

## RAPID MALIGNANT TRANSFORMATION OF PRIMARY SYNOVIAL CHONDROMATOSIS INTO CHONDROSARCOMA

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**Chondrosarcoma of the synovium is rare. It may arise de novo from the synovium or pre-existing synovial chondromatosis may undergo malignant transformation into chondrosarcoma. Diagnosing a malignant transformation of the synovium remains a big challenge. It is based on the correlation of clinical findings, imaging and histology, as illustrated in this case report.**

**Key-word:** Bone neoplasms, MR.

### Case report

A 45-year-old woman presented with recurrent swelling, pain and stiffness of the left knee. Initial plain radiography depicted small round and oval radio-opaque fragments within the joint as well as joint effusion. No osteophytes, subchondral sclerosis or other signs of osteoarthritis were seen (Fig. 1). MR imaging demonstrated in detail the synovial changes and suspected the presence of loose bodies. T2-weighted images (WI) showed multiple, round synovial nodules with

low-to-intermediate signal intensity in the popliteal fossa and in the posterior intercondylar fossa as well as joint effusion (Fig. 2A-B). Some of the nodules enhanced after intravenous (IV) Gadolinium contrast administration (Fig. 2C). Two months later an arthroscopic synovectomy was performed. Histologically, the diagnosis of synovial chondromatosis was made.

Within the following 2 months, the clinical symptoms of the patient aggravated and malignancy was suspected on subsequent follow-up MR examination. Despite the arthros-

copic synovectomy, there was a recurrence of multiple intra-articular nodules of low-to-intermediate signal intensity on T2-WI. The extracapsular retrotibial nodules as well as the supracondylar retrofemoral nodules recurred and clearly increased in size and were of a higher signal intensity (Fig. 3A). Multiple new nodules of low-to-intermediate signal intensity on T2-WI appeared in the lateral and medial parapatellar pouches (Fig. 3B-C). Joint effusion and soft tissue extension were also detected (Fig. 3A). Consequently, an open total synovectomy and capsulectomy were performed. Again, histology confirmed the diagnosis of synovial chondromatosis.

Follow-up plain radiographs three months after this surgery depicted joint destruction with obliteration of the joint line and subchondral bone cyst formation in the femoral condyle and the tibial plateau. Posterior subluxation of the tibia was present (Fig. 4A). MR examination showed diffuse soft tissue extension, especially posteriorly. Several areas of subchondral bone erosions and subchondral bone sclerosis were apparent (Fig. 4B). Progression of the disease to cruciate ligament caused the posterior subluxation of the tibia.

Finally, the diagnosis of low-grade chondrosarcoma was made by the interdisciplinary bone tumor commission. This diagnosis was based on the postoperative recurrence, the rapid clinical and radiological progression and the marked hypercellularity and nuclear atypia on histological examination (Fig. 5). An above-knee amputation was performed.

### Discussion

Primary synovial chondromatosis (PSC) is a non-neoplastic, proliferative and metaplastic disorder of the synovium. It is characterized by the formation of multiple cartilaginous nodules in the synovium of joints,



*Fig. 1.* — Initial lateral radiograph of the left knee. Radiopaque round calcifications in popliteal fossa (open arrow) and associated soft tissue swelling (black arrows).

