

Osteochondritis dissecans of the knee fixed with biodegradable self-reinforced polyglycolide and polylactide rods in 24 patients

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Summary. Over a period of 7 years (1987–1994), 24 cases of osteochondritis dissecans of the knee were treated with self-reinforced polyglycolic acid (SR-PGA) and polylactic acid (SR-PLLA) rods. Rods measuring 1.1 mm, 1.5 mm and 2 mm in diameter, and 20–40 mm in length were used in the fixation of the fragment depending on the size of the lesions. There were 23 patients with osteochondritis dissecans in the medial and 1 in the lateral femoral condyle. The average age of the patients was 25 years (range: 16–48). Follow-up was for 3.3 years (range: 1–7.6). There were 6 lesions in situ, 3 early separations, 11 were partially detached, and there were 4 loose bodies. SR-PGA rods were used in 12 patients, SR-PLLA rods in 11 patients, and both SR-PGA and SR-PLLA rods in 1 patient. The rod in each case was inserted subchondrally and in 9 cases arthroscopically, using a special instrument. In our study, the clinical result was excellent in 13 patients, good in 6, fair in 1 and poor in 4. On radiological assessment the fragment had healed in 19 cases. Synovitis occurred in 1 patient in the SR-PGA group (1/13): the effusion continued for 6 months postoperatively but, after treatment by needle aspiration, there were no symptoms at follow-up 4.2 years later. We conclude that SR-PGA and SR-PLLA rods can be used intra-articularly for the adequate fixation of osteochondritis dissecans.

Résumé. De 1987 à 1994 vingt-quatre malades présentant une ostéochondrite du genou ont été traités au moyen de broches résorbables, polymères autoreinforcés de polyglycolides et polylactides. Parmi celles-ci il y avait 23 ostéochondrites du condyle interne et une du condyle externe. Les broches utilisées pour la fixation de la fracture étaient de 1,1 mm, 1,5 mm et 2 mm. L'âge moyen était de 25 ans (de 16 à 48 ans). La durée moyenne de contrôle postopératoire a été 3,3 ans (de 1 à 7,6 ans). Dans 6 cas lésion était sans déplacement, dans 3 une séparation précoce, dans 11 un détachement partiel et dans 4 cas une libération complète ont été observés. Les broches de SR-PGA (autoreinforcé, polyglycolide) ont été utilisés dans 12 cas, celles en SR-PLLA (autoreinforcé, polyglycolide) dans 11 cas, et ensemble dans 1 cas. La fixation a toujours été faite dans l'os sous-chondral, et 9 fois par arthroscopie. Les résultats de l'évaluation clinique post-opératoire ont été considérés comme excellent chez 13, bon chez 6, satisfaisant chez 1 et mauvais chez 4 malades. La consolidation radiologique a été obtenue chez 19 malades. Il y a eut une synovite parmi les 13 patients du groupe SR-PGA qui a persisté jusqu'à 6 mois après l'opération exigeant un traitement par ponctions. Dans l'évaluation clinique à quatre ans et deux mois, le genou était asymptomatique. Les broches de polymères autoreinforcés de polyglycolides et polylactides peuvent être utilisés comme un matériau fiable dans la fixation des ostéochondrites du genou.

