# Severe aseptic synovitis of the knee after biodegradable internal fixation

## A case report

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Biodegradable rods made of polyglycolide (Dexon®, Biofix®) or lactide-glycolide copolymer (Vicryl®) have been used for the past 5 years for internal fixation of a variety of fractures and osteotomies (Böstman et al. 1989, 1990b). Experience from using such rods for fixation of intraarticular osteochondral lesions seems to be less extensive. We report a case of severe synovial reaction to biodegradable rods used for fixation of osteochondritis dissecans of the knee and discuss possible reasons for the increased risk of foreign-body reactions when these rods are used intraarticularly.

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A 21-year-old man, active in competitive sports and with no history of inflammatory joint disease, was treated with Biofix® pinning for osteochondritis dissecans in the medial femoral condyle of both knee joints. The right knee was operated on in 1988 using four Biofix® rods (*with* dye) to fixate a previously asymptomatic, large osteochondral fragment that had become loose after a minor rotational injury. A slight-to-moderate effusion and warmth were present for 6–8 weeks postoperatively; but these decreased subsequently, and the patient had no further symptoms from this joint.

In 1986, the patient developed symptoms from the left knee, with intermittent swelling of a popliteal cyst. The radiographs were normal, and no therapy was instituted, as the only symptom was a subtle decrease in the range of flexion. After a minor rotational sports injury that he sustained 4 years later, the radiographs revealed a large osteochondritis dissecans with fragmentation, and the patient suffered from swelling, catching, and pain. Surgery was delayed for 10 weeks. At arthrotomy, a 25 × 55-mm piece of cartilage (with three thin and one thick subchondral bony component) was found that had loosened from the medial femoral condyle, and which was attached by only a posterior cartilage bridge. After abrasion of the hard bone in the defect, eight 2-mm-diameter Biofix® rods containing *no* dye were used to secure proper fixation. Immobilization and nonweight bearing were prescribed postoperatively, and prophylactic antibiotics were given for 3 days.

The wound healed without complications; but after 2 weeks, signs of arthritis were noted, with warmth and effusion, but only minor tenderness. Four weeks after surgery, the body temperature was increased to 38 °C, and the ESR and CRP were respectively 48 mm/h and 38 mg/L. Joint fluid was sent to the bacteriology laboratory for culturing, and antibiotics were given for a few days; but the latter were discontinued when no bacteria were found on microscopic examination and after the cultures had proved negative. The WBC was normal, but there was an increased number of leukocytes ($3.6 \times 10^9$/L) in the joint fluid. Treatment with anti-inflammatory drugs was instituted; but 6 weeks postoperatively, the joint was still severely swollen, and the ESR and CRP had increased to 85 mm/h and 214 mg/L, respectively. No bacteria were found upon repeated culturing of the joint fluid, which appeared macroscopically normal, although of low viscosity. At 8 weeks after surgery, the body weight had decreased 7 kg, the ESR had increased to 100 mm/h, but the CRP had decreased to 126 mg/L. The number of leukocytes in the joint fluid had decreased to $2.5 \times 10^9$/L; and a glucose consumption of 50 percent as compared with the blood level was noted. The radiographs now showed a patchy osteopenia of the femoral condyles, and a large synovial mass was palpable in addition to the effusion. No bacteria were found upon culturing the joint fluid.

Because the patient's general condition was poor and because he had a slightly increased body temperature (37°–38°) and persisting local symptoms, the joint was examined by arthroscopy. The joint fluid was still transparent, but large masses of white, thready fibrin clots were evacuated. The synovial membrane was severely hypertrophied and was bluish-red in color.