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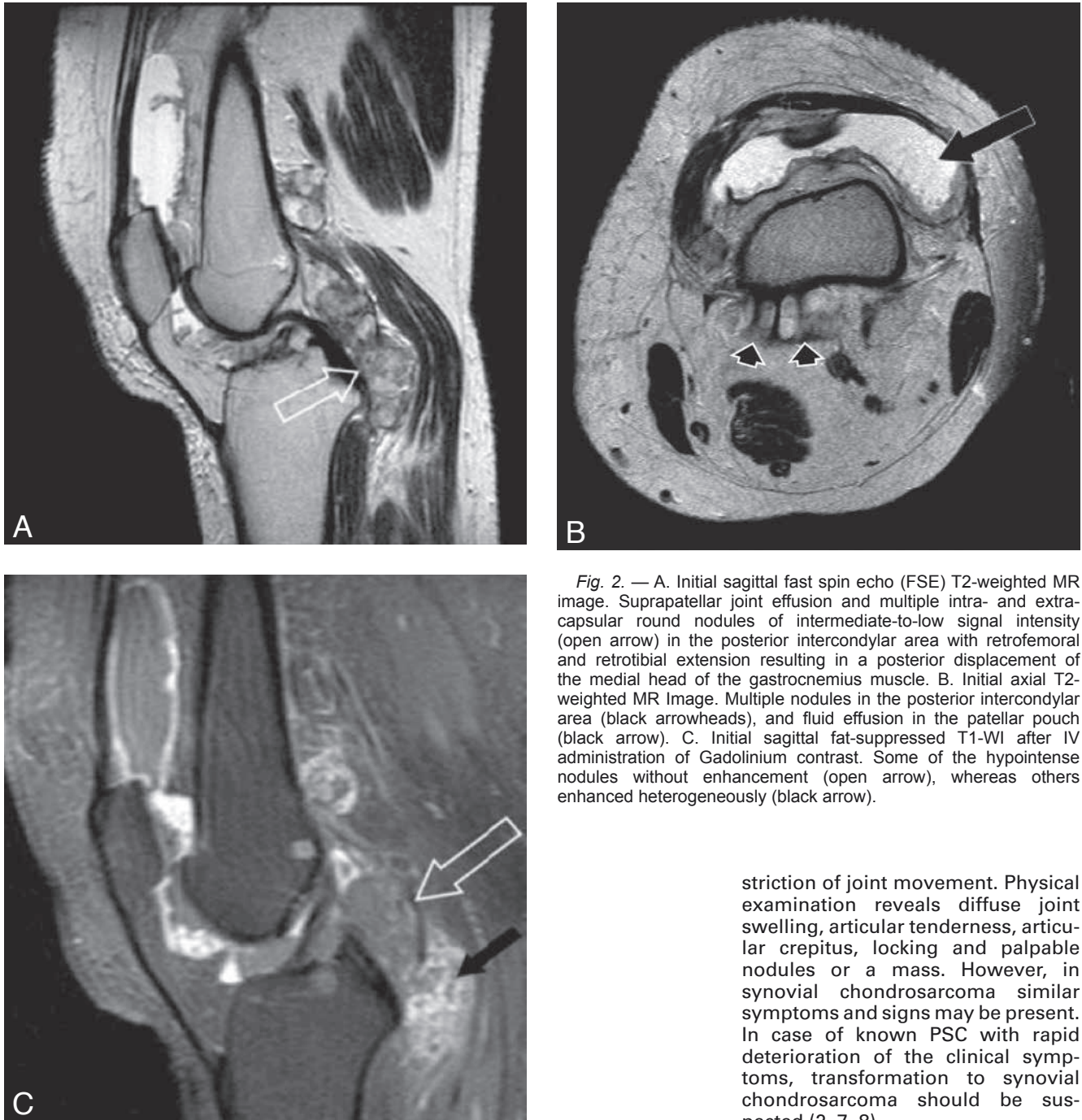


Fig. 2. — A. Initial sagittal fast spin echo (FSE) T2-weighted MR image. Suprapatellar joint effusion and multiple intra- and extra-capsular round nodules of intermediate-to-low signal intensity (open arrow) in the posterior intercondylar area with retrofemoral and retrotibial extension resulting in a posterior displacement of the medial head of the gastrocnemius muscle. B. Initial axial T2-weighted MR Image. Multiple nodules in the posterior intercondylar area (black arrowheads), and fluid effusion in the patellar pouch (black arrow). C. Initial sagittal fat-suppressed T1-WI after IV administration of Gadolinium contrast. Some of the hypointense nodules without enhancement (open arrow), whereas others enhanced heterogeneously (black arrow).

tendons and bursae (1, 2). PSC can occur in virtually every joint. The knee is the most commonly affected site, followed by the hip. Monoarticular involvement is the rule (3).

