ANTEROMEDIAL OSTEOARTHRITIS OF THE KNEE

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Medial tibial plateaux excised during 46 unicompartmental arthroplasties for osteoarthritis were collected and photographed. The anterior cruciate ligament was intact in all joints. In every case the cartilage and bone erosion was centred anteriorly on the plateau and the posterior cartilage was intact. The site of the lesion and the intact state of the cruciate ligaments taken together explain why varus deformity was observed only in the extended knee, and why the deformity was correctable and had not become fixed.

Failure of the anterior cruciate ligament may allow the erosion to extend posteriorly, producing fixed varus deformity and leading to degeneration of the lateral compartment.

Anteromedial osteoarthritis is a distinct clinicopathological entity; its radiographic features enable it to be diagnosed from lateral radiographs; its anatomical features render it suitable for treatment by unicompartmental arthroplasty.

The pathological specimens described in this study became available because of our practice of performing unicompartmental arthroplasty rather than tibial osteotomy in the treatment of elderly people with painful varus knees (Goodfellow et al 1988). We could observe the exact site and extent of the joint erosions and relate them to the state of the cruciate and collateral ligaments.

The physical signs of anteromedial osteoarthritis can be explained if the state of the ligaments are considered as well as the extent and location of the articular surface erosions.

METHODS AND FINDINGS

The tibial plateau – morbid anatomy. In this prospective study, the medial tibial plateaux excised during 46 unicompartmental arthroplasties for primary osteoarthritis were collected and photographed. All the joints fulfilled our anatomical criteria for medial unicompartmental arthroplasty:

1) The articular cartilage in the medial compartment of the knee was eroded at least down to the subchondral bone and usually beyond (stages 2, 3 and 4, Ahlbäck 1968).
2) The articular cartilage in the lateral compartment was preserved in its full thickness. Fibrillation was not a contra-indication and even localised areas of ulceration were sometimes accepted.
3) Anteroposterior radiographs of the knee stressed into valgus showed correction of the varus deformity.
4) The anterior cruciate ligament was intact as observed at surgery.

For descriptive purposes the tibial plateau was divided transversely into four zones, A, B, C and D, from front to back. The anterocentral zone (B) was most often involved. The lesion seldom extended to the posterior zone, and never reached the posterior joint margin (Fig. 1).

The site of the deepest point of erosion in each knee is shown in Figure 2; in no case did it lie behind the midpoint (B/C) of the tibial plateau.

Lateral radiographs. In all cases, pre-operative lateral radiographs were available and were studied independently of the pathological specimens to see how accurately they revealed the site and extent of the bone erosions. The medial tibial plateau was distinguished from the lateral by using the signs described by Jacobsen (1981).

The site of the deepest point of the erosion correlated well with the morbid anatomical localisation, and in no case differred by more than one zone (Fig. 2).

Clinical signs. Two physical signs were consistently observed:

1) The varus deformity was correctable in every case by application of manual stress into valgus (see Fig. 5b).
2) Varus deformity was present in the extended posture but diminished during flexion and was never visible at 90°.

Illustrative case. Several of the clinical and radiographic features of anteromedial osteoarthritis are demonstrated in the following case. The radiograph in Figure 3 was taken in 1975 when the 60-year-old patient was already suffering discomfort in both knees. She had varus deformities with loss of both medial joint spaces and early bone erosion (Ahlbäck stage 3). No surgical treatment was undertaken.

Figure 4 shows the photographic and radiographic appearances 12 years later, in 1987, when the varus deformities had progressed.

The photograph in Figure 5a was taken on the same day as that in Figure 4a, and demonstrates the patient's ability to correct the varus deformities actively by bracing her knees together. The radiograph (Fig. 5b) which matches the photograph was made with the knees held in the manually corrected position (Gibson and Goodfellow 1986).
Photograph (a) and radiograph (b) of the patient shown in Figure 3, 12 years later.

Photograph taken the same day as that in Figure 4a showing the patient's ability to correct the varus deformities actively by bracing the knees together; and (b) a radiograph, made with the patient's knees held together manually in the corrected position.

