09 days (range 1 to 4 days), and the average time between the initial symptoms and the operation was 4 ± 1.3 days (range 1 to 7 days). The average WBC value of the cases was 12200 ± 5200 (6000-27800) per cubic millimeter, the average CRP level was 49 ± 25 (10.1-98.7) mg/L and the average ESR was 72 ± 21 (30-110) mm/h. Three patients' culture was positive. Eight patients' culture was negative, but gram (+) cocci were detected on microscop-

ic examination of the aspirate. In one case, the bacteria, isolated by the microbiological culture, was *Staphylococcus aureus*, in another, group-A beta hemolytic streptococcus and in three other cases, *Pseudomonas aeruginosa* were isolated. Nine patients' cultures were negative and no bacteria was detected during the microscopic direct examination of the aspirate. The patient, with *Pseudomonas aeruginosa*, had Type 1 diabetes mellitus for 10 years. The etiology of septic arthritis was a hematogenous, spread in 18 patients and iatrogenic in 2.

Table 1. Gachter criteria.

Stage 1	Blurred effusion, hyperemic synovium
Stage 2	Purulent effusion, fibrin deposits, hypertrophic synovium
Stage 3	Synovial adhesions, necrotic areas in the synovium and cartilage
Stage 4	Diffuse necrosis in the cartilage, bone erosion and osteolysis

Table 2. Bussiere functional evaluation scale.

Excellent	Pain-free full range of motion. No recurrence in follow-ups.
Good	Occasional minimal pain, but full range of motion. No recurrence in follow-ups.
Fair	Frequent moderate pain. Occasional joint effusion. Limited range of motion, with less than 120° flexion, and with a flexion contracture, less than 10°
Poor	Continuous severe pain, effusion, severe limitation in the range of motion, with less than 90° flexion, and with a flexion contracture, more than 10°

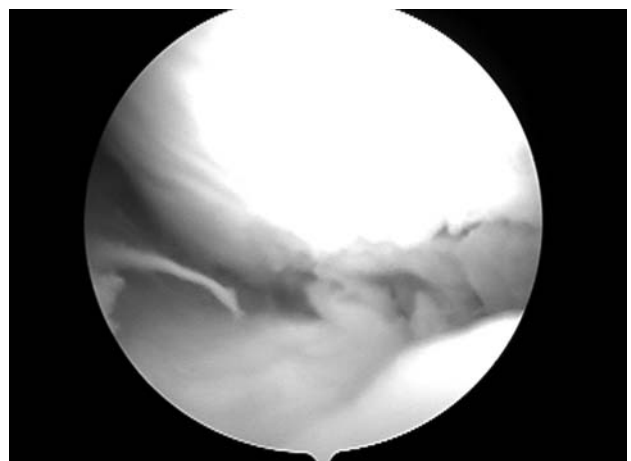


Fig. 3. Evaluation of the cartilage structure.

All patients had arthroscopic debridement and irrigation. Continuous irrigation was performed for 3 days after the operation. The patient with diabetes mellitus had poor results on the Bussiere scale and underwent a revision arthroscopy for debridement and irrigation. This patient had a limited range of motion at the last follow-up. On average, 9 liters of solution (range 6 to 12 liters) was used for irrigation during the arthroscopy. In 3 patients, with synovial hypertrophy, synovectomy was performed. In the other patients, only synovial biopsy was taken for pathology and culture. The surgical procedure lasted approximately 32 minutes (range 23 to 44 minutes).

According to the Gachter staging; 4 patients (20%) were Stage 1, 10 patients (50%) were Stage 2, 5 patients were Stage 3 (25%) and 1 patient (5%) was Stage 4.

The patients' complaints and signs disappeared in the early postoperative period. All patients except one, who had a revision arthroscopy, had good results after rehabilitation.

The clinical evaluation of the patients in the last follow-up was performed by the Bussiere and Beaufils' functional evaluation scale. The results of 13 patients (65%) were excellent, 5 patients (25%) were good, 1 patient was fair (5%) and 1 patient (5%) was poor. The functional evaluation results were different in various Gachter stages (McNemar test, $p=0.003$). A statistically significant and strong correlation was detected between the Gachter stages and functional results. (correlation coefficient: 0.780; $p<0.001$) (Table 3).