Synovial chondrosarcoma is an extremely rare condition. It may occur as a primary process or as a transformation of PSC into a low-grade chondrosarcoma. It affects patients between the fourth and seventh decades of life and is slightly more common in men than women (4, 5). Strictly spoken, if there is no documented radiological or histo-

logical evidence of pre-existent PSC, the synovial chondrosarcoma should be regarded as primary (6).

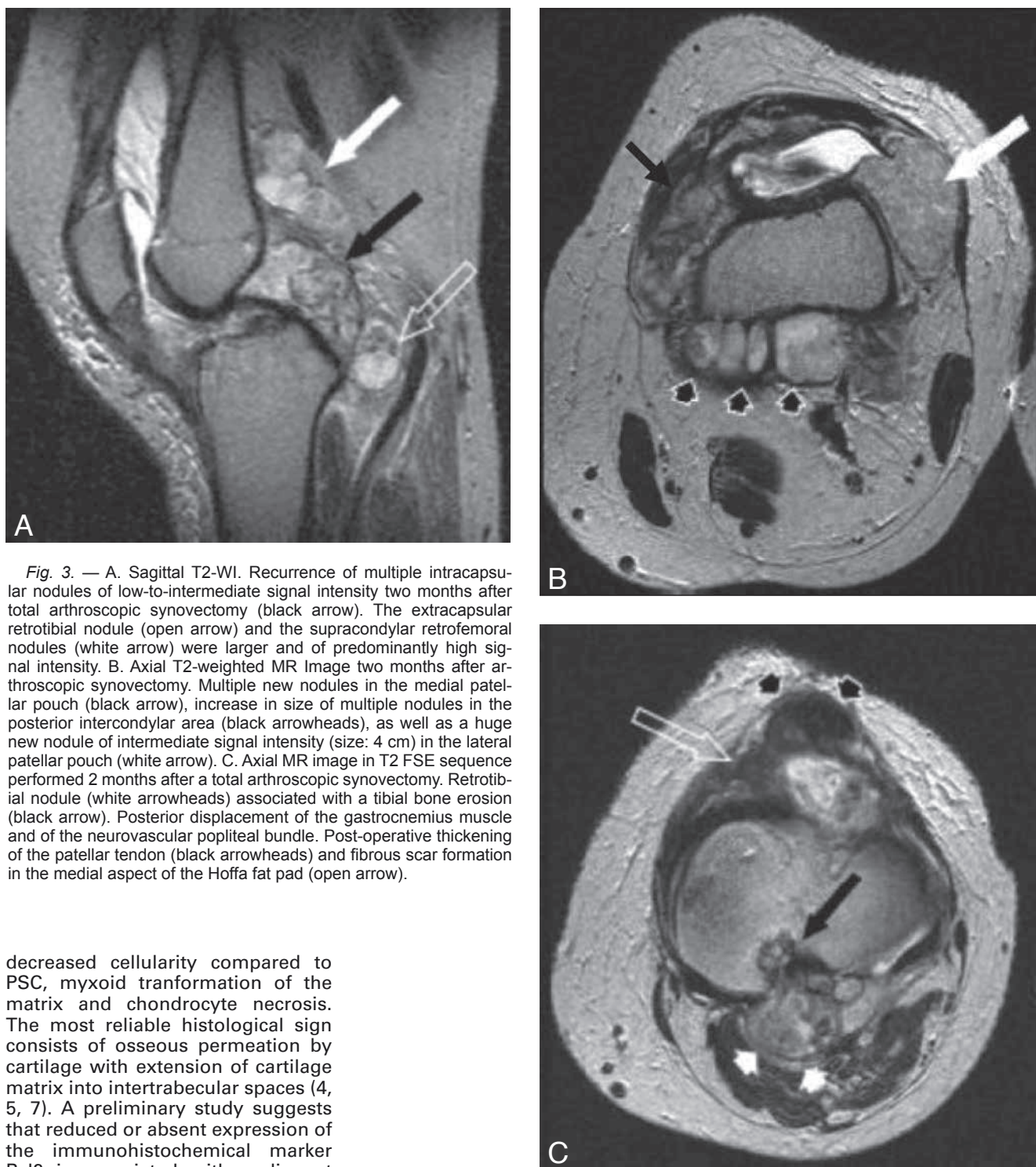
The distinction between PSC and malignant transformation is problematic, either clinically, histologically and radiologically. Therefore the diagnosis should be based on a combination of clinical, radiological and histological parameters to minimize the risk of misinterpretation of PSC as chondrosarcoma and vice versa (6, 7).

