Two-stage Arthroplasty for the Treatment of Chronic Osteomyelitis After Routine Arthroscopic Knee Surgery

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abstract

Corynebacterium pseudodiphtheriticum is a normal inhabitant of the upper respiratory tract and is rarely thought of as a true pathogen. Although this microorganism has been associated with respiratory complications, a few case reports have demonstrated its ability to cause orthopedic infections. A recent review of the literature was performed regarding this specific bacteria and its association with bone and joint infection.

To the author’s knowledge, the current case is the first reported case of chronic osteomyelitis from Corynebacterium pseudodiphtheriticum after arthroscopic knee surgery. Isolation of this bacterial species on routine microbial cultures has been proven to be challenging in prior studies. In the current case, difficulty isolating this bacterial species on routine cultures led to a significant delay in diagnosis, which ultimately resulted in end-stage joint destruction. Treatment of the infection was accomplished using a 2-stage total knee arthroplasty technique, with the initial placement of an articulated, antibiotic-loaded spacer followed by a subsequent conversion to total knee arthroplasty. This case serves as a useful reminder that clinically subtle infections can occur after minor orthopedic surgery. Surgeons must remain vigilant to render a timely diagnosis and avoid severe sequelae that can result from an undetected pathogen after arthroscopic surgery.

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Figure 1: Magnetic resonance image prior to arthroscopy showing normal preservation of hyaline cartilage.

Figure 2: Anteroposterior magnetic resonance image after arthroscopy showing severe degeneration and bone marrow edema.
A
though knee arthroscopy is gen-
erally thought of as a safe pro-
dure with low complication rates,
the number of these surgeries has recently
significantly increased. Between 1996 and
2006, the number of arthroscopic knee
surgeries increased by 50% in the United
States alone. Furthermore, it is estimated
that 1 million knee arthroscopies are per-
dependent each year in the United States, and
approximately 500,000 are performed for a
diagnosis of meniscal tear. Thus, the
enormous volume of these surgical pro-
dures can and does lead to unexpected
complications.

Infection is one of the most severe com-
lications that can occur after musculo-
skeletal surgery. The majority of infections
after arthroscopic surgery are attributed to
gram-positive cocci and *Staphylococcus*
species. The reported incidence of infec-
tion after arthroscopic knee surgery is low
and has previously been estimated to be
between .01% and .48%. Moreover, the
reported incidence of postarthroscopic in-
fec tion due to atypical bacterial, such as
*Corynebacterium* species (traditionally
thought of as nonpathogenic or less viru-
 lent) is not well documented.

A few cases of bone and joint infection
due to *Corynebacterium pseudodiphthe-
riticum* have been described in the past. To
the author’s knowledge, the current
case report is the first in the literature to
report chronic osteomyelitis secondary to
*Corynebacterium pseudodiphtheritcium*
after knee arthroscopy. Treatment of this
infection was ultimately accomplished us-
ing 2-stage total knee arthroplasty (TKA)
with radical debridement and placement of
an antibiotic-loaded articulated spacer. The
patient received 6 weeks of intravenous
(IV) antibiotics and underwent subsequent
TKA after all inflammatory markers had
normalized.

**Case Report**

A 67-year-old woman was referred to
the author’s office with a history of osteo-
arthritis and a request to perform TKA.
She presented with debilitating chronic
right knee pain and stiffness. She reported
undergoing unsuccessful arthroscopy for a
meniscus tear approximately 1 year prior.
Although she reported no complications
from her previous knee arthroscopy, she de-
scribed having fluid drained from the knee
after arthroscopic surgery. However, the
workup was negative for infection.

Physical examination demonstrated
mild, diffuse warmth and swelling over the
close joint right knee. Signs of redness, indura-
tion, and effusion were absent. Her range
of motion was severely limited; she had a
20° flexion contracture, and maximal flex-
ion was 55°. Radiographs revealed severe
joint space narrowing with cystic-appearing
subchondral erosions.

A review of the patient’s medical records
showed that she had undergone previous
knee arthroscopy approximately 1 year pri-
or to presentation. The procedure consisted
of limited debridement of a small degenera-
tive medial meniscus tear. Chondromalacia
of the patella was described in the opera-
te report, with no other pertinent findings.
Knee radiographs and magnetic resonance
imaging (MRI) obtained prior to arthros-
copy demonstrated a normal-appearing
knee joint with no evidence of cartilage de-
generation (Figure 1). The medical records
also revealed that her initial orthopedic sur-
geon had aspirated her knee 3 months post-
operatively due to ongoing knee pain and
stiffness. The initial synovial fluid aspirate
showed 27,250 white blood cells (WBC)/
mm³ with a negative bacterial culture result.
Magnetic resonance imaging without intra-
venous contrast 5 months after arthroscopy
revealed increased signal intensity within
the tibial plateau, but the radiologist pre-
sumed this to be a bone bruise.

