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Severe cartilage damage by broken poly-L-lactic acid (PLLA) interference screw after ACL reconstruction

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Abstract Poly-L-lactic acid (PLLA) bioabsorbable interference screws are widely used for fixation of tendon to bone and bone to bone in anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) reconstructions. Complications are rare. To our knowledge this is the first report of severe chondral damage caused by late breakage of the screw. Breakage of bioscrews has only been published in cases with tendon to bone fixation.

Keywords Anterior cruciate ligament reconstruction · Bioabsorbable interference screw · Poly-L-lactic-acid · Biodegradable

Introduction

Interference screws are widely used for fixation of tendon to bone and bone to bone in ligament reconstructions. Metal interference screws have become the standard method for this purpose in anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) reconstruction. Through the last decade, poly-L-lactic acid (PLLA) biodegradable interference screws gained wide acceptance. Bioscrews do not distort postoperative MRI [13]. If the biodegradable screw is fully replaced by new bone formation, revision surgery is facilitated [10]. Furthermore, some surgeons believe that bioscrews have reduced risk of graft laceration [5, 7], even if this has never been proven. We present a case of a broken bioabsorbable PLLA interference screw, which resulted in severe chondral damage at the femoral condyle.

Case report

A 27-year-old female presented herself to our sports medicine clinic with persistent pain and swelling of her

right knee. Eleven years ago she had sustained a handball injury and underwent ACL reconstruction with a patellar tendon autograft. Femoral fixation was achieved by metal interference screw and tibial fixation by using a staple. One year later she suffered a second trauma, and arthroscopy revealed a rerupture of the ACL reconstruction. A partial medial meniscectomy was performed, but no revision surgery was done on the ACL. Nine years later, ACL revision surgery was performed because of chronic instability. An autogenous doubled semitendinosus graft was used and secured with an EndoButton (Smith and Nephew, Mansfield, MA, USA) on the femoral side and with a PLLA biodegradable interference screw (BIO RCI, Smith and Nephew) on the tibial side.

The patient did well until 12 months after the operation when she felt persistent swelling and intermittent locking of the knee.

Physical examination showed a mild knee-joint effusion, full range of motion and severe tenderness at the midjoint line. The knee was stable to Lachmann and pivot-shift examination.

On the preoperative radiographs there was no evidence of tunnel widening or displacement of the

radio-opaque fixation devices, i.e., the EndoButton, metal interference screw, and tibial staple (Fig. 1).

The MRI revealed breakage of the tibial interference screw with the head in an intraarticular position. The ACL graft appeared to be intact (Fig. 2).

At arthroscopy there was no evidence of inflammation and an intact ACL autograft. The head of the interference screw was easily detected in the intercondylar fossa, and was removed without any complications. There was severe chondral damage on the medial femoral condyle (Grade 3 according to Outerbridge) and on the medial tibial plateau (Grade 4 according to Outerbridge). After screw removal the patient had complete resolution of symptoms at the 4-month follow-up (Fig. 3).

Discussion

Biodegradable implants promise the advantages of easier revision surgery, undistorted MRI, and reduced risk of graft laceration. For these reasons, biodegradable devices have gained popularity among arthroscopic surgeons in recent years.

In the knee, bioabsorbable interference screws are being widely used for ligament reconstruction. Initially,



Fig. 1 Radiographs of the knee showing no evidence of tunnel widening or of displacement of the metal fixation devices. Note the anterior placement of the femoral interference screw from the first ACL reconstruction

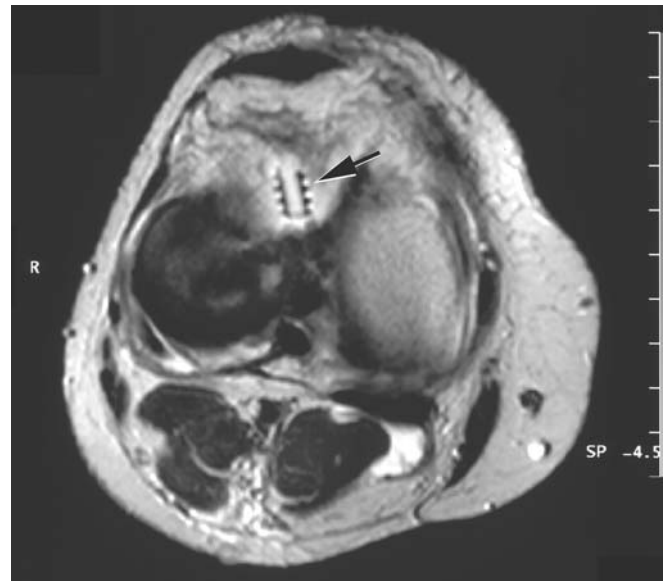


Fig. 2 MRI shows head of interference screw lying in the intercondylar notch (*big arrow*)