The *clinical manifestation* of PSC includes pain, joint swelling and re-

striction of joint movement. Physical examination reveals diffuse joint swelling, articular tenderness, articular crepitus and palpable nodules or a mass. However, in synovial chondrosarcoma similar symptoms and signs may be present. In case of known PSC with rapid deterioration of the clinical symptoms, transformation to synovial chondrosarcoma should be suspected (2, 7, 8).

The histological findings in PSC are variable, but in general, the degree of cellularity is fairly striking. The cartilage is hypercellular with plump hyperchromatic nuclei and binucleate forms that would be interpreted as malignant if the cartilage occurred within a bone. Despite the cellularity of chondromatosis, individual chondrocytes often have a very definite pattern characterized by arrangement into micronodular clones (4, 6, 7).

On the contrary, histological features that are in favour of a synovial chondrosarcoma include: loss of the micronodularity of the chondrocytes,



**Fig. 3.** — A. Sagittal T2-WI. Recurrence of multiple intracapsular nodules of low-to-intermediate signal intensity two months after total arthroscopic synovectomy (black arrow). The extracapsular retrotibial nodule (open arrow) and the supracondylar retrofemoral nodules (white arrow) were larger and of predominantly high signal intensity. B. Axial T2-weighted MR Image two months after arthroscopic synovectomy. Multiple new nodules in the medial patellar pouch (black arrow), increase in size of multiple nodules in the posterior intercondylar area (black arrowheads), as well as a huge new nodule of intermediate signal intensity (size: 4 cm) in the lateral patellar pouch (white arrow). C. Axial MR image in T2 FSE sequence performed 2 months after a total arthroscopic synovectomy. Retrotibial nodule (white arrowheads) associated with a tibial bone erosion (black arrow). Posterior displacement of the gastrocnemius muscle and of the neurovascular popliteal bundle. Post-operative thickening of the patellar tendon (black arrowheads) and fibrous scar formation in the medial aspect of the Hoffa fat pad (open arrow).

