Surgical Treatment for Septic Arthritis of the Knee Joint in Elderly Patients: A 10-year Retrospective Clinical Study

Chao-Ming Chen, MD; Hsi-Hsien Lin, MD; Shih-Chieh Hung, MD; Tung-Fu Huang, MD; Wei-Ming Chen, MD; Chien-Lin Liu, MD; Tain-Hsiung Chen, MD

Abstract

Septic arthritis is the most rapidly destructive joint disease, but its early diagnosis remains challenging; delayed or inadequate treatment, even by expert physicians, can lead to irreversible joint destruction. Between 25% and 50% of patients develop irreversible loss of joint function, which is especially concerning in elderly patients. To understand the factors influencing the outcome of septic arthritis, the authors reviewed patients aged older than 50 years who had undergone debridement surgery for primary septic arthritis at their institution between 1998 and 2008. Ninety-two patients (92 knees) were enrolled in the study; 14 did not meet inclusion criteria and were excluded from the final analysis. Of the 78 included patients, 7 underwent arthrodesis, 22 underwent total knee arthroplasty, 19 were indicated for total knee arthroplasty for severe knee joint osteoarthritis but did not undergo surgery by the end of this study, and the remaining 30 had no or mild symptoms of osteoarthrosis and did not receive any surgical procedure.

Staphylococcus aureus was the most common pathogenic agent (38%), followed by mixed bacterial infection (10%). Several factors negatively influenced the final clinical outcome, including delayed treatment, advanced macroscopic staging made during debridement surgery, performing multiple debridement surgeries, and a larger Lysholm score difference pre- and posttreatment. More antibiotics administered, longer duration of antibiotic treatment, and more pathogenic agents present were also significantly correlated with poor outcome. These findings shed new light on the management of septic arthritis. Accurate diagnoses and effective treatments are important for the clinical outcome of knee joint bacterial infection in elderly patients.

The authors are from the Department of Orthopedics and Traumatology, Taipei Veterans General Hospital (C-MC, H-HL, S-CH, T-FH, W-MC, C-LL, T-HC); and also from the School of Medicine (S-CH, T-FH, W-MC, C-LL, T-HC), National Yang-Ming University, Taiwan, Republic of China.

The authors have no relevant financial relationships to disclose.

Correspondence should be addressed to: Tung-Fu Huang, MD, Department of Orthopedics and Traumatology, Taipei Veterans General Hospital, School of Medicine, National Yang-Ming University, No. 201, Sec. 2, Shihpai Rd, Beitou District, Taipei City, Taiwan 11217, Republic of China (smfhuang@gmail.com).

doi: 10.3928/01477447-20130327-19
Septic arthritis is an intensely painful bacterial infection of a joint. Its yearly incidence in Western Europe is 4 to 10 per 100,000, but can be higher among those with diabetes mellitus and previous joint pathology, especially rheumatoid arthritis.1,2

The diagnosis of septic arthritis can be challenging because the differential diagnosis of 1 or more hot, swollen joints can indicate various conditions. As a consequence, delayed or inadequate treatment can lead to irreversible joint destruction, even in expert hands. Septic arthritis is considered the most rapidly destructive joint disease, with a fatality rate of 5% to 15%, and up to 25% to 50% of patients develop irreversible loss of joint function.3,5

Knee joint infection is most commonly noted patients with septic arthritis, accounting for 40% to 50% of all cases.5 Again, clinical diagnosis of knee joint septic arthritis is difficult, especially when the patient has other concomitant joint diseases.2 Diagnosis is especially difficult in elderly patients. Past clinical experience has shown progression of degeneration after acute knee joint infection.6 To the authors’ knowledge, no previous study has focused on the elderly population. Therefore, the purpose of this study was to review a database of elderly patients with knee joint infection who were treated and followed up at the authors’ institution.

