Case Report

Delayed Intra-articular Inflammatory Reaction Due to Poly-L-Lactide Bioabsorbable Interference Screw Used in Anterior Cruciate Ligament Reconstruction

Ji Hoon Kwak, M.D., Jae Ang Sim, M.D., Si Hwan Kim, M.D., Kyoung Chan Lee, M.D., and Beom Koo Lee, M.D.

Abstract: Bioabsorbable interference screws have replaced metal interference screws in anterior cruciate ligament reconstruction surgery because they have several advantages. Poly-L-lactide (PLLA) is one of the commonly used materials for bioabsorbable interference screws. PLLA produces a lower inflammatory reaction than polyglycolide as a result of its slower degradation rate and better biocompatibility. We describe a case of a delayed intra-articular inflammatory reaction caused by a PLLA bioabsorbable interference screw used in anterior cruciate ligament reconstruction.

Key Words: Anterior cruciate ligament reconstruction—Bioabsorbable interference screw—Delayed inflammatory reaction.

Bioabsorbable interference screws are one of the most widely used fixation methods in anterior cruciate ligament (ACL) reconstruction. Bioabsorbable interference screws are produced by a variety of materials with different compositions. Polyglycolide (PGA), poly-L-lactide (PLLA), and poly-D,L-lactide (PDLLA) are the most commonly used materials for this purpose. Adverse complications of bioabsorbable screws are rare. The adverse effects reported so far include a fractured screw, intra-articular migration of a screw, cyst formation with osteolysis, abscess formation, and an inflammatory reaction. However, there are few reports of an intra-articular inflammatory reaction due to a bioabsorbable screw in the knee joint after ACL reconstruction.

We report a case of a delayed inflammatory reaction caused by a PLLA bioabsorbable interference screw used for the femoral fixation of an Achilles tendon allograft in ACL reconstruction.

CASE REPORT

A 26-year-old man sustained ACL rupture in his left knee during a Korean traditional wrestling match in April 2003. One month after the injury, ACL reconstruction with an Achilles tendon allograft was performed at another clinic. Graft fixation was achieved with a BioScrew (Linvatec, Largo, FL) in combination with an EndoPearl device (Linvatec) in the femoral tunnel and a metal interference screw in the tibial tunnel. He was able to return to full sporting activity 6 months after surgery. However, 45 months after surgery he came to our clinic complaining of pain and effusion of the knee lasting for more than 1 month without any traumatic event.

The physical examination revealed massive effu-
sion sufficient to limit flexion up to 70°. The Lachman
test and anterior drawer test showed grade 1 laxity.
The pivot-shift test was negative, and there was no
other ligamentous instability.

The laboratory evaluation revealed an erythrocyte sed-
imentation rate and C-reactive protein level that were
slightly higher than normal, at 50 mm/h and 3.82 mg/dL,
respectively. The serial joint fluid culture and Gram’s
stain were negative for organisms. The simple radi-
ographs showed a large osteolytic lesion with radiolu-
cency at the femoral tunnel (Fig 1). Magnetic resonance
imaging showed the graft to have a homogeneous low
signal with continuity. The femoral tunnel was enlarged
and the screw could be identified on imaging (Fig 2).

The arthroscopic examination revealed synovitis on
the suprapatellar pouch, and white particulate debris
was found. The reconstructed graft was partially in-
jured but stable and was covered with normal syno-
vium with adequate tension. At the femoral tunnel, an
opening channel connecting the knee joint and cyst in
the femoral tunnel was found. From the opening,
white chalky debris was observed flowing into the
joint. The opening was enlarged with a curette, and the
inner aspect of the femoral tunnel could be inspected.
The bioabsorbable devices were degraded without any
bony substitution, and only chalky debris was ob-
served with some granulation tissue. Although the
screw was absorbed, the screw tract in the femoral
tunnel was clearly visible (Fig 3). The femoral tunnel
was irrigated and debrided, and the chalky remnants
of the bioabsorbable devices were removed. Arthro-
scopic synovectomy was performed, and the metal
interference screw in the tibial tunnel was removed.

A microscopic evaluation of the material revealed
particles that were consistent with the debris of the
bioabsorbable device and inflammatory cells. Giant
cells with a granulomatous reaction could be observed
around the particles, which is believed to have led to
a chronic inflammatory response (Fig 4).

At 2 months after the arthroscopic debridement and
synovectomy, the patient was free of symptoms and
showed no signs of recurrence.

