Acta Orthop Scand 56, 457–460, 1985

Glued periosteal grafts in the knee

Periosteal grafting was performed in 4 patients with osteochondritis dissecans of the medial femoral condyle and 1 patient with osteonecrosis of the lateral femoral condyle following prednisone therapy. The lesions were drilled out deep into the cancellous bone. The periosteal graft was taken from the medial facet of the tibia and fixed to the excavated bony defect by the tissue glue Fibrinkleber Human Immuno® (Tisseel). The patients were followed clinically, by arthroscopic examination and by radiography at 3, 6, and 12 months. After 1 year the borderline between the new and surrounding cartilage was hardly visible.

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In animal experiments Rubak (1982) demonstrated that the cambium layer of periosteum contains primitive mesenchymal cells which, when placed in an articular environment, proliferate towards chondroblasts, forming hyaline-like cartilaginous tissue. Rubak et al. (1982a) have also demonstrated that deep joint-surface defects, after grafting with periosteum, fill with bony tissue lined with hyaline-like cartilaginous tissue of a thickness and on a level with the original surrounding tissue.

Our aim was to test Rubak's technique in human knee joints using a tissue glue for fixation of periosteal grafts.

Patients and methods

Case 1. A 16-year-old girl had osteochondritis dissecans of the medial femoral condyle in her right knee diagnosed radiographically 4 years ago. She had been treated by a relieving and sparing regime, but she now complained of intermittent pain, a limp, and recurrent episodes of locking. At operation a 2 × 1½ cm lesion was found, which was not suitable for refixation.

Case 2. A 34-year-old man had a loose body removed from his right knee 13 years ago. During the past 18 months he had been suffering from pain on walking and a dull ache on the medial aspect of the knee. Radiography showed the sequelae to osteochondritis dissecans of the medial femoral condyle. At operation a 3½ × 3½ cm area with soft, cicatricial, fibrocartilaginous tissue was found.

Case 3. A 22-year-old woman had been treated for 8 years for osteochondritis dissecans of the medial femoral condyle of her right knee, first by fixation of the fragment, which later had to be removed because it came loose. Radiography showed sequelae to osteochondritis dissecans of the medial femoral condyle. At operation a 3 × 1½ cm area, with cicatricial, fibrocartilaginous tissue was found.

Case 4. A 30-year-old man, on getting out of a car, had sudden pain and an extension defect of his left knee joint. Radiography demonstrated an osteochondritis dissecans lesion which had become partially detached from the medial femoral condyle. At operation a 2½ × 2 cm soft, partially necrotic lesion was found.

Case 5. A 22-year-old man had been treated, 2 years previously, with prednisone after a kidney transplantation. Thereafter, he developed a localized osteonecrosis centrally on the lateral femoral condyle in his left knee. At operation a 2½ × 1 cm area with partially detached and fragmented, necrotic cartilage and bone penetrating about 1½ cm down into the underlying bone was found.

Methods

After arthroscopy the patients were selected for periosteal grafting. The abnormal cartilage on the femoral condyle was excised, and drilling of the subchondral bone was done deep down into the cancellous bone, in an area corresponding to half the diameter of the defect. The periosteal graft was taken from the medial facet of the tibia and fixed to the excavated bony surface (Figure 1) by the tissue glue Fibrinkleber Human Immuno® (Tisseel). After the operation the patients were treated by immediate intensive quadriceps training and full weight-bearing. Elbow crutches were used during the first 2