MATERIALS AND METHODS

The clinical data of patients diagnosed with a knee joint infection at the authors’ institution between 1998 and 2008 were reviewed. Patients younger than 50 years and those with prosthesis-related infection were excluded. A total of 92 patients (92 knees) were enrolled in the study.

Each patient’s general condition was evaluated at admission. The diagnosis of knee joint infection relied on the modified criteria used by Newman,7 according to which at least 1 of the 4 following criteria should be met: (1) isolation of a pathogenic organism from the affected joint; (2) isolation of a pathogenic organism from another source (eg, blood) in the context of a hot, red joint with suspected sepsis; (3) typical clinical features and turbid joint fluid in a patient who had previously received antibiotic treatment; and (4) postmortem or pathological features indicating septic arthritis. The patients’ underlying disease and surgical history were obtained after septic arthritis diagnosis. Etiology of the infection was classified into (1) hematogenous infection; (2) infection after injury or trauma; (3) postoperative infection, including infections associated with intra-articular injection and acupuncture; or (4) other or unknown etiology. The causes of infection were recorded and analyzed along with the final outcome.

Delay Before Treatment

Delays before treatment were recorded for each patient. The relationship between the delays and final outcomes was analyzed.

Surgery and Antibiotic Treatment

All patients underwent surgical debridement, either by arthroscopy or the traditional open method. The macroscopic appearance of joint destruction was classified according to the 4-stage classification system reported previously by Vispo Seara et al (Table 1).8 Surgical debridement was performed thoroughly, with all infected materials and bony fragments being removed carefully. At least 10 L of Ringer’s solution per patient was used for irrigation. A suction system was placed in the joint cavity for complete drainage. Immediate rehabilitation was arranged according to each patient’s postoperative condition. Cellular culture and pathological analyses were performed.

Parenteral antibiotic therapy was continued for a minimum of 4 weeks postoperatively. The antibiotic route of administration was changed to oral if C-reactive protein levels and white blood cell counts had returned to normal levels. In these cases, oral antibiotics were continued for a minimum of 4 weeks until the joint fluid was clear and C-reactive protein levels tended to remain within the normal range. Repeat surgical debridement was performed if symptoms persisted and lab data showed no clinical improvement after antibiotic treatment.

Macroscopic staging was associated with the final outcome using Fisher’s exact test. The number of infective pathogens present, number of debridement surgeries performed, number of antibiotics administered, and duration of antibiotic treatment were also associated with final outcome by using the Kruskal-Wallis test. The number of infective pathogens was correlated with the number of debridement surgeries using Spearman’s correlation.

Image and Clinical Performance Evaluation

Imaging data, functional performance, subjective functional performance by Lysholm knee scoring scale,9,10 and range of motion (ROM) were compared pre- and posttreatment. The relationship between these differences and the final clinical outcome was established using the Kruskal-Wallis test.

Knee joint extension, ROM, and pain were reported according to the classification system used by Vispo Seara et al (Table 1).8 The difference between staging pre- and posttreatment was calculated and correlated with the delay before treatment and with the number of surgeries performed. The results were analyzed using Spearman’s correlation.

Biplanar imaging studies were performed. The Kellgren-Lawrence classification of knee joint osteoarthrosis was applied to evaluate the degree of knee joint osteoarthrosis (Table 2).11 The change in osteoarthrosis degree was calculated. The difference between Kellgren-Lawrence grade pre- and posttreatment was also calculated and correlated with the difference.
in Lysholm scores using Spearman’s correlation.

**RESULTS**

The study group comprised 92 patients with 92 primarily infected knee joints (48 right knees and 44 left knees). Fifty-two patients were men and 40 were women (age range, 50-92 years). Mean patient age at first visit to the authors’ institution was 67.7 years. The medical history of each patient was recorded, and the number of patients per medical condition was calculated (Figure 1). No history of intravenous drug abuse existed among the patients.

