

## Long-term Results After Transfixation of an Osteochondritis Dissecans Fragment to the Femoral Condyle Using Autologous Bone Transplants in Adolescent and Adult Patients

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**Summary.** A review is reported covering 16 adolescent and 15 adult patients treated for osteochondritis dissecans of the femoral condyles by reconstruction of the articular surface and transfixation of the fragment in situ using autologous bone transplants and followed up for a period of up to 18 years. Sixty percent of the patients were totally symptom-free, whereas in others the clinical symptoms had consistently decreased. A radiologically estimated total remodelling of the condylar surface with union of fragment to the osseous bed was seen in 90%. The reduction of the fragment was incorrect in 16% of the cases. Resorption of the distal ends of cortical bone transplants in the articular surface of the condyle was total in 87%. No immobilization or removal of bone transplants was needed after surgery and all patients later on returned to their previous work.

**Zusammenfassung.** Es wird eine Übersicht gegeben über die Behandlungsergebnisse von 16 heranwachsenden und 15 erwachsenen Patienten, die wegen Osteochondritis dissecans der Femurcondylen mit Rekonstruktion der Artikulationsflächen und Transfixation der Fragmente in situ operiert worden waren. Hierbei kam autologes Knochentransplantat zur Anwendung, und die Observationszeit postoperativ betrug bis zu 18 Jahren. Sechzig Prozent der Patienten waren völlig beschwerdefrei, während die Symptome der übrigen durchgehend nachgelassen hatten. Radiologisch konnte in 90% der Fälle eine vollständige Remodellierung der Kondylenfläche und eine Verschmelzung des Fragments mit dem Knochenbett nachgewiesen werden. In 16% der Fälle war die Reduktion des Fragments ungenau. Eine Resorption der distalen Abschnitte des kortikalen Knochentransplantats in die Artikulationsfläche des Kon-

dylen war vollständig in 87% der Fälle. Immobilisierung oder eine Entfernung des Knochentransplantats wurde postoperativ nicht erforderlich, und sämtliche Patienten konnten wieder ihren früheren Beruf ausüben.

Numerous different techniques are available for the treatment of osteochondritis dissecans of the knee. In most cases, conservative treatment is sufficient in children and adolescents. Surgery is recommended, if the fragment is loosening or has already separated from the condylar bed [8, 10, 17]. In adults, the treatment should also primarily be conservative. However, surgery is needed in definite cases. When a weight-bearing surface of the distal femur is affected by a large area of osteochondritis dissecans, every effort should be made to restore the articular surface [12, 13, 17]. In reconstruction of the condylar surface, numerous techniques are used, intra- as well as extra-articular methods, such as drilling holes through the fragment and fixation with screws or Kirchner wires, Smillie pins, or differently modelled transplants [5].

The last-mentioned techniques has been used and modified by the authors. The following description intends to illustrate how this technique was adopted in 31 adolescent and adult patients and combined with post-operative treatment as well as a clinical and radiologic follow-up.

### Clinical Series

The clinical series is composed of 31 patients operated with the same fixation technique using bone transplants of an osteochondritic fragment in the femoral condyle. There were 16

adolescent patients with open epiphyseal growth zones with an average age of 12.5 years (8–15 years) and 15 adult patients with an age of 20 years (17–24 years) at the start of the first knee symptoms. The distribution between the sexes was 24 males and seven females. The patients in the first group were operated on at an average age of 14 years (11–15 years), those in the second group, at 22 years (16–30 years) (Fig. 1).

The period passing from the start of symptoms to surgery was 3 years (3 months–8 years) and 4 years (3 months–14 years), respectively.

The patients were observed during the observation period, and their age at follow-up was 17 years (15–21 years), and 27 years (16–41 years) in the respective groups.

In 90% of the cases the osteochondritic lesion was located in the medial condyle, in the remaining cases in the lateral condyle, including, totally, the weight-bearing surface in 68% and, partly, in 32%. A cleavage in the articular surface was recognized in 68% of the cases, although the fragment was observed to be unstable at palpation during surgery in other operated cases, too.