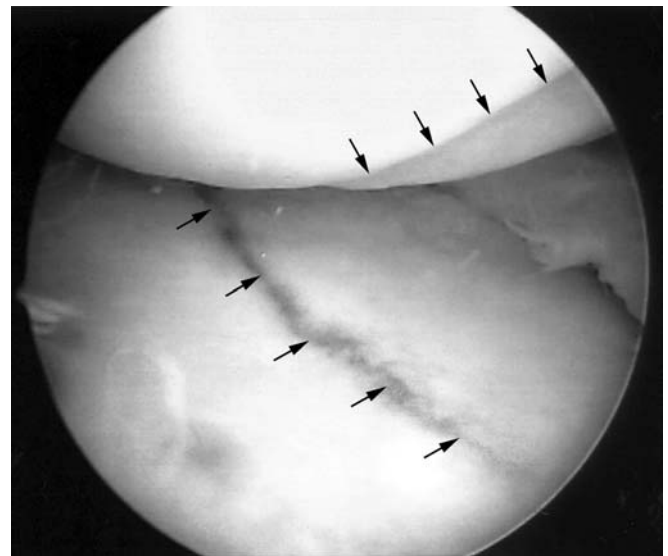


Fig. 3 Arthroscopy shows grinding injuries (*arrows*) of articular cartilage on the tibial and on the femoral side

the primary concern with PLLA interference screws was their inferior mechanical strength in comparison to metallic implants [8]. Screw breakage on insertion may occur in ten percent of the operations [7, 8]. This intraoperative complication does not interfere with the clinical outcome of the patient, but the initial breakage raised concern about primary stability. Biomechanical tests revealed sufficient pull-out strength [17], and clinical results of a prospective trial showed results comparable to those for metallic interference screws [7]. For

these reasons, implants consisting of PLLA have gained wide acceptance in recent years, and are rapidly increasing their market share compared to metallic screws [4]. Late breakage of PLLA interference screw in the knee, as described in our case report, is rare.

A recent report [12] showed two cases of PLLA screw breakage and intraarticular migration 15 and 23 months after reconstruction. The first case occurred with tibial fixation of a hamstring tendon in ACL reconstruction, the second with tibial fixation of Achilles tendon allografts in PCL reconstruction. In neither case was there evidence of intraarticular chondral damage or synovitis.

Another recent report demonstrated screw breakage with intraarticular migration of the foreign body 5 months after operation [18]. The PLLA screw was used for tibial fixation of quadrupled hamstring tendons. There was radiologic evidence of tunnel enlargement. At revision arthroscopy there was no lesion of the articular cartilage from the screw.

In yet another report, intraarticular migration of a complete bioabsorbable screw was observed 7 months after ACL reconstruction. The screw had been used for tibial fixation of a quadruple semitendinosus graft [3].

Breakage or migration of PLLA screws may be caused either by mechanical factors or by an inflammatory process. There has been no evidence of an inflammatory reaction in any reported case of screw breakage. To our knowledge there has been no report of synovitis in the knee joint when PLLA material was used for interference screws. However, there are a few case reports of foreign body reaction in the knee associated with other pathology such as intraarticular fractures [2, 15]. Inflammatory response to PLLA implants seems to be rare especially when compared to polyglycolic acid (PGA) implants.

There is more evidence of breakage of bioscrews caused by mechanical factors: all case reports occurred in fixation of hamstring or Achilles-tendon grafts, and not in patellar bone blocks (BPTB). Osseous integration of patellar bone blocks is achieved after 4–6 weeks, whereas healing of a tendon–bone interface takes 12–26 weeks [9, 16]. Therefore, a fixation device in soft-tissue fixation must withstand load forces longer than one used for BPTB graft [16], which may predispose to breakage of the degrading PLLA screw.

The exact resorption time of PLLA implants is still not well known: some reports indicated that PLLA screw resorption can take up to 5 years [1, 2, 4, 6, 14]. However, biomechanical properties of PLLA material are altered by the resorption process much earlier: *in vitro* tests showed that PLLA screws lose 50% of their compression strength due to hydrolytic degradation between 2 and 5 months depending on their chemical composition [11]. In shoulder arthroscopy, several patients had to undergo revision surgery in the early 1990s. The broken heads of PLA tacks that had been used for Bankart repair had to be removed from the glenohumeral joint. This complication was considered to be caused by unpredictable degradation from the tack, and use of the PLA tack was suspended [4] for many years. In knee surgery, biodegradable devices for meniscal repair have become popular in the past few years. Implant migration and chondral damage are potential complications [4].

This report shows that late breakage of PLLA interference screw can result in severe chondral damage. If pain and swelling of the knee are present after the use of bioabsorbable screws, one should be aware of this rare complication.

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