Table 1. Patients, methods, and results

Patient	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	48	M	3	3	27×26	4	-	1	2	2	4,6	-	+	E	E
2	18	M	2	3	25×45	3	-	1	1	1	6	-	+	E	E
3	19	M	5	1	18×18	1	-	1	1	2	6	-	+	E	E
4	33	F	5	3	18×25	2	-	2	2	2	3,2	-	-	P	P
5	19	F	4	3	25×30	4	-	1	2	1	6	-	+	G	E
6	21	M	2	3	22×24	4	-	1	3	1	6,5	-	-	P	G
7	35	F	5	3	34×40	1	+	2	1	3	2	-	+	G	E
8	31	F	1	5	23×30	6	-	1	6	1	7,6	-	+	G	E
9	21	F	1	3	20×30	4	-	1	3	1	4,2	+	+	E	E
10	17	F	1	1	14×14	1	+	2	3	3	2,5	-	+	E	E
11	28	M	4	2	23×20	1	+	1,2	3	3	3,8	-	-	G	G
12	20	M	2	3	15×20	2	-	1	2	3	1,3	-	-	F	G
13	17	M	2	4	32×20	3	-	2	11	1	1,8	-	-	P	F
14	21	M	3	3	20×20	4	-	1	2	1	2,8	-	+	P	F
15	23	M	5	5	40×45	6	-	1	4	1	4,8	-	+	G	G
16	12	F	2	1	5×5	1	+	1	2	3	2,8	-	+	E	E
17	20	M	3	2	15×25	1	+	2	2	3	1,4	-	+	E	E
18	28	F	2	1	14×15	2	+	2	3	2	2,8	-	+	G	G
19	19	M	2	2	15×30	1	+	1	1	3	3,8	-	+	E	E
20	29	F	1	1	15×10	1	+	2	1	2	1,3	-	+	E	E
21	19	M	4	4	26×32	3	-	2	2	3	1,4	-	+	E	G
22	26	F	3	3	21×35	5	-	2	4	2	1,3	-	+	E	E
23	19	M	1	3	25×25	2	-	2	4	4	1,1	-	+	E	E
24	16	M	2	1	15×15	1	+	2	1	2	1	-	+	E	E

A Age (years)

B Sex (M = male, F = female)

C Duration of symptoms: 1 0–1 months, 2 2–6 months, 3 7 months–3 years, 4 4–6 years, 5 7–10 years

D Diagnosis (Guhl 1982): 1 intact (in place) lesion, 2 early separated, 3 partially detached, 4 salvageable loose body, 5 unsalvageable loose body

E Size of the lesion in x-ray mm × mm

F Treatment: 1 fixation, 2 drilling and fixation

3 curettage and fixation

4 curettage, drilling and fixation

5 curettage, bone transplantation, and fixation

6 osteoperiosteal transplantation, and fixation

G + Arthroscopy, – Arthrotomy

H Fixation material: 1 SR-PGA rod, 2 SR-PLLA rod

I Number of rods

J Postoperative treatment: 1 Plaster cast, 2 No weightbearing, 3 Partial weightbearing, 4 Weightbearing with crutch

K Follow-up, years

L Synovitis

M Radiological result (+ healed, – not healed)

N Clinical result (E = excellent; G = good, F = fair, P = poor)

O Subjective result (E = excellent, G = good, F = fair, P = poor)

Introduction

The treatment of osteochondritis dissecans is still controversial. In 1952, Green and Banks showed that osteochondritis dissecans in children heals when treated by immobilization [7]. With later presentation, drilling of the crater has been used as treatment. Since internal fixation was first carried out by Smillie using a nail gun, different methods have been developed ranging from arthroscopic K-wires to compression screw fixation. These were used to shorten immobilization time and to enhance ossification and retention of the fragment [21, 9, 24].

Satisfactory results have been obtained with metallic fixation, but a second operation to remove the implanted material is needed. This can be avoided by using bone peg fixation [6], by excision of the detached fragment, or by removal of the loose body [14]. The outcome following treatment

is generally better in young patients than in adults [3]. There is an increased incidence of osteoarthritis of the knee with age [12].

Different methods of more biological fixation have been studied. Cyano-acrylate adhesives [11] and fixation with polydioxone (PDS) pins, which are suitable for securing small osteochondral fragments, were used in the knees of rabbits [8]. Fibrin sealant, PDS pins and K-wire fixation were compared in rabbit knees and no difference was found between a PDS pin or K-wire fixation [20]. In a clinical series, Thomas et al. [23] reported 18 fixations of osteochondritis dissecans with polydioxone rods, and detailed favourable results. Cartilage avulsion has been attempted during re-fixation with fibrin sealant and polydioxone pins but the results were questionable [17].