In 62%, the fragment was situated in the bed, in 19%, it was connected with a stylus of synovial and ligamentous tissue, and in another 19%, it was a loose body in the joint cavity. During a period varying from 4 days to 4 weeks, the body was observed to be freely moving in the joint.

All patients examined complained of symptoms from the knees, pain during rest or at movement being the main symptom.

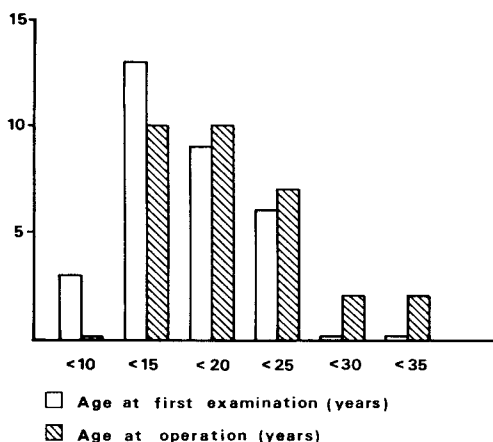


Fig. 1. Age of patients at the start of the first symptoms recognized and at surgery

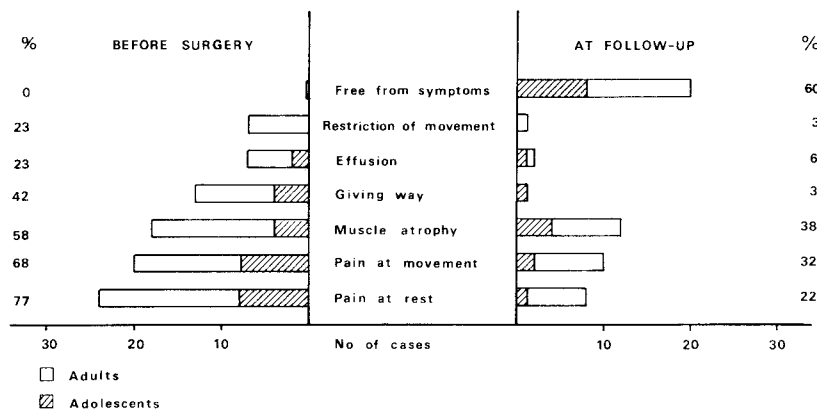


Fig. 2. The main symptoms recorded in adolescent and adult patients before surgery and at follow-up

Atrophy of the quadriceps muscle was noted in about one half of the patients. Giving way, effusion and restriction of movement due to loose bodies in the joint were other symptoms recognized (Fig. 2).

## The Surgical Procedure

A medial parapatellar longitudinal approach was undertaken under tourniquet. The patella was laterally dislocated, and the knee flexed at an angle of 90°. There were no difficulties in recognizing the osteochondritic bed varying in size from 1.0 cm × 1.0 cm to 3.0 cm × 4.0 cm. The fragment was loosened from its bed, which was refreshed, and, in some urgent cases, spongy bone taken from the anterior part of the tibia was transplanted to the bed. If the fragment was anchored to the bed without a clear cut in the articular surface, no dislocation was performed. Using a 2 mm thick drill, several holes were driven through the fragment and the condylar metaphyseal bone. Bone pegs, about 2 mm thick and of a triangular or quadratic shape and about 1–2 cm of length were taken with an oscillating saw from the anterior tibial cortex. These pins were impacted in every other bone hole for a firm fixation of the fragment to the condylar bed. The ends of the bone pegs were further impacted beneath the articular cartilage surface. Four bone pegs on average (varying between 2–8) were used (Fig. 3). The operation wound was closed and a vacuum drainage was put in the anterior popliteal fossa. No immobilization in a plaster cast was performed. During 6–8 weeks post-operatively, full weight-bearing was avoided. The post-operative condition of the osteochondritic fragment fixated was immediately recorded on X-ray.