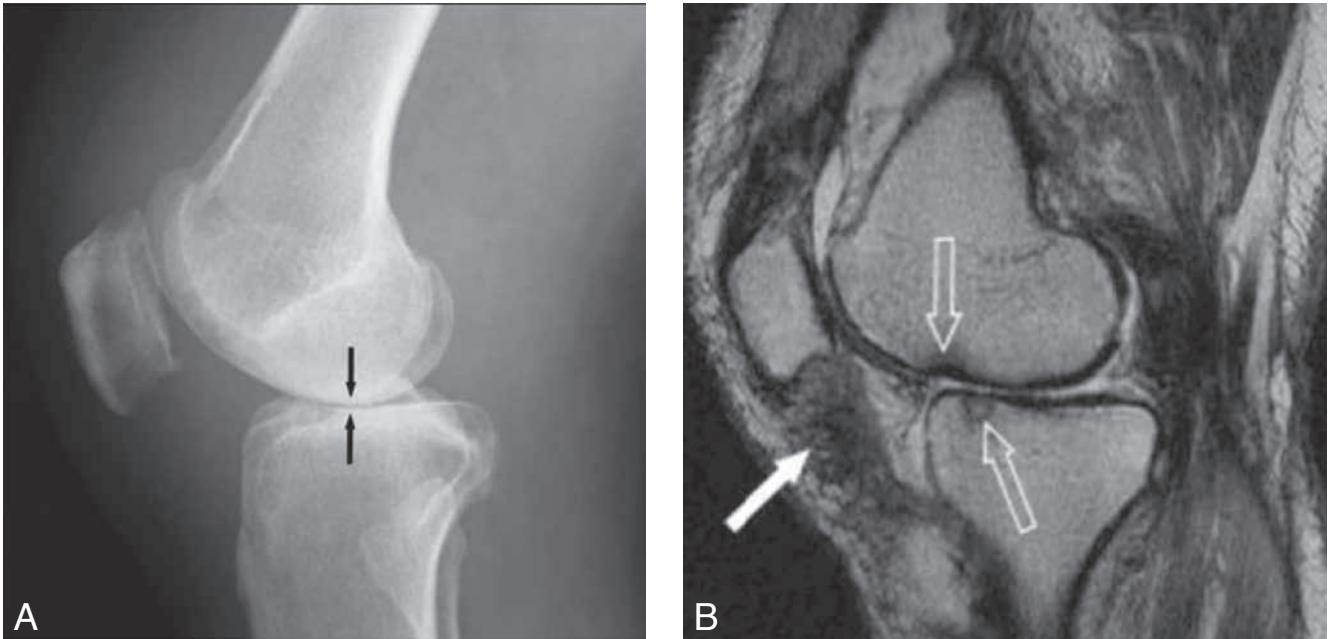
decreased cellularity compared to PSC, myxoid transformation of the matrix and chondrocyte necrosis. The most reliable histological sign consists of osseous permeation by cartilage with extension of cartilage matrix into intertrabecular spaces (4, 5, 7). A preliminary study suggests that reduced or absent expression of the immunohistochemical marker Bcl2 is associated with malignant transformation of chondromatosis (9).

The imaging techniques in differentiating PSC and synovial chondrosarcoma are conventional radiography, computed tomography (CT) and magnetic resonance imaging (MRI). A rapidly enlarging extra-articular mass and true cortical destruction with bone marrow invasion and permeation are imaging features that should be considered as potential signs of malignancy (7, 8, 11).