**DISCUSSION**

Interference screws have been shown to provide
sufficient strength for rehabilitation and graft incorpo-
ration into the bone after ACL reconstruction.5,6
However, metallic interference screws have potential
disadvantages, which include screw divergence, lac-
eration of the graft, magnetic resonance image distor-
tion, and difficulty of revision surgery.7,9 Bioabsorb-
able screws have become the favored method for graft
fixation to decrease these complications and have ad-

**FIGURE 1.** Plain radiographs show an enlarged radiolucent lesion
with osteolysis in the femoral tunnel.

**FIGURE 2.** Sagittal magnetic resonance image at 45 months after
ACL reconstruction. The enlarged tunnel is filled with material,
which shows intermediate signal intensity.
absorbable screw can be degraded and replaced by the host tissue, and there is no need to remove the implant. Radiologic evaluation can be performed without image distortion. In addition, the graft can be fixed securely with less chance of graft laceration.\textsuperscript{10}

The composite materials in bioabsorbable screws generally include PGA, PLLA, and PDLLA. The rate of degradation depends on the material used and is associated with complications, such as an inflammatory reaction. PLLA has a slower degradation rate than PGA and causes a lower inflammatory response.\textsuperscript{11} Complications of PLLA bioabsorbable interference screws in ACL reconstruction have been rarely reported. Sassmannshausen and Carr\textsuperscript{12} reported the transcutaneous migration of a PLLA tibial bioabsorbable interference screw after a successful ACL reconstruction without any graft insufficiency or inflammatory reaction. MacDonald and Arneja\textsuperscript{2} reported an intra-articular dislocation of a fractured PLLA bioabsorbable screw that manifested as a loose intra-articular body. Regarding inflammatory reactions of bioabsorbable screws, Martinek and Friederich\textsuperscript{3} reported the first case in 1999. They reported a tibial and pretibial cyst formation with osteolysis 8 months after ACL reconstruction fixed with a PDLLA bioabsorbable screw in the tibial tunnel. There was no intra-articular inflammatory reaction or graft insufficiency. Busfield and Anderson\textsuperscript{4} reported similar cases in 2007. They reported 2 cases of extra-articular pretibial abscess formation with minimal osteolysis occurring 3 years and 18 months after ACL reconstruction fixed with a PLLA bioabsorbable screw in the tibial tunnel. Weiler et al.\textsuperscript{13} reported that the maximum extent of foreign-body reactions associated with PGA implants would occur approximately 12 weeks after surgery. Although there are few reports of

\begin{figure}[h]
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  \includegraphics[width=\textwidth]{figure3.png}
  \caption{(A) On arthroscopic examination, white chalky material was found. (B) At the femoral tunnel, further white chalky debris was found and previously inserted bioabsorbable devices were degraded without bony substitution. The threads of a previously inserted screw were clearly visible.}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=\textwidth]{figure4.png}
  \caption{Histologic evaluation showed particles that were consistent with bioabsorbable device debris (arrows) and surrounding inflammatory cells, and giant cells (arrowheads) with a granulomatous reaction could be seen around the particles (H&E stain; left, original magnification ×100; right, original magnification ×400).}
\end{figure}
foreign-body reactions associated with PLLA implants, they can occur between 1 and 2 years at the earliest but normally occur later. Many reports have been presented over the last several years, but there are few reports associated with an intra-articular inflammatory reaction in the knee joint after ACL reconstruction. There is only 1 report of foreign-body gonitis due to a broken PLLA screw after fracture surgery at 3 months postoperatively.1

We believe that the following mechanism was responsible for the intra-articular inflammatory reaction in our case. After bioabsorbable materials are degraded, they remain in granulated form in the femoral tunnel without connection to joint cavity. A traumatic partial injury of the graft on the femoral side makes a connection between the degraded bioabsorbable materials in the femoral tunnel and knee joint cavity. These connections result in the leakage of bioabsorbable materials into the joint and induce a delayed inflammatory reaction and synovitis. In addition, combined fixation with the EndoPearl device and BioScrew results in a larger volume of biodegradable materials, and this overloading of biodegradable materials might have a role in the delayed inflammatory reaction.

The common causes responsible for the intra-articular inflammatory reaction after ACL reconstruction include infection, an immune response to allograft by a host, and an inflammatory reaction to the bioabsorbable screw. In our case we believe that infection can be excluded because of the lack of organisms on Gram’s staining and serial joint fluid culture. In addition, we believe that an immune reaction by the host had less of a role in the inflammatory reaction because the reconstructed graft was well covered by normal synovium and looks grossly intact. The fact that our patient recovered quickly after arthroscopic debridement of the chalky material indicated that the white chalky material from the femoral tunnel was responsible for the inflammatory reaction of the knee joint. The histologic evaluation, which shows a chronic inflammatory response, confirmed our belief, too.

We have presented the case of an intra-articular inflammatory reaction that occurred 45 months after ACL reconstruction fixed with a PLLA bioabsorbable interference screw. The inflammatory reaction resolved after arthroscopic debridement. Even though PLLA bioabsorbable interference screws are useful in ACL reconstruction with few adverse effects, surgeons should be aware of the possibility of a delayed inflammatory reaction.

REFERENCES