Polyglycolic acid (PGA) and polylactic acid (PLLA) implants have been used in the treatment

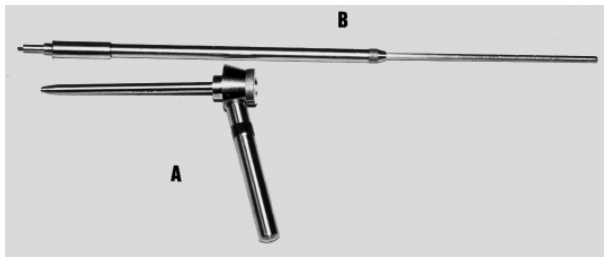


Fig. 1. The instrument used in arthroscopic insertion of the rods. Drilling is performed first through the lesion using a drill and *part A* of the instrument. The implant is then inserted into *part B*, and both parts are locked together before inserting the implant flush with the subchondral bone. This happens automatically with this special instrument

of cancellous bone fractures since 1985 and 1988 respectively. Only a few previous studies have reported the use of absorbable fixation devices in osteochondritis. Friden and Rydholm [5] described severe synovitis of the knee after fixation with SR-PGA pins (containing no dye) which necessitated synovectomy.

We report a study of 24 patients treated with SR-PGA or SR-PLLA rods in the fixation of osteochondritis dissecans of the knee.

Patients and methods

Operations were carried out on 24 patients with osteochondritis dissecans of the femoral condyle over a period of 7 years (1987–1994) using SR-PGA and SR-PLLA rods measuring 1.1 mm, 1.5 mm and 2 mm in diameter and 20–40 mm in length depending on the size of the lesions. The lateral femoral condyle was involved in 1 patient, and osteochondritis dissecans affected the medial condyle in the other 23. There were 14 males and 10 females (Table 1). The average age of the patients was 25 years (range: 16–48). The average duration of symptoms was 2.6 years (range: 0–16). Removal of loose bodies had been performed previously in 3 patients. Fixation with Kirschner wires had been undertaken 11 months previously in 1 patient, and another patient had undergone bone peg fixation 7 years before our operation. Common complaints were of a dull aching pain, a feeling of swelling, and “locking”. The onset of symptoms was sudden in 9 patients, and 2 complained of locking of the knee. The right knee was involved in 16 cases, and the left in 8. Two were bilateral. Anteroposterior radiographs showed that 16 of the lesions were classical, 3 extended classical, 4 infero-central and 1 lateral according to Aichroth’s classification [1]. Lateral views showed 1 anterior and 3 posterior lesions according to Harding’s lines [10]. The size of the lesion on the radiograph varied from 5 mm × 5 mm to 40 mm × 45 mm, and the average surface area was 447 mm² (range: 19.6–1411). The surface area was calculated from the radiographs, and the lesion was considered a circle. Five of the 6 patients with osteochondritis dissecans in situ, 3 with early separated lesions and 1 with a partially detached lesion were treated arthroscopically using a special instrument to place the rod subchondrally (Fig. 1). In arthrotomies, a straight incision was used to approach the knee

from the side of the lesion. Curettage, drilling and fixation were performed in 5 of the 11 patients with partially detached lesions; curettage and fixation in 1; curettage, bone transplant and fixation in 1; fixation alone in 1, and drilling and fixation in 3. There were 2 salvageable loose bodies which were treated by curettage and fixation, and 2 other bodies treated by osteoperiosteal transplantation and fixation.

SR-PGA rods 2 mm in diameter were used for fixation in 11 patients; 2 rods (range: 1–6) were used to fix the fragment in 5 patients; 2 SR-PGA rods 1.5 mm in diameter were used in 1 patient; 1–5 SR-PLLA rods 2 mm in diameter were used in 9 patients; 8 SR-PLA rods 1.1 mm and 3 SR-PLLA rods 1.5 mm in diameter were used in 1 patient, and 4 SR-PLLA rods 1.5 mm in diameter were used in 1 patient. Fixation by both SR-PGA and SR-PLLA rods was performed in 1 patient.