Moreover, the patient had undergone 4
separate synovial fluid aspirations from her
knee joint over a period of 9 months. The
first 3 samples yielded negative results. The
most recent sample grew rare quantities of
*Corynebacterium* species almost 1 year
postoperatively. However, it was unclear
whether this result was due to possible con-
tamination or whether a true pathogen had
been isolated.

**Sedimentation rate**, C-reactive protein,
rheumatology consultation, and knee MRI
with and without IV gadolinium were or-
dered after the patient presented to the au-
thor’s office. The erythrocyte sedimenta-
tion rate was markedly elevated at 70 mm/
hour (reference range, 0-15 mm/hr), and
the C-reactive protein was also elevated at
3.98 mg/dL (reference value, less than 1).
The rheumatology workup was negative
for autoimmune disease. The MRI with IV
contrast showed significant bone marrow
edema and areas of peripheral enhance-
ment adjacent to the tibial plateau and later-
al femoral condyle concerning for chronic
infection (Figure 2).

After completing a thorough history and
physical examination and reviewing the lab-
atory and radiographic data, infection
was included in the differential diagnosis.
The patient underwent arthroscopic tissue
biopsy to make a definitive diagnosis and
to guide further treatment. Multiple syno-
val and bone biopsies were obtained and
sent for microbiology and histopathologic
examination.

On arthroscopic inspection, the synovi-
um was fibrotic with numerous adhesions;
however, no obvious acute synovitis was
encountered. Several soft, erosive osteo-
chondral lesions were identified. These
were curretted deeply, but no evidence of
purulent material was found in the sub-
chondral bone. The synovial fluid and tis-
sue samples were negative for infection on
final culture. However, a tibial bone biopsy
was positive for gram-positive rods. Final
histopathology also confirmed acute and
chronic inflammation suggestive of ongo-
ing chronic bone infection. The infectious
disease service was consulted, and the pa-
tient underwent a subsequent 2-stage TKA.

**Surgical Technique**

The first stage of the TKA consisted of
irrigation and complete synovectomy
with radical soft tissue and bone debride-
ment. All remaining joint surfaces were re-
moved, and the intramedullary canals were reamed. Cutting jigs obtained from a standard arthroplasty set (AGC Knee; Biomet, Warsaw, Indiana) were used to perform the osteotomies. Multiple intraoperative tissue cultures were obtained. A commercially available spacer mold (Stage One; Biomet) was used to create a dynamic antibiotic spacer with intramedullary dowels (Figure 3). A combination of 9 g of tobramycin and 6 g of vancomycin powder were mixed into 3 bags containing 40 g of Palacos bone cement (Zimmer, Warsaw, Indiana). The antibiotic spacer was then applied to the bone surfaces using a poor bonding technique, which allows some blood to get between the spacer and the bone and for some motion to occur in the knee prior to cement hardening, to facilitate later removal. The soft tissues were closed without the use of a suction drain. Once again, intraoperative synovial tissue cultures were negative. However, bone cultures ultimately came back positive for Corynebacterium pseudodiphtheriticum. The patient was treated with 6 weeks of IV penicillin per the infectious disease service. C-reactive protein and erythrocyte sedimentation rate were followed postoperatively. Four weeks after completion of antibiotics, the inflammatory markers had normalized.

The patient then underwent the second stage of the TKA. Calcium sulfate pellets (Osteoset; Wright Medical Technology, Inc, Arlington, Tennessee) impregnated with antibiotic powder were packed distally into the intramedullary canals. A commercially available premixed Palacos G bone cement (Zimmer) containing low-dose gentamicin (0.5 mg/bag) was also used. All cultures taken intraoperatively were negative.

The patient was followed up at 3, 6, 12, and 18 months postoperatively. At most recent follow-up, she had no recurrent signs of infection. She was pain free with prolonged ambulation. Her final range of motion was 0° of extension to 88° of flexion, a significant improvement from her preoperative total range of motion of 35°. Recent postoperative radiographs revealed a properly aligned TKA with no evidence of loosening or infection (Figure 4).