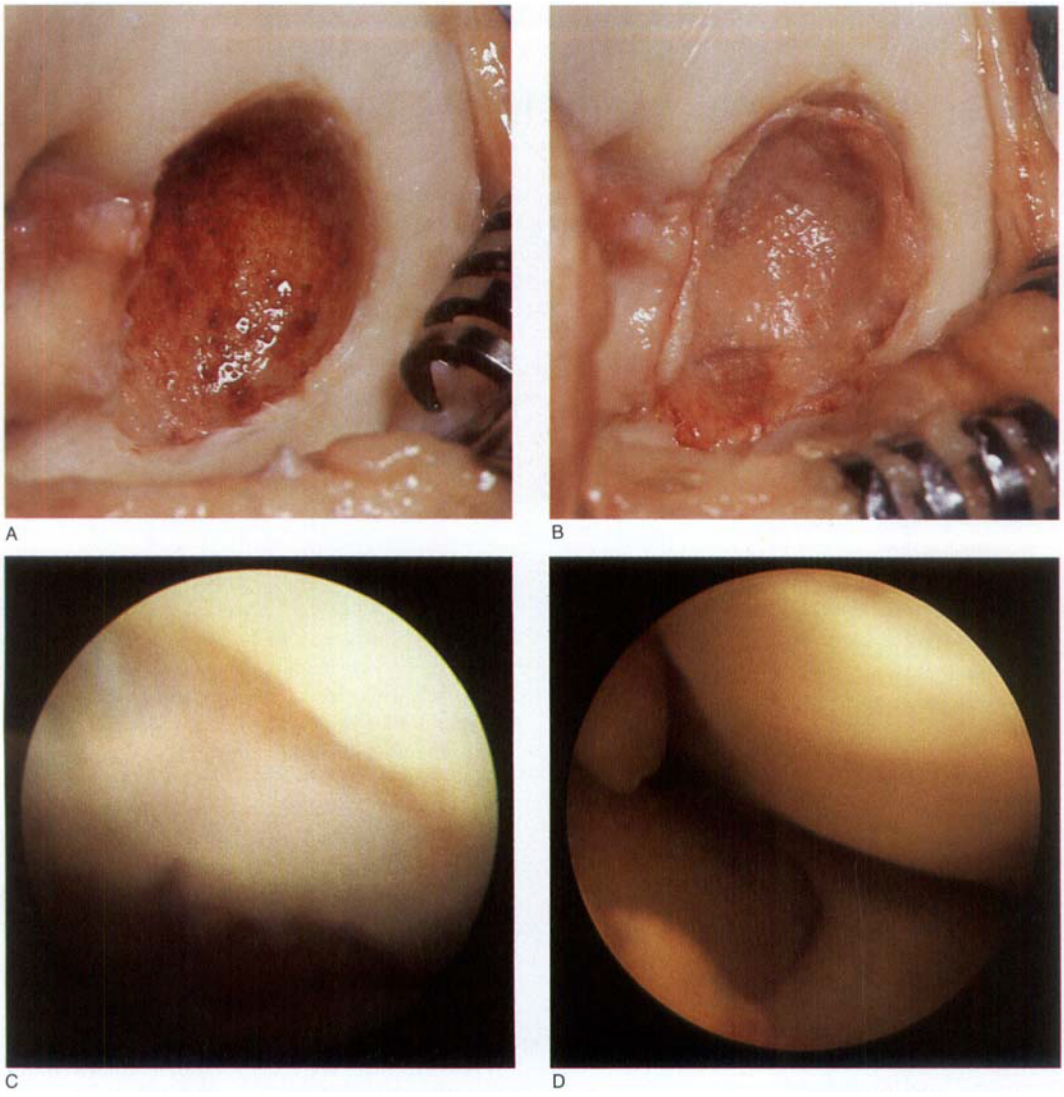

Figure 1. Case 2. A 34-year-old man with ostechondritis dissecans in the right knee. Loose body removed 13 years ago.
A. The defect in the medial femoral condyle after drilling through the subchondral bone and deep into the underlying cancellous bone.
B. The periosteal graft fixed with Fibrinkleber Human Immuno® to the drilled, excavated bony defect on the medial femoral condyle.
C. Arthroscopic appearance 3 months after the periosteal grafting. The defect is covered with a thin greyish tissue membrane. Centrally in this membrane there is an opening through which the bony defect could be seen to be filled with rough, reddish, shiny masses of bone.
D. Arthroscopic appearance 12 months after the periosteal grafting. The new cartilage glistens with a mother-of-pearl hue, and the borderline between the new and the original surrounding cartilage is hardly visible.