Of the 24 patients in our study, postoperative treatment included a plaster cast in the most severe cases for 4–8 weeks, no plaster but only partial weightbearing for 3–6 weeks in 8, no weightbearing for 2–6 weeks in 7 and immediate full weightbearing using 1 crutch in 1 patient.

At follow-up the clinical results were assessed as excellent, if the patient had no symptoms, had returned to the previous sports level, the range of movement was normal and the radiograph showed that the lesion had healed; good, if the symptoms were slight on exertion but with a good level of activity and the radiograph showed that the lesion had healed; fair, if activity was impaired, the pain was slight and there was restriction of knee movement and poor, if the patient could not participate in sports and had pain with or without the presence of a loose body. The average follow-up was 3.3 years (range: 1–7.6).

Results

The clinical result was excellent in 13 patients, good in 6, fair in 1 and poor in 4. There was no difference in the clinical results obtained by fixation with SR-PGA rods compared with using SR-PLLA rods. The subjective outcome was excellent in 15 patients, good in 5, fair in 3 and poor in 1.

Radiologically, the fixed lesion had healed in 18 cases, ossification had not occurred in 5, and it had fragmented and healed in 1. Radiography showed medial osteoarthritis in 1 patient. Fixation of the fragment was excellent in 19 cases and poor in 5, of whom 2 had a favourable result following further operation. There was no difference in the healing or retention of the lesion whether SR-PGA rods or SR-PLLA rods were used for fixation. Two years and 7 months after curettage, drilling and fixation of a partially detached lesion, a fragment 10 mm × 15 mm became loose and had to be removed in 1 patient who had been weight-lifting. The subjective result was good at follow-up. In another patient a previously fixed intact lesion became loose, also during weight-lifting, and was re-fixed arthroscopically using SR-PGA rods 2 mm in diameter and 1 SR-PLLA rod 2 mm in diameter. The final result was good.



Fig. 2. **a** Radiograph of a posterior lesion in situ in the medial condyle of a 19-year-old male fixed with 1 SR-PGA rod 2 mm in diameter. **b** After a 6-year follow-up the result was excellent with slight irregularity and no evidence of arthrosis

Of the 8 patients treated postoperatively with a plaster cast there were 3 poor clinical results; in the group treated with no weightbearing there was 1 poor result; in the group treated with partial weightbearing there was 1 fair result, and of the remainder the results were good or excellent.

The average time from the operation to a return to previous sporting levels was 6 months (range: 1–18), with an average of 5 months (range: 2–6) for arthroscopically treated patients and 7.6 months (range: 1–18) for those treated by arthrotomy.

The average operation time for patients treated by arthroscopy was 44 min (range: 15–96), and with arthrotomy 66 min (range: 37–102) ($P=0,06$). The average sick leave was 78 days (range: 55–137), but 9 patients were students with no entitlement to this.

The range of movement was normal in 22 patients and only 2 had slight restriction of flexion.

The average surface area of the lesion was calculated from radiographs and was divided by the number of rods. The average area fixed by 1 rod was 254 mm², and 253 mm² in the SR-PLLA group. The findings were the same in patients with poor results.

A female patient developed an effusion after curettage, drilling and fixation of a partially detached lesion using 3 SR-PGA rods 2 mm in diameter. Whilst after 2 months, in a cast, she developed an effusion which continued for 4 months following immobilisation; 40 ml of yellow fluid with a leucocyte count of 23,000 was aspirated. The C-reactive protein was 25, and all bacterial cultures were negative. She was treated by further needle aspirations. She had received 3 SR-PGA

(with dye) rods 2 mm in diameter; after 4.2 years she was symptomless and had an excellent result.

Previous fixation with Kirschner wires had been performed in another patient who continued to complain of pain, and at arthroscopy 11 months later the fragment was found to be loose and was re-fixed using 2 SR-PGA rods. There was an excellent result after 2 years.