**DISCUSSION**

The incidence of deep infection after arthroscopic surgery of the knee is low and has been estimated to be less than 1%. Thus, a high index of suspicion is necessary to make the diagnosis. The current patient was originally referred to the author for TKA after being seen multiple times by 2 orthopedic surgeons. Despite the initial workup, her cultures remained negative, and she had a substantial delay in diagnosis. Indolent septic arthritis led to rapid chondrolysis and chronic, smoldering osteomyelitis of the knee. The author diagnosed infection prior to performing routine TKA; not doing so would have resulted in a predictably poor outcome. However, it is understandable why the diagnosis of progressive osteoarthritis was made by other orthopedic surgeons, especially given the unique diagnostic challenges that existed in this patient.

Synovial fluid samples were consistently negative, indicating that this microorganism was difficult to isolate on routine culture. Furthermore, the degenerative process observed on repeat radiographs and MRI took place over a 1-year period from the time of initial arthroscopy. This protracted disease course may have resembled joint space narrowing that one may expect to occur with the progression of osteoarthritis. However, the history of progressive stiffness and the results of the initial synovial fluid aspiration 3 months after arthroscopy yielding
27,500 WBC/mm$^3$ were concerning, despite the negative culture results.

Nevertheless, the negative culture data led to a diagnostic dilemma for the patient’s previous surgeons and created challenges for the author. Multiple synovial fluid cultures were negative and inconclusive. Ultimately, the diagnosis of infection required repeat arthroscopy and bone biopsy, which confirmed the suspicion of chronic osteomyelitis. Furthermore, given the delay in diagnosis prior to presentation, the patient had significant bone and joint space destruction that required radical debridement. This was achieved with a 2-stage TKA with temporary implantation of an articulated antibiotic spacer. This procedure is usually reserved for chronic periprosthetic joint infection, but in this case it was used to control infection of a native knee joint.

Repeat arthroscopic surgery to obtain tissue biopsy was the author’s preferred method for establishing the diagnosis of chronic osteomyelitis. However, other methods of diagnosis have been previously described. In a case report by Kemp et al., the use of polymerase chain reaction using bacterial primers targeting the 16S rRNA gene and subsequent DNA sequencing was used to isolate Corynebacterium pseudo-diphtheriticum in an acutely septic knee after TKA. Initial bacterial cultures were negative, and the use of antibiotics in the perioperative period prompted the current author to use polymerase chain reaction on the synovial fluid instead of repeating the bacterial cultures.

Roux et al. also used 16S rRNA gene sequencing analysis to identify various musculoskeletal infections due to Corynebacterium species. Isolation of Corynebacterium on routine culture was felt to be problematic, prompting the authors to use DNA sequencing.

Although this novel technique may prove useful in the future, it is currently considered investigational, without widespread availability. A limitation of this type of molecular technology is that it does not allow for phenotypic characterization, such as antibiotic susceptibility testing, and therefore it may not help guide pharmacologic therapy. Also, the possibility of contamination and false positive results when using DNA and polymerase chain reaction techniques is concerning. Thus, the gold standard for the diagnosis of synovial joint and bone infection continues to be microbiologic cultures.

**Conclusion**

The clinical manifestation of synovial joint infection can be widespread and ranges on a continuum from life-threatening sepsis to subclinical, smoldering joint infection. This varying presentation of disease likely depends on a complex interaction between the host’s immune system and the microorganism in question. A high index of suspicion is necessary when evaluating for postoperative bone and joint infection.

Despite the low incidence of deep infection after arthroscopic surgery, surgeons must remain vigilant to render an early diagnosis and treatment. This is especially true when considering the diagnostic challenges that certain microbial species may present. Without early detection, serious complications can occur. Although noninvasive studies, such as MRI, may be useful adjuncts, they are often inconclusive and not definitive in ruling out infection. Surgical tissue biopsy for aerobic, anaerobic, routine fungal, and acid-fast bacilli cultures should always be considered when the diagnosis remains in question.

Total knee arthroplasty provided the current patient with excellent pain relief and reasonable functional results. Although the patient had no significant evidence of joint degeneration prior to her initial arthroscopic procedure, she required a major reconstructive effort to mitigate a severe complication that resulted from this seemingly benign surgery.

_Corynebacterium pseudo-diphtheriticum_ is a normal inhabitant of the respiratory tract, but in certain, unusual circumstances, it may cause orthopedic infections that are elusive and difficult to detect. This microorganism caused an indolent degenerative process in the current patient that ultimately destroyed her native knee joint, necessitating major reconstructive surgery. This case serves as a reminder that clinically subtle infections occur after minor orthopedic surgery. Surgeons must remain vigilant to render a timely diagnosis and avoid severe sequelae that can result from an undetected pathogen after arthroscopic surgery.

**References**