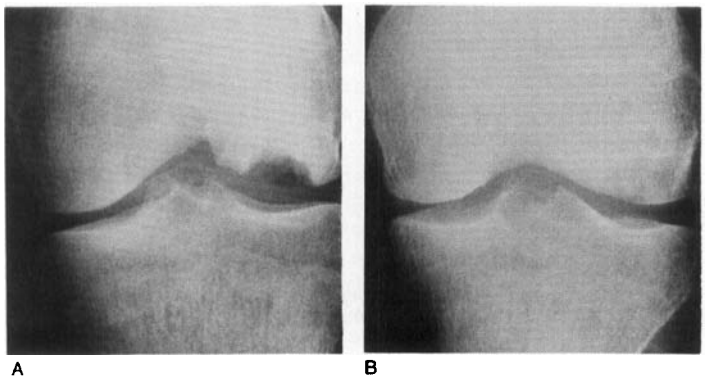

Figure 2. Case 5. A 22-year-old man with osteonecrosis 2 years after kidney transplantion.
A. Immediately after excision of the necrotic bone in the lateral femoral condyle, drilling, and periosteal grafting.
B. 2 months after the periosteal grafting. The defect in the femoral condyle has now filled with bony tissue, and the contour of the subchondral bone is at the level of the surrounding subchondral bone.

weeks until the sutures were removed. The patients were seen for clinical, radiographical, and arthroscopic examinations 3, 6, and 12 months after the operation.

Results

The arthroscopic appearance was exactly similar in all patients after 3, 6, and 12 months. Radiographic examination after 3 and 6 months showed increasing osseous consolidation of the defect; after 12 months it had completely filled with bone (Figure 2).

One year after the operation all the patients had a normal range of motion. All, except for one who still had some dull pain in the knee, were free of pain and had good muscular function and strength. However, one still had 1 cm quadriceps atrophy. There was no swelling or effusion after the first 3–4 postoperative weeks.

After 3 months arthroscopy showed the defect to be covered with a thin, greyish membrane on a level with the surrounding cartilage. Rough, reddish, shiny masses of bone almost filled the original bony defect (Figure 1).

After 6 months the defect was covered with a thick layer of cartilage, somewhat rough and uneven on the surface and at the level of the surrounding cartilage. Using a hook, it was possible to see, through the arthroscope, that the new cartilage was softer than normal.

After 12 months it was hardly possible to discern, using the arthroscope, the borderline between the surrounding and the new cartilage which had acquired a mother-of-pearl shine, and which now seemed to be just as hard as the surrounding cartilage (Figure 1).

Discussion

Rubak's (1982) studies were performed on rabbit knee joints in which hyaline-like cartilaginous tissue was demonstrable histologically as early as 8 weeks after the operation. This process appears to be slower in human joints. In our investigation histological examinations were not done, since we did not like to disturb the process by taking biopsies. Besides, we attached more importance to the macroscopic arthroscopic appearance and testing with a hook, as a histological finding of hyaline cartilaginous tissue is not tantamount to the biomechanical properties. However, Ritsilä et al. (1980, 1981) have carried out a few reconstructions of joint-surface defects on human patellae, femoral condyles and metatarsophalangeal joints and found histological evidence of hyaline cartilaginous tissue after 1 year.

According to Poussa et al. (1980) the new formation of bone from a periosteal graft need not necessarily be through an enchondral process. A vascular environment with a high oxygen tension seems to promote a direct new formation of bone. The vascular, cancellous bone at the bottom of the drilled-out bony defect possibly exerted such a potentiating effect in our study. On the other hand, the low oxygen tension and the articular environment in general at the surface of the defect seem to facilitate new formation of cartilage.

The importance of joint motion in the healing of cartilaginous lesions has been demonstrated by Salter et al. (1975) and Rubak et al. (1982b). In our opinion, the conditions for an optimal articular environment are multifactorial, including the extremely important factor, weight-bearing. We therefore, aimed at active as well as passive mobilization of the knee joint, intensive training of the quadriceps muscle, and full weight-bearing immediately after the operation.

In recent years a new biological "tissue glue" has been developed on the basis of highly concentrated human fibrinogen (Tisseel). This tissue glue has proved its usefulness within many fields of surgery, and a number of publications bear witness to its clinical applicability (Bösch et al. 1977a, Kirkegaard et al. 1982, and Osgaard 1984). In addition to its adhesiveness, this tissue glue has a haemostatic effect (Bösch et al. 1977b) which in the present study may have prevented haematoma formation beneath the periosteal graft. Towards the end of the operation the bloodless field was abolished, and the graft was observed. Haematoma formation beneath the graft was not observed in any case.

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