At first examination, the patients typically revealed leukocytosis (average leukocyte count, 13,300 cells), elevated erythrocyte sedimentation rate (average, 46-113 mm per half hour), and elevated C-reactive protein (average, 11.3 mg/L; range, 2.3-30.2 mg/L). Fever was uncommon. Infected joints showed generalized tenderness (70%), swelling (94.3%), and pain and limited ROM (100%).

**Etiology of Disease and Causative Pathogens**

Intra-articular fluid collected before or during debridement surgery was analyzed for the presence of bacteria (Gram staining and aerobic, anaerobic, and tuberculosis culture) (Figure 2). In 13 (14%) patients, no microorganism was identified, but in 11 of them, antibiotics had been treated with different regimens.

---

**Table 1**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Extension</th>
<th>Flexion</th>
<th>Pain</th>
<th>Macroscopic Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Full weight-bearing capability</td>
<td>Full range of motion</td>
<td>No pain</td>
<td>Turbid joint fluid effusion, synovial hyperemia</td>
</tr>
<tr>
<td>2</td>
<td>Lack of extension (&lt;10°)</td>
<td>Lack of flexion (&lt;10°)</td>
<td>Moderate pain under strain</td>
<td>More turbid fluid and synovitis, hypertrophy of hemorrhagic synovial tissue</td>
</tr>
<tr>
<td>3</td>
<td>Lack of extension (&gt;10°, &lt;20°)</td>
<td>Lack of flexion (&gt;10°, &lt;40°)</td>
<td>Evident pain under strain</td>
<td>Villous synovitis, adhesions</td>
</tr>
<tr>
<td>4</td>
<td>Lack of extension (&gt;20°)</td>
<td>Lack of flexion (&gt;40°)</td>
<td>Pain at rest</td>
<td>Chondrolysis, bony erosion</td>
</tr>
</tbody>
</table>

*Adapted from Vispo Seara et al.*

**Table 2**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>I</td>
<td>Doubtful narrowing of joint space, possible osteophyte development</td>
</tr>
<tr>
<td>II</td>
<td>Definite osteophytes, absent or questionable narrowing of joint space</td>
</tr>
<tr>
<td>III</td>
<td>Moderate osteophytes, definite narrowing, some sclerosis, possible joint deformity</td>
</tr>
<tr>
<td>IV</td>
<td>Large osteophytes, marked narrowing, severe sclerosis, definite joint deformity</td>
</tr>
</tbody>
</table>

*Adapted from Kellgren et al.*

---

**Figure 1:** Graph showing the distribution of past medical disease.
administered at another hospital prior to culture. These patients were included in the current study because they presented with clinical symptoms, laboratory blood values, and histological findings compatible with joint infection. A total of 79 culture specimens showed positive results. 

*Staphylococcus aureus* was the most common pathogen (35 [38%] patients). In 12 of these patients, gram-negative bacterial infection was found: 4 (5%) cases of *Pseudomonas aeruginosa*, 4 (5%) cases of *Escherichia coli*, 2 (2%) cases of *Klebsiella pneumoniae*, and 2 (2%) cases of *Salmonella enteritidis*. Three (3%) patients had *Mycobacterium tuberculosis* infection. Among the 92 patients, 9 (10%) had mixed bacterial infection. Antibiotic treatment was adjusted according to the culture results and the clinical response after treatment.

Seven patients were lost to follow-up. Six patients died within 3 months after initial diagnosis due to late-stage cancer or severe infection. One patient underwent right-side above-knee amputation due to intractable infection. The remaining 78 patients were included in the final analysis.