Discussion

Good or excellent results were observed in 19 of the 24 patients in our series. There was one child and the other patients had the adult form of the disease. In a previous report of bioabsorbable fixation, Thomas et al. [23] used fibrin glue, a cancellous bone graft and polydioxone pins for the fixation, and achieved promising results in all 18 of their patients, 7 of whom had the juvenile form of the disease. In a recent study, Matsusue et al. [18] fixed 3 cases of osteochondritis dissecans and 2 of osteochondral fractures with poly-L-lactide pins measuring 2 mm in diameter, and reported good bone union in all cases within 3 months of operation. Their patients included 3 children. Average follow-up was for 4.1 years and no inflammatory reactions were observed. Using bone peg fixation, Lindholm et al. [13] described 15/20 excellent or good results in a 5-year follow-up. Previously they had reported 32/40 excellent or good results with removal of the fragment alone [14].

With regard to metallic fixation, Thomson [24] achieved 16/18 unions with a Herbert screw; 4 of the patients were children. Cugat et al. [4] inserted a Herbert screw arthroscopically with 12/15 ex-



Fig. 3. **a** Radiograph of an 18-year-old male with a partially detached lesion of the medial condyle measuring 25 mm × 45 mm treated with curettage and fixation with 1 SR-PGA rod 2 mm in diameter. **b** Radiograph after a 6-year follow-up. The clinical outcome was excellent. **c** MRI after a 6-year follow-up. The lesion has healed

cellent subjective results after 1 year. The epiphysis had not closed in 7 of the patients. Using metallic pin fixation, Lipscomb et al. [15] had 6/7 excellent or good results, and Guhl [9] had 40/46 excellent or good results in arthroscopic procedures. In Guhl's series 20 of the patients were children, and in Lipscomb's patients there was 1 child. Guhl mentioned metallic complications including pin breakage, loosening and erosion through the skin in 5/49 cases. Merchan and Galindo [19] also reported breakage of Herbert screws during removal.

Synovitis of the knee following fixation with SR-PGA has been described in previous reports [2, 5]. In our series, 1 case of synovitis lasted for 6 months after operation, but at follow-up the re-

sult was excellent and the calculated surface area fixed by 1 rod was 163 mm², while in the present series the average area fixed by 1 SR-PGA rod was 255 mm². In the report by Friden and Rydholm [5] the right knee had received 4 rods (with dye) and synovitis did not occur; the left knee, in which synovitis did occur, had received 8 rods 2 mm in diameter (no dye) in an area of 25 × 55 mms, giving an area 157 mm² for each rod. It seems, therefore, that too many rods too close together predispose to synovitis, probably by exceeding the buffer capacity of the cancellous bone.

One reason for the synovitis might be the larger rod volume/area, but in 4 of our present cases the area fixed by 1 SR-PGA rod was smaller than 163 mm² and no synovitis resulted. The present

technique is to place the rod subchondrally and in arthroscopic procedures a special instrument can be used to ensure this. We suggest that the operation technique is the most important factor in avoiding synovitis, and believe that the rod should be placed subchondrally. In the present series, 1 fixation with SR-PGA rods was followed by synovitis. We had no inflammatory complications using SR-PLLA rods. Tegnander et al. [22] had diffuse swelling in 6/10 knees during the post-operative period. However this is too soon to have resulted from PLA degradation which may cause swelling much later, but it could be explained either by the rod insertion technique, the lesion, or the operation. Tegnander also found high levels of CSa des Arg in plasma incubated in the presence of polylactic acid. This suggests a lack of biocompatibility of polylactid acid. However the test procedure was later found to have been inadequately designed and thus the conclusions against biocompatibility of poly(L-lactide) have not been substantiated [16].

It is concluded that bioabsorbable fixation with SR-PGA and SR-PLLA rods can be used in the treatment of osteochondritis dissecans of the knee with good clinical and subjective results and with a low complication rate.

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