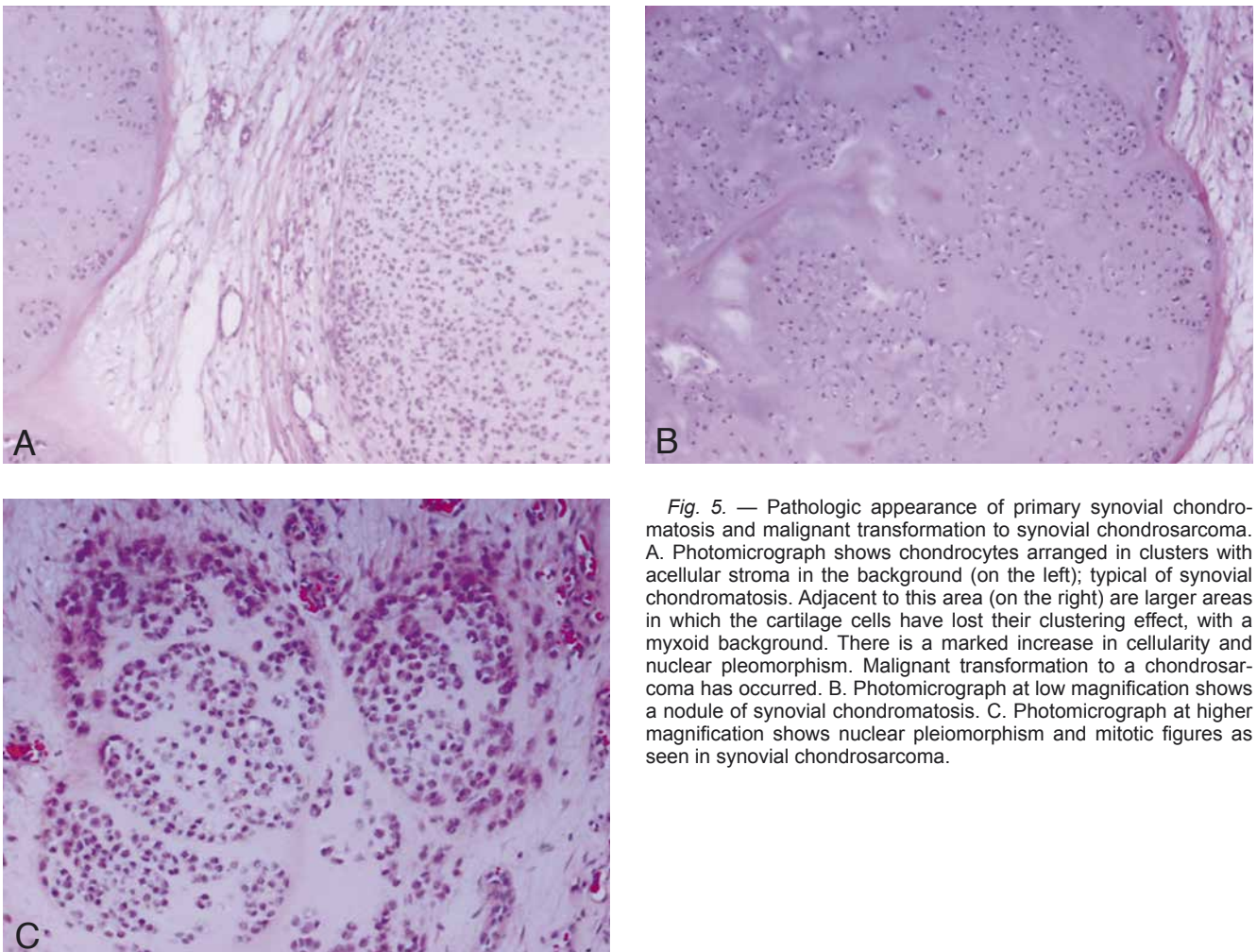
Bone scintigraphy and ultrasound have not yet been extensively evaluated.

Conventional radiography in PSC can demonstrate multiple intra-articular calcifications with a very similar shape and typically distributed evenly throughout the joint. A typical chondroid ring-and-arc pattern of mineralisation is common. Further maturation of the fragments is possible with enchondral ossification. A

target appearance is also possible, consisting of a central focus and a single peripheral rim of calcification. Joint effusion can be seen. The joint space is typically maintained, however, asymmetric joint space narrowing is possible in chronic disease (8). Extrinsic erosion of the bone, usually on both sides of the joint, has also been reported (10). In 5-30% of patients with PSC radiography can be normal (3). The radiographical diag-



**Fig. 4.** — A. Lateral radiograph, 3 months after open synovectomy and capsulectomy: obliteration of the femorotibial joint line (black arrows). The popliteal loose bodies have disappeared. B. Sagittal T2-WI of the final MR examination depicted severe thinning of the articular cartilage with hypointensity of the subchondral bone with subchondral sclerosis and cyst formation (open arrows). Irregular delineation of the patellar tendon and fibrous scar formation in Hoffa's fat pad (white arrow).



**Fig. 5.** — Pathologic appearance of primary synovial chondromatosis and malignant transformation to synovial chondrosarcoma. A. Photomicrograph shows chondrocytes arranged in clusters with acellular stroma in the background (on the left); typical of synovial chondromatosis. Adjacent to this area (on the right) are larger areas in which the cartilage cells have lost their clustering effect, with a myxoid background. There is a marked increase in cellularity and nuclear pleomorphism. Malignant transformation to a chondrosarcoma has occurred. B. Photomicrograph at low magnification shows a nodule of synovial chondromatosis. C. Photomicrograph at higher magnification shows nuclear pleomorphism and mitotic figures as seen in synovial chondrosarcoma.