Mean follow-up was 74.8 months (range, 36-144 months). The most likely etiology of infection was determined to be hematogenous in 27 patients who had recent systemic infection; knee joint injury or trauma of the same lower limb in 20 patients; a recent medical procedure in the affected knee, including acupuncture, intra-articular steroid injection, and elective knee joint surgery, in 7 patients; and unknown in the remaining 24 patients. Seven patients underwent arthrodesis, 22 underwent total knee arthroplasty (TKA), 19 patients were indicated for TKA for severe knee joint osteoarthritis but did not undergo TKA by the conclusion of this study, and the remaining 30 patients had no or mild symptoms of osteoarthrosis and did not receive any surgical procedures (Table 3). The imaging series performed pre- and posttreatment and at final outcome are shown in Figures 3 through 6. Thirty-three patients underwent arthroscopic debridement surgery and 45 underwent open debridement surgery. Twenty-seven patients underwent debridement surgery more than twice (range, 2-7 surgeries).

The etiology of infection was associated with the final outcome (Table 3). In the arthrodesis group, trauma- or injury-related knee joint infection was noted in 5 (71%) patients; this percentage was significantly higher than in the other 3 groups. However, no significant correlation existed between the cause of infection and the final outcome. The percentage of those having no specific cause of infection was higher in the TKA group (45%). Hematogenous infection was more common in those indicated for TKA (42%) and in those with mild sequelae (43%). No statistically significant correlation existed between the etiology of infection and the clinical outcome.

### Delay Before Treatment

Delay before treatment was recorded (Table 4). The number of patients who began treatment more than 3 weeks after the onset of clinical symptoms was 6 (86%) in the arthrodesis group, 18 (82%)...
Figure 3: Anteroposterior (A) and lateral (B) pretreatment radiographs of a 61-year-old man who presented with a left knee infection after a motor vehicle accident showing a moderate degree of knee joint degeneration. Anteroposterior (C) and lateral (D) radiographs 2 months posttreatment showing severe joint space narrowing, osteophyte formation, and flexion contracture. Anteroposterior (E) and lateral (F) radiographs 6 months posttreatment after unreconstructable knee joint degeneration occurred and arthrodesis with an Ilizarov system was performed.

Figure 4: Anteroposterior (A) and lateral (B) pretreatment radiographs of an 84-year-old man with a history of liver cirrhosis who presented with septic arthritis of the right knee due to previous left lower leg cellulitis showing a moderate degree of knee joint degeneration. Anteroposterior (C) and lateral (D) radiographs 5 months posttreatment showing the affected site with severe cartilage destruction and severe joint space narrowing. Anteroposterior (E) and lateral (F) radiographs 3 years posttreatment and after the patient had undergone total knee arthroplasty. No residual infection was evident at the end of the study.

Figure 5: Anteroposterior (A) and lateral (B) pretreatment radiographs of a 72-year-old man admitted for surgical reduction of a left proximal tibial–fibular fracture showing a mild degree of knee joint degeneration. Postoperatively, the patient developed septic arthritis of the left knee resulting from compartment syndrome of the lower left leg. Anteroposterior (C) and lateral (D) radiographs 4 months posttreatment showing progression of cartilage destruction and joint space narrowing. Anteroposterior (E) and lateral (F) radiographs 4 years posttreatment after severe knee joint degeneration occurred and total knee arthroplasty was indicated.

Figure 6: Anteroposterior (A) and lateral (B) pretreatment radiographs of a 64-year-old woman with a history of type 2 diabetes mellitus and a right knee infection due to recent urinary tract infection showing a mild degree of knee joint degeneration. Anteroposterior (C) and lateral (D) radiographs 6 months posttreatment showing a mild progression of knee joint degeneration. Anteroposterior (E) and lateral (F) radiographs 5 years posttreatment showing a mild degree of degeneration.
in the TKA group, and 18 (79%) in the indicated for TKA group. No patient in these 3 groups began treatment within the first week after the onset of the symptoms. However, 27 (90%) patients with mild sequelae began treatment within the first 3 weeks. The duration of delay before treatment and the clinical outcome were significantly correlated (P < .001).