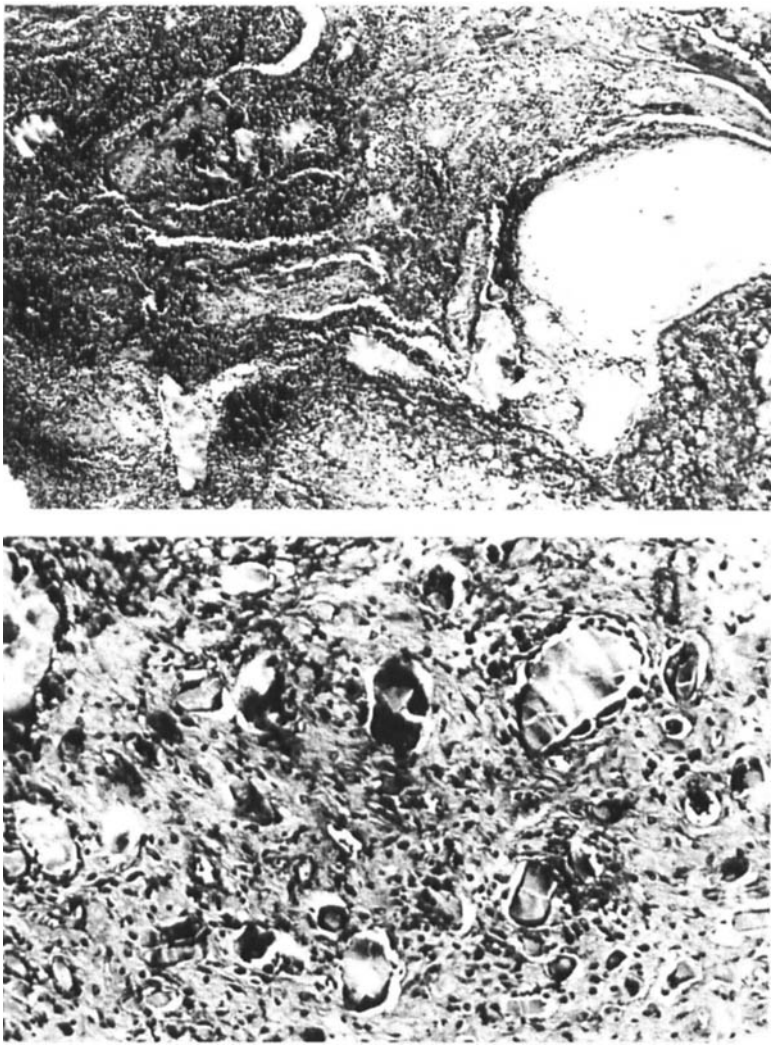

Figure 1. Histologic specimen from the synovial membrane of the left knee showing massive inflammatory response (top; HE, ×25), and foreign-body reactions and multiple giant cells containing masses of phagocytosed debris (bottom; HE, ×50).

These findings made an arthrotomy and subtotal synovectomy mandatory. The synovial membrane was found to be enormously hypertrophied, with giant edematous villi and abundant fibrin. The membrane was easily detached from the fibrous capsule because of the edema, and it was sent to the pathology laboratory for histologic examination. A massive inflammatory reaction was found with foreign-body reactions and multiple giant cells containing phagocytosed debris (Figure 1). The osteochondral fragment was still in its bed, but was mobile and could be easily removed as a result of the degradation of the intraosseous parts of the Biofix® rods and a total lack of osseous healing. The subchondral bone bed was covered with a layer of debris, which probably resulted from the degradation of the rods. The condylar intraosseous parts of the rods were completely degraded, leaving a considerable amount of liquid debris with softening of the surrounding bone leading to large bony defects after debridement. Because bacterial cultures from multiple samples of the synovial membrane were negative, antibiotics were only given for 5 days postoperatively.

The wound healed without complications; and 2 weeks after surgery, the patient's general condition was improved, and the ESR had fallen to 80 mm/h. However, 4 weeks after the synovectomy, there was still a massive effusion in the joint; and in addition to bacterial culturing, which again was negative, samples of the joint fluid and blood were sent to the medical microbiology department for analyses of complement

proteins (Sjöholm et al. 1986). $C_3$ in EDTA plasma was increased to 160 percent (reference value 70–136 percent) of a control standard, $C_4$ was increased to 292 percent (reference value 53–207 percent), and $C_3$ degradation fragments were increased to 8 percent (reference value < 6 percent), whereas $C_{1q}$ and $C_{1s}$ were normal. In joint fluid collected in EDTA, the corresponding values were 81 percent ($C_3$), 198 percent ($C_4$), 28 percent ($C_3$ degradation fragments). The concentration of $C_{1q}$ and $C_{1s}$ was 120 percent and 122 percent of the normal plasma concentrations, respectively.