The varus deformities shown in Figure 5a disappeared when the patient sat with her knees flexed to 90°. This is explained by the lateral radiographs (b), which show that when seated, the medial femoral condyles roll on to the intact posterior parts of the tibial plateau.
Figure 6a shows that when the patient was seated with the knees flexed to 90° the varus deformities were no longer apparent. The lateral radiographs (Fig. 6b), show that the medial femoral condyles have rolled backwards out of the anterior erosions and lie on the undamaged posterior parts of the plateaux.

![Image](image_url)

**Fig. 7**

The same patient's right knee at operation. The anterior cruciate ligament is well preserved as is the lateral tibiofemoral compartment. There is a deep erosion into the anterior part of the medial tibial plateau. In this flexed position the medial femoral condyle has rolled backwards out of the deep depression on to the preserved cartilage of the back of the plateau.

Figure 7 shows the right knee at operation. The anterior cruciate ligament was intact and the articular cartilage of the lateral compartment was well preserved. Medially, there was a deep erosion of the anterior part of the tibial plateau. The left knee was similar.

All the features illustrated by this case were recorded in the 46 knees whose tibial plateaux we have described, though few of them had such deep erosions or such severe deformities as this example.

**DISCUSSION**

Previous descriptions of the morbid anatomy of osteoarthritis of the knee have depended either upon post-mortem examinations or on the interpretation of radiographs.

The post-mortem studies (Heine 1926; Keyes 1933; Bennett, Waine and Bauer 1942) were concerned with non-symptomatic degenerative changes which affect the population at large and have shed little light on the pathomechanics of symptomatic osteoarthritis of the knee.

In contrast, Ahlbäck's radiological study (1968) was based on 370 knees with clinical osteoarthritis. In 85% of these joints he found that radiographic evidence of degeneration was limited to only one compartment, the medial joint space being affected 10 times more often than the lateral. He defined five grades of joint degeneration from narrowing of the joint space through to articular subluxation. The natural history of the arthritic knee was reported by Hernborg and Nilsson (1977). They studied the radiographs of 94 symptomatic joints and found that in 90% the radiographic lesions were exclusively medial and rarely progressed to involve the lateral compartment when followed over many years.

Very few observations have been made on the radiographic appearance of the lesions of osteoarthritis of the knee in the sagittal plane. Indeed, Altman et al. (1987) dismissed lateral radiographs as having little significance. We have shown that it is possible to determine accurately the site and the extent of tibial plateau erosions from the lateral radiographs.

We have found no previous study of the morbid anatomy of tibial lesions in symptomatic osteoarthritis of the knee, and have shown that the tibial erosion in medial unicompartmental osteoarthritis (if the anterior cruciate ligament is intact) is situated in the anterior part of the plateau. Its extent varies with the severity of the disease but in no case did it extend to the posterior margin of the plateau. The combination of an anterior erosion and an intact cruciate mechanism offers a logical explanation for the clinical signs:

1) The anterior position of the articular surface erosion explains why the varus deformity is present in extension and not in flexion. The intact cruciate ligaments, acting with the preserved articular surfaces of the lateral compartment, together oblige the medial femoral condyle to roll back in flexion, out of the anterior depression and onto the intact cartilage of the posterior tibial plateau (Fig. 6b).

2) Therefore, each time the patient flexes the knee, the medial collateral ligament is stretched out to its proper length. This explains why the varus deformities remained correctable by manual stress and why no soft-tissue release was required at operation in any of our cases. In the case illustrated here, this mechanism maintained the medial collateral ligaments at their normal lengths for at least 12 years of demonstrable varus deformity (Figs 5 and 6).

We propose the term 'anteromedial osteoarthritis of the knee' for the distinct clinicopathological entity described. The clinical picture, the radiographic and anatomical findings, and the suitability for unicompartmental arthroplasty all distinguish these cases from the other group of varus osteoarthritic knees in which both compartments of the joint are involved, fixed deformity is commonly present and