## Results

In 1979, all patients operated on were followed up clinically, including plain X-ray examination of the knees. In adolescent patients with open epiphyseal lines at surgery the re-examination was performed 3 years on average (2–8 years) and in adult patients 5 years on average (2–18 years) after operation. One of those patients had been re-operated after bone pegging because of symptoms from a lateral discoid meniscus. In another case, an arthrotomy was performed because of a threatening loosening of one peg. As a control



**Fig. 3.** Intra-operative photographs (22-year-old man) showing the loose osteochondral fragment located intra-condylarily and the condylar bed filled out with fibrotic and synovial tissue (a). The same state is presented on X-ray in Fig. 3e. Soft tissue and pieces of necrotic bone were thoroughly evacuated from the bed (b), which was filled out with cancellous bone taken from the proximal tibia. In this case, a 7 mm thick layer of spongy bone was compressed in the bed (c). The loose fragment was adopted to the bed, and care was taken to obtain congruency between the surface of the fragment and that of the condyle. Several holes were bored through the fragment, and in some of them, autologous cortical bone transplants taken from the tibial condyle were anchored. The distal ends of the pins were impacted beneath the articular surface (d). A radiograph shows the loose fragment and the bed in the medial condyle (e). A radiograph taken about 1 year after transfixation shows a smooth articular surface. The bed can still be recognized, and the fragment has united with almost total resorption of the cortical bone transplants (f and g)



**Fig. 4.** Radiograph of an osteochondritic fragment with sclerotic borders in the medial femoral condyle in situ (13-year-old boy). The fragment is unstable and shows a cleavage in the articular surface (a and b). Nine months later, the fragment was stably transfixed to the condyle with autologous cortical transplants (c). Thirteen months later, there was still some irregularity in the articular surface of the fragment transfixed, marking the distal ends of the bone pins (d). Shadows of the proximal ends of the pins are observed in the condyle but the borders of the fragment are not observed (e). The patient was symptom-free

measure, arthroscopy was additionally performed in two cases. The clinical examination revealed that 60% of the patients were symptom-free, although all patients showed some kind of symptom before the operation. Pain in movement or pain at rest was recognized in 30% of the cases, and in 70% before operation. Muscle atrophy was still seen in 38% (in 58%, before operation). In comparison to the situation before operation, only very few knees showed symptoms of effusion, restriction of movement, or giving way (Fig. 2).

The roentgenological follow-up revealed that four patients had small loose bodies in the joint, slight

changes of osteoarthritis were seen in three patients, and subchondral osteosclerosis and local osteoporosis was noticed in two other patients (Table 1 and Figs. 3 and 4). The defect in the condylar articular surface was roentgenologically found to be filled out totally with calcified tissue in 90% of the cases and partly in the remainder. The fragment had united to the bed after 2–6 months in all cases but one, which at first created a pseudarthrosis, but later after 9 months proved to be totally united. In 16% of the cases operated on, the reduction of the fragment was not exact and showed incongruity with the condylar surface. In the other cases, no kind of fragment dislocation was recorded.

**Table 1.** Radiological findings recorded at follow-up after transfixation of osteochondritic fragments of the femoral condyle of 31 adolescent and adult patients

	General signs			State/Lesion			State/Fragment			State/Bone peg		
	Young	Adults	% of total	Young	Adults	% of total	Young	Adults	% of total	Young	Adults	% of total
Local osteoporosis	—	2	6									
Subchondral osteosclerosis	—	3	9									
Slight secondary osteoarthritis	—	3	9									
Loose bodies	—	4	12									
Totally filled out				10	18	90						
Partly filled out				—	3	10						
United after 2–6 months				10	20	97						
United after 9 months				—	1	3						
Non-union				—	—	0						
Congruent with joint surface							10	16	84			
Dislocation of fragment							—	5	16			
Joint surface of fragment:												
smooth							9	12	68			
depressed							1	5	19			
raised							—	4	13			
Resorption of distal cortical ends												
totally										10	17	87
partially										1	3	13
Visualization of cortical pins in condylar metaphysis										8	14	71

In 68% of the cases, the joint surface was smooth and congruent at follow-up. The fragment was supposed to be depressed in 19%, raised in 13%.

In 87% of the cases, the distal ends of the bone pegs impacted beneath the surface of the articular cartilage were noted to be totally resorbed at follow-up, while in the remainder, the resorption had just started.