**Macroscopic Staging of Septic Arthritis**

Macroscopic staging of septic arthritis was assessed (Table 4). In the arthrodesis group, 6 (86%) patients were stage IV and 1 (14%) was stage III. In the TKA group, 9 (41%) patients were stage IV and 11 (50%) were stage III. In the indicated for TKA group, fewer patients had severe degeneration; 7 (37%) patients each were stages III and IV, respectively, and the remaining 5 (26%) were stage II. In the mild symptoms group, 7 (23%) patients were stage IV, 10 (33%) were stage III, 12 (40%) were stage II, and 1 (3%) was stage I. A significant statistical correlation existed between intraoperative macroscopic staging and the final clinical outcome (P < .05).

**Number of Surgical Procedures**

The median (Q1-Q3, ie, first to third quartile; 25th to 75th percentile) number of surgeries performed was significantly higher in the arthrodesis group than in the other 3 groups (P < .001) (Table 4).

**Type and Duration of Antibiotic Treatment**

The median (Q1-Q3) number of antibiotics administered was significantly higher in the arthrodesis group than in the indicated for TKA or the other 3 groups (P < .001) (Table 4). No statistical difference existed between patients undergoing TKA and the other 3 groups. Regarding the duration of antibiotic treatment, patients with mild symptoms were administered antibiotics for significantly shorter periods (P < .001). During follow-up, 1 of the 3 patients who underwent TKA along with antibiotic-impregnated bone cement had a postoperative prosthetic infection.

**Number of Pathogenic Agents**

The number of pathogenic agents present was significantly higher in the arthrodesis group than in the other 3 groups (P < .05) (Table 4).

**Imaging and Functional Performance of the Knee Joint**

The difference in Lysholm score (post-minus pretreatment) was compared with the final outcome (Table 4; Figure 7). The relationship was significant in the arthrodesis, TKA, and indicated for TKA groups (P < .001).

Aggravation of arthrosis signs assessed by plain film radiography was found in 71 (91%) patients (Figure 8); the degree of arthrosis between pre- and posttreatment remained unchanged in 5 patients.

A negative correlation was found between the difference in Lysholm scores and Kellgren-Lawrence grades pre- and posttreatment (r = −0.634; P < .001) (Figure 9).

Fourteen patients had no change in knee joint ROM posttreatment (Figure 10). Only 1 patient showed an improved ROM after antibiotic treatment. The remaining 59 (75%) patients showed deterioration of knee joint ROM after infection. The difference in knee joint ROM staging was negatively correlated with the delay before

---

**Table 4**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Arthrodesis (n = 7)</th>
<th>TKA Indicated (n = 19)</th>
<th>Mild Symptoms (n = 30)</th>
<th>Post-hoc Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of debridement surgeries</td>
<td>4 (2 to 7)</td>
<td>1 (1 to 2)</td>
<td>1 (1 to 2)</td>
<td>Arthrodesis&gt;TKA=TKA indicated=mild symptoms</td>
</tr>
<tr>
<td>No. of antibiotics administered</td>
<td>4 (3 to 4)</td>
<td>2 (2 to 3)</td>
<td>3 (2 to 4)</td>
<td>Arthrodesis&gt;TKA indicated=mild symptoms</td>
</tr>
<tr>
<td>Duration of antibiotic treatment</td>
<td>33 (22 to 192)</td>
<td>16 (9 to 26)</td>
<td>16 (9 to 28)</td>
<td>Arthrodesis&gt;TKA indicated=mild symptoms</td>
</tr>
<tr>
<td>Bacterial count</td>
<td>2 (1 to 3)</td>
<td>1 (1 to 2)</td>
<td>1 (1 to 1)</td>
<td>Arthrodesis&gt;TKA indicated=mild symptoms</td>
</tr>
<tr>
<td>Pre- and posttreatment lysholm score differences</td>
<td>−73 (−73 to −25)</td>
<td>−53.5 (−66 to −48)</td>
<td>−54 (−64 to −44)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviation: TKA, total knee arthroplasty.