In addition to the effusion, three 3–4-mm-wide, rounded defects developed in the skin incision, as well as a subcutaneous fluid accumulation containing 15 mL of clear fluid. No communication with the joint was found, but there was a contact with the resorbable sutures (Dexon®) in the capsule. The hygroma was evacuated, and healing took place by granulation in 3 weeks. The patient was given antibiotics after bacterial culturing, but this treatment was discontinued when no bacterial growth was found, neither from the hygroma nor from the sinuses.

At the latest follow-up 4 months postoperatively, the range of motion was 0°–140°, but the thigh muscles were still slightly wasted. No effusion or tenderness was found, and the ESR and CRP were normal.

## Discussion

Osteochondritis dissecans of the knee may in some cases be difficult to treat with conventional fixation techniques, and the concept of resorbable stiff rods is attractive. The rods have been used extraarticularly with good results (Böstman et al. 1987, 1989). Less documentation exists for the treatment of osteochondritis dissecans; but in standardized surgical lesions of the medial condyle of sheep, fixation with biodegradable rods leads to healing of the osteochondral fragment (Claes et al. 1986). The biocompatibility of Dexon® and Vicryl® used as suture material is well known. However, an inflammatory response with foreign-body reactions and in some cases sterile fistulae after treatment with the same material as rods has been reported to occur in about 8 percent in a group of 516 patients (Böstman et al. 1990b). The healing time in these cases varied from a few weeks to 4 months. The frequency of this inflammatory reaction was less (about 5 percent) when these devices were used for fixation of malleolar fractures than when used to treat intraarticular fractures of the knee (15 percent) or in scaphoid nonunion (25 percent).

The time required for degradation of the implants, principally by hydrolysis, is estimated to be between 3 and 4 months (Böstman et al. 1989, 1990a); and clinical signs of foreign-body reaction generally occur with a delay of several weeks (Böstman et al. 1987, 1989), which is a longer delay than that which occurred in our patient.

Our patient had his right knee operated on immediately after the loosening of the fragment, which could be fixed with good stability using four rods, whereas the left knee was treated after a considerable delay, and here eight rods were necessary to obtain a stable fixation. It is possible that there is a dose/response relation, because both knees in our patient showed postoperative reactions, but with severe general constitutional symptoms and no spontaneous improvement on the left side, where more foreign material was implanted. The reported wound sinuses after malleolar fractures, however, have been found to be independent of the volume of implanted material (Böstman et al. 1989).

The operative delay may also be of importance. The reported high incidence of inflammatory complications after treatment of scaphoid nonunions may be due to the absence of callus during the degradation of the rods. The chances of an osteochondral fragment healing, provided that the fixation material gives stability equivalent to its use in, for example, malleolar fractures, is probably higher when surgery is performed acutely or subacutely. The early and severe inflammatory response in our patient could be due to a combination of enhanced intraarticular reactivity against the foreign material and a possible aggravation by instability in the contact area between the rods and bone.

It is possible that the rather long degradation period, as well as the considerably greater amount of the material when compared with its use as suture material, signifies an increased risk of immunologically mediated reactions to the material, especially in an intraarticular environment, which is different as regards cells and enzymes. One possible mechanism causing the severe reaction in the latest operated on knee could be a sensitization to the polyglycolic acid during the first implantation 4 years earlier. Analysis of complement proteins in our patient revealed increased concentrations of $C_3$ and $C_4$ in the blood samples. The concentration of $C_3$ degradation fragments in the joint fluid was markedly high, and this evidence of $C_3$ cleavage locally is suggestive of an immunologically mediated mechanism. $C_3$ degradation, however, could also be a result of activity of enzymes released from granulocytes. The finding of local $C_3$ cleavage in the involved joint was unambiguous and deserves further investigation.

The immunobiological response to Biofix® rods used for malleolar fractures has been investigated by Santavirta et al. (1990). They found a slight non-specific lymphocyte activation secondary to inflammatory mononuclear cell migration and adhesion. A lymphocyte-mediated immunologic reaction against the implant thus seems probable.

The possibility that our patient had a bacterial infection could be ruled out by a total of 14 negative cultures from the joint fluid, the synovial membrane, and the fistulae. All the samples for bacterial culture were harvested while the patient was not receiving antibiotic treatment.

In our opinion, it seems justified to urge some caution against the intraarticular use of biodegradable devices until the mechanism of foreign-body reactions has been fully understood or the composition of the biodegradable material has been further improved.

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