Beneath the subchondral border of the articular cartilage the distal ends measured on X-ray showed to have a length of 1–2 mm in 32% of the cases and of 3–5 mm in three other cases. In two other cases there was a remodelling like an osteophytic process around the end of a bone peg.

In 71% of the cases followed up, the proximal ends of the pegs located in the subchondral bone of the femoral condyle were still visualized on X-ray.

## Discussion

The use of bone transplants for securing osteochondral fragments or loose bodies has been practised by the authors also to reconstruct osteochondral fractures and fragments due to osteonecrosis of other etiology [13]. The technique has been adopted and found suitable for

attaching purposes also in other joints, e.g., due to lesions of osteochondritis dissecans of the talus or in the femoral head [14].

We think that instead of excising fragments from the osteochondritic bed the fixation technique using bone transplants should always be applied. From our clinical experience as also from other studies it is well-known that, compared to other techniques, radiologically demonstrable osteoarthritic changes develop more evidently after evacuation of the articular defect [3, 15]. Furthermore, instead of simple extraction, viable loose bodies should, if possible, always be transfixed to the bed and the articular surface restored.

The transfixation technique recommended by Smillie in its genuine or other applied forms has so far been widely accepted and most frequently used by a great many orthopaedic surgeons [1, 12, 18]. However, in this operation, giving per se excellent results, the material used for the osteosynthesis (metallic pins or threads) should, according to prevailing recommendations, be extracted some months after the operation. Such additional procedures are not always accepted by the patients [16].

Conservative treatment is generally recommended for children and adolescents [15]. However, our

experience shows that, in a great many adolescents with osteochondritis dissecans, the fragments gradually get loose. Transfixation using steel nails or Kirschner wires has been practised with good success [1, 9, 16]. In our series, 15 adolescent patients with still open epiphyseal growth zones were treated using cortical bone pins for fixation taken from the tibial condyle. There followed no complications from the growth zones, and the healing proceeded just as regularly as in adults.

In adult cases, we always intended to transfix the fragments or loose bodies to their beds, if they are totally or partially located in the weight-bearing area of the condyle and, moreover, have a diameter of almost 1 cm. These prerequisites are also identical in adolescent cases.

Fragments or loose bodies with a diameter of somewhat less than 1 cm should be excised, as well as those not interfering with the weight-bearing joint surface. It is reported that an osteochondral defect in the medial femoral condyle of ponies do not heal completely at a diameter of the lesion measuring more than 9 mm [7]. On the other hand, especially in adult patients, an articular surface defect may cause the development of osteoarthritis. Children and adolescents with osteochondritis dissecans have a better prognosis in respect of secondary osteoarthritis [11].

We prefer to use fresh spongy and cortical bone for transplantation, although cortical bone pegs achieved from the bone bank are also used and recommended by others [4]. This technique has now been frequently used for 18 years, although most of the cases have been operated on during the 1970's [12, 13, 14, 15]. Re-arthrotomy or arthroscopy showed a good healing tendency of the articular surface and remodelling of the bore holes. Experiments have shown that an osteochondral body attached to the bed will be united, provided that the fixation is stabilized using differently modulated metallic pins or that the osteochondral fracture was per se considered stable, while unstable fractures or fragments developed non-union or loose bodies [2, 6].

To confirm the clinical results the authors also performed an experimental study on rabbits. The primary results gave evidence that the fragment almost always united to its bed, the fixation pins underwent remodelling, and the condylar articular surface was restored. The fracture gap in the osteochondral surface and the bore holes were filled out by fibrotic and cartilage tissue. In these experiments as well as in the clinical series the results achieved depend on the technical quality of the surgical procedure and involve absence of complications during surgery or under the healing period.

Conclusively, it may be determined that (1) by the use of the technique described full stability of the transfixed fragment can be achieved; (2) the trans-

plantation of autogen bone may per se inhibit the development of a non-union or a pseudarthrosis; (3) no re-arthrotomy or arthroscopy is needed for excising fixation material; (4) compared to techniques using metallic fixation materials, the distal ends of the bone pins in the articular surface of the fragments utmost slightly irritate the tibial articular surface; (5) no immobilization of the leg is needed, and the technique can also be adopted for the fixation of osteoarticular fragments of other origin in other joints.

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