*Kruskal-Wallis test.*
treatment ($r = -0.311; P = .006$) (Figure 11). The difference in knee joint ROM staging was also negatively correlated with the number of debridement surgeries ($r = -0.188$), but not significantly so ($P = .101$) (Figure 12). In turn, delay time before treatment and number of debridement surgeries performed were positively correlated ($r = 0.154$), but with no statistical significance ($P = .178$) (Figure 13).

A statistically significant positive correlation existed between the number of pathogenic agents present and the number of debridement surgeries performed ($r = 0.409; P < .001$) (Figure 14).

**Discussion**

The knee joint is the most common site of bacterial septic arthritis. Bacterial toxin and autogenous cytokine response exert negative effects on cartilage and secondary joint degeneration in animal models. However, similar studies have not been conducted with humans, including elderly people, a population with reduced potential of cartilage regeneration after infection compared to young children. To the authors’ knowledge, the current study is the first to retrospectively review aging patients with knee joint septic arthritis.

Although the yearly incidence of bacterial arthritis is less than 1% in the general population, the incidence seems to be higher in aging people. However, hot swelling in knee joints in this population leads to broad differential diagnoses, including osteoarthritis, rheumatoid arthritis, and gouty arthritis with acute attacks. This makes early diagnosis of septic arthritis difficult. A previous prospective study showed that 44% of patients with adult-onset septic arthritis present with fever, 15% with cold sweating, and less than 6% with rigors. To improve adequate and prompt diagnosis of septic arthritis, laboratory tests and joint fluid analysis and culture are needed, especially when pain is more intense than in previous joint disease.

In the current study, longer delay of treatment appeared to be a determining factor for more severe knee joint degeneration. A delay in treatment of more than 3 weeks resulted in a significant decrease in knee joint ROM and increased the possibility of joint replacement or arthrodesis (Figure 11; Table 4). Delay of diagnosis and treatment may also lead to more de-
bridement surgery (Figure 13), yet this factor did not reach statistical significance in the current study.

These data corroborate with many previous studies showing that chronic medical problems may compromise the immune system and predispose patients to the development of septic arthritis. Preexisting joint damage may increase the risk of developing septic arthritis.

In the current study, imaging data obtained before treatment revealed a high prevalence of knee joint arthritis (Figure 8), followed by gouty arthritis (17.3%) and autoimmune joint disease (14.1%). Recent infection of other sites, including cutaneous infection, may also increase the risk of knee joint sepsis. According to Kaandorp et al, knee joint sepsis may result from direct inoculation of bacteria from trauma or hematogenous transmission of the pathogen. Trauma of the affected limb accounted for 26% of cases in the current study, and the percentage of patients with recent infections of the body was as high as 34.6%. Bacteria may be introduced during joint surgery, fluid aspiration, or local corticosteroid injection, but this route was less common in the current study (9%). No definite predisposing factor exists for the development of septic arthritis, but previous infection of the knee joint is a good candidate.

In the current study, staphylococci were the most common causative pathogens. This is in agreement with a previous
study that showed that *Staphylococcus aureus* was responsible for primary septic arthritis in 37% to 56% of patients.\textsuperscript{17,19} Gram-negative bacilli was common in intravenous drug users, elderly patients, and seriously immunocompromised patients\textsuperscript{3,5} and accounted for 14% of all pathogens in the current study. *Mycobacterium tuberculosis*, although uncommon in bacterial arthritis, was found in 3% of the current cases. All current patients were immunocompromised due to other underlying medical problems, which is in agreement with a previous trend of mycobacteria infection in immunosuppressed patients.\textsuperscript{20}

After bacteria enter the closed joint space, a series of inflammatory responses are triggered,\textsuperscript{12} with cytokines and proteases causing irreversible subchondral bone loss within days.\textsuperscript{12,21} If left untreated, or if a delay of treatment occurs, early-onset joint degeneration may cause a loss of joint function.