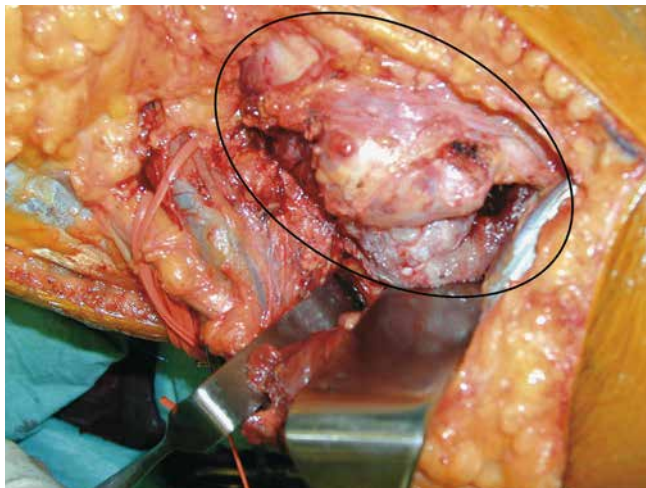


Fig. 6. — Peroperative photograph during open arthrotomy. Posterior view of the knee demonstrates a huge synovial cartilaginous mass.

nosis of malignant transformation can be difficult because of its possible radiographically similar appearances with PSC. An extensive calcified soft-tissue mass about and within the joint (with potential extension into the adjacent soft tissues) and extrinsic erosion of bone can occur both in PSC as in chondrosarcoma. However, a rapidly enlarging extra-articular mass and true cortical destruction are radiographical features that should be considered as potential signs of malignancy.

CT in PSC is superior to conventional radiography (CR) in distinguishing low attenuation synovial thickening with lobular outer contour from synovial fluid. Furthermore, CT is superior to CR in detection and characterisation of calcifications and subtle extrinsic erosion of bone. In combination with arthrography, CT may define the precise location of the chondral nodules (intra-articular, bursal, tenosynovial) (3, 8, 12). The potential signs of malignancy on CT are similar to those on CR.

MRI in PSC can provide adjacent information by depicting subtle extrinsic bone erosion, not seen on radiography. Peripheral and septal contrast enhancement may be seen in the nodules (8). MRI may subdivide PSC in three subtypes according to the classification of Kramer et al. (13). The most frequent pattern consists of intra-articular lobules of homogeneous intermediate signal intensity similar to muscle on T1-WI, high signal intensity on T2-WI

images and intralesional areas of low signal intensity on all pulse sequences. The areas of signal void may correspond to regions of calcification on radiographs or CT scan and are more conspicuous on gradient-echo MR images owing to magnetic susceptibility effects. The second most common subtype is similar, except for the absence of focal intra-articular areas of low signal. No calcifications are seen on corresponding radiographs or CT. The third pattern has features similar to those of the other patterns but also includes high-signal-intensity foci, iso-intense relative to fat with a peripheral rim of low signal intensity.

MRI is superior to CR and CT for the assessment of bone marrow invasion as a potential sign of malignancy (14).

### Conclusion

The most important features that would suggest malignant transformation of PSC into low-grade chondrosarcoma are: a rapid increase in size of the lesion, a rapid clinical deterioration, cortical destruction on radiography and medullary invasion on MRI. In these cases biopsy may contribute to the correct diagnosis.

From a surgical point of view, any patient with recurrent synovitis of the knee and difficult histological differential diagnosis between synovial chondromatosis and chondrosarcoma, should be suspected of having

co-existing chondrosarcoma or malignant transformation to chondrosarcoma. A multidisciplinary discussion is required, as the definitive diagnosis can only be made on a combination of clinical, radiological and histological criteria.

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