Discussion

A treatment algorithm has not been established for the knee septic arthritis yet. Four important points

are emphasized for successful results:^[15] early diagnosis and treatment, proper joint drainage, appropriate systemic and oral antibiotherapy, and early rehabilitation. Joint pressure decreases with drainage, which is the first step of treatment. Thus, the pain is resolved and the negative effects of the increased intra-articular pressure on the cartilage and the blood circulation are diminished.^[16] The irrigation, after the drainage, washes out the necrotic deposits, bacteria wastes and enzymatic products. In addition, by preventing adhesions, it improves the joint's range of motion.^[16]

Joint drainage can be performed with a single or a repetitive aspiration, arthroscopy or arthrotomy. The advantage of the arthroscopy, compared to the aspiration, is the ability to perform the irrigation and debridement by visualizing the joint surfaces. The advantage of the arthroscopy, compared to the open debridement, is better functional results and the decrease of morbidity.^[17] The success ratio for eliminating infection by arthroscopic debridement and irrigation, in patients with septic arthritis, was reported to be between 79% and 100%.^[18,19] In our study, the treatment of infection with one session of arthroscopic debridement and irrigation was successful by 95%. Only one patient needed a second arthroscopic debridement and irrigation.

It is reported that the time between initial symptoms and the operation is an important prognostic factor.^[10] Wirtz et al.^[10] reported that the results of the patients, who had 12 days or less between initial symptoms and the operation, were more successful. In our study, delayed arthroscopy was consistent with poor results.

It is reported that the amount of the intra-articular lesions, during the arthroscopy, has an impact on

Table 3. The correlation between intraoperative Gachter stages and functional outcomes according to Bussiere classification.

Bussiere classification	Gachter stages			
	Stage 1	Stage 2	Stage 3	Stage 4
Excellent	4	0	0	0
Good	9	0	1	0
Fair	0	5	0	0
Poor	0	0	0	1

McNemar test: $p=0.003$; Spearman correlation coefficient: 0.78; $p<0.001$

success.^[11] Stutz et al.^[11] reported that the success rates were 96, 95 and 67%, respectively, in patients with Gachter stages I, II and III. In our study, the relation between the Gachter staging and functional results was consistent with the literature. It was also shown that the functional results of patients with lower Gachter stages were better. In our study, the patient with the Gachter Stage 4 had the worst prognosis.

Bussiere et al.^[14] reported that the results were worse in older patients and patients with multiple organ insufficiencies. Balabaud et al.^[2] reported that age, sex, extremity, preoperative risk factors, previous surgery and the microorganisms responsible for the etiology, had no effect on the results. In our study, the patients with poor functional results were older and had diabetes mellitus and osteoarthritis. In addition, these patients' microbiological culture was positive, while others had negative results in the synovial fluid. However, there were not enough patients to conclude that such factors directly have an impact on the results.

It is possible to make a partial and sub-total synovectomy with arthroscopy.^[20] Even though some authors do not recommend synovectomy, many prefer it, due to the synovial inflammation.^[21] Experimental and clinical studies showed that synovectomy was beneficial during the early stages of treatment.^[22] We applied synovectomy on patients with synovial hypertrophy.

After the operation, continuous irrigation-drainage system is recommended for cleaning enzymatic products and necrotic material.^[20] Debris material can prolong the destruction of cartilage, even if the joint could be sterilized. The irrigation-drainage system was recommended for periods from 2 to 6 days, but it can also be applied for more than a week.^[17] We applied the irrigation-drainage system for three days, after surgery. Some authors advised to add antibiotics or antiseptic in the irrigation solution.^[9] However, as these solutions may cause a chemical synovitis and pain, balanced electrolyte solutions was recommended for mechanical cleaning.^[20] Since the *Staphylococcus aureus*, the most frequent cause of septic arthritis, may localize intracellularly, the irrigation solution may not be effective. Therefore, we preferred balanced electrolyte solutions for irrigation.

Many studies reported that postoperative early motion had a positive effect on the functional results.^[23] We started joint motion on the first day after surgery. We thought that early joint range of motion had significant impact on the functional results.

In the literature, there is limited information about the most appropriate antibiotic regimen. Intravenous antibiotherapy is the common treatment at the onset of septic arthritis.^[24] There was no consensus on the duration of the antibiotherapy. The general recommendation is for 6 to 12 weeks.^[25] We used parenteral antibiotics for one week and orally for 5 weeks, for a total of 6 weeks.

As a result, septic arthritis can be diagnosed with clinical judgment and joint aspiration during the early period. The functional results of patients with lower Gachter stages, during the arthroscopy, were more successful than the functional results of patients with a higher Gachter stage. As stated in many studies, the time between the initial symptoms and the operation has a direct effect on the functional results.