Two parameters were used to characterize knee joint function before and after treatment of septic arthritis. The Lysholm knee scoring scale is a subjective parameter scored by the patients themselves.\textsuperscript{9,10} When the difference in Lysholm score is greater than 50, a poor outcome with the need for arthrodesis or arthroplasty is expected. Knee joint ROM staging is an objective parameter of knee joint contracture status.\textsuperscript{8} In the current study, differences in pre- and posttreatment Lysholm scores and Kellgren-Lawrence grades were significantly correlated (Figure 9). The subjective deterioration of knee joint function is reflected by changes in plain radiograph grading.

Intraoperative macroscopic staging was statistically related to clinical outcome. Stage IV chondrolysis and stage III severe adhesion synovitis were common in the arthrodesis, TKA, and indicated for TKA groups, representing a poor prognosis indicator. Late macroscopic staging of the knee joint would cause irreversible bone and soft tissue destruction, ultimately resulting in early-onset osteoarthritis. However, macroscopic staging in those with mild symptoms was significantly less severe, with only 23.3% of patients in stage IV.

No obvious statistically significant relationship existed between the etiology of infection and the final outcome. One patient presented with a history of injury and trauma, which made definition of the exact cause of infection difficult. Nevertheless, among those receiving arthrodesis, injury or trauma was the most common (71%) cause of knee joint infection. Lower-limb trauma complicated with knee joint infection is often a consequence of poor soft tissue condition. Arthrodesis is usually helpful in these patients, especially elderly patients.\textsuperscript{22,23}

Arthrodesis is usually indicated for unreconstructable knee joint following septic arthritis, including extensor mechanism disruption, poor bone stock, and poor soft tissue condition after severe infection, especially in the case of severe trauma.\textsuperscript{22} The success of modern reconstruction techniques has decreased the number of candidates for knee joint arthrodesis. Nevertheless, arthrodesis is still the treatment of choice, especially in elderly patients with poor soft tissue condition and less functional requirements.\textsuperscript{22-24}

The number of debridement surgeries and the number of pathogenic agents present was significantly higher in the arthrodesis group, indicating a more complex situation at first infection, which may result in poorer soft tissue condition, unsuitable for replacement surgery.\textsuperscript{23,24} However, a positive significant correlation existed between the number of debridement surgeries performed and the number of infecting pathogens (Figure 14). Regardless of the pathogenic species, Vispo Seara et al\textsuperscript{8} reported a significantly higher number of debridement surgeries in patients with mixed bacteria septic arthritis.

The number of debridement surgeries performed also tended to negatively correlate with change in functional grading. Peacock\textsuperscript{25} suggested that repeated open joint surgery may change the molecular bonding of collagen synthesis, resulting in joint stiffness. In the current study, not all patients received open debridement; therefore, a decrease in knee joint ROM among those undergoing multiple debridement surgeries was not obvious.

This study also found that delay before treatment was not significantly correlated with the number of debridement surgeries performed. Nonetheless, delay before treatment had an effect on knee joint degeneration but did not increase the number of pathogenic agents.

The number of antibiotics administered and the duration of antibiotic therapy were related to the final outcome. Patients undergoing arthrodesis used more antibiotics for longer periods than the patients in the other groups. Those with mild symptoms used fewer antibiotics for shorter periods. These findings corresponded well with the clinical complexity of infection in each study group.

**CONCLUSION**

This study is the first to retrospectively review the long-term outcomes of elderly patients with knee joint septic arthritis. Previous joint pathology, chronic medical disease, and trauma history typically predispose patients to knee joint infection. Joint cartilage can be destroyed rapidly after bacterial invasion, and this study identified various factors affecting the final outcome of the disease. To prevent rapid progression of knee joint degeneration after infection, prompt and accurate diagnosis with early treatment is crucial, particularly in the elderly population.

**REFERENCES**