Conflicts of Interest: No conflicts declared.

References

1. Esterhai J, Gelb I. Adult septic arthritis. Orthop Clin North Am 1991;22:503-14.
2. Balabaud L, Gaudias J, Boeri C, Jenny JY, Kehr P. Results of treatment of septic knee arthritis: a retrospective series of 40 cases. Knee Surg Sports Traumatol Arthrosc 2007; 15:387-92.
3. Morrissy RT. Bone and joint infection in the neonate. Pediatr Ann 1989;18:33-4,36-8,40-4.
4. Nade S. Acute septic arthritis in infancy and childhood. J Bone Joint Surg Br 1983;65:234-41.
5. Toğrul E, Baytok G, Gülfem M, Herdem M, Sarpel Y. Çocukluk çağında kalça septik artrit. Acta Orthop Traumatol Turc 1998;32:194-8.
6. Lane JG, Falahee MH, Wojtys EM, Hankin FM, Kaufer H. Pyarthrosis of the knee. Treatment considerations. Clin Orthop Relat Res 1990;(252):198-204.
7. Dittrich V, Attmanskpacher W, Stedtfeld HW. Mehrzeitiges arthroskopisches Vorgehen bei Kniegelenkempyemen. Arthroskopie 1999;12:137-43.
8. Chung WK, Slater GL, Bates EH. Treatment of septic arthritis of the hip by arthroscopic lavage. J Pediatr Orthop 1993;13:444-6.
9. Gainor BJ. Installation of continuous tube irrigation in the septic knee at arthroscopy. Clin Orthop 1984;(183):96-8.

10. Wirtz DC, Marth M, Miltner O, Schneider U, Zilkens KW. Septic arthritis of the knee in adults: treatment by arthroscopy or arthrotomy. *Int Orthop* 2001;25:239-41.
11. Stutz G, Kuster MS, Kleinstuck F, Gachter A. Arthroscopic management of septic arthritis: stages of infection and results. *Knee Surg Sports Traumatol Arthrosc* 2000;8:270-4.
12. Jerosch J, Hofstetter I, Schridder M, Castro WH. Septic arthritis: Arthroscopic management with local antibiotic treatment. *Acta Orthop Belg* 1995;61:126-34.
13. Smith MJ. Arthroscopic treatment of the septic knee. *Arthroscopy* 1986;2:30-4.
14. Bussiere F, Beaufils P. Apport de l'arthroscopie au traitement des arthrites septiques a pyogenes banals du genou de l'adulte. *Rev Chir Orthop* 1999;85:803-10.
15. Broy SB, Schmid FR. A Comparison of medical drainage (needle aspiration) and surgical drainage (arthrotomy or arthroscopy) in the initial treatment of infected joints. *Clin Rheum Dis* 1986;12:501-22.
16. Broy SB, Stulberg SD, Schmid FR. The role of arthroscopy in the diagnosis and management of the septic joint. *Clin Rheum Dis* 1986;12:489-500.
17. Parisien JS, Shaffer B. Arthroscopic management of pyoarthrosis. *Clin Orthop* 1992;(275):243-7.
18. Jackson RW. The septic knee-arthroscopic treatment. *Arthroscopy* 1985;1:194-7
19. Smith MJ. Arthroscopic treatment of the septic knee. *Arthroscopy* 1986;2:30-4
20. Michiels I, Schmitz B, Stridde E. Die Spil-Saug-Drainage und Sinovektomie in der Behandlung des Kniegelenkempyems. *Unfallchirurg* 1993;96:508-16.
21. Ballard CA, Burkhalter CW, Mayfield CGW, Brown PW. The functional treatment of pyogenic arthritis of the adult knee. *J Bone Joint Surg Am* 1975;57:1119-23.
22. Riegels-Nielsen P, Rimodt-Muller N, Sorensen M, Jensen JS. Sinovectomy for septic arthritis. Early versus late sinovectomy studied in the rabbit knee. *Acta Orthop Scand* 1991;62:315-8.
23. Salter RB, Bell RS, Keeley FW. The protective effect of continuous passive motion on living articular cartilage in acute septic arthritis. *Clin Orthop* 1981;(159):223-47.
24. Cimmino MA. Recognition and management of bacterial arthritis. *Drugs* 1997;54:50-60.
25. Le Dantec L, Maury F, Flipo RM, Laskri S, Cortet B, Duquesnoy B, et al. Peripheral pyogenic arthritis. A study of one hundred seventy-nine cases. *Rev Rhum Engl Ed* 1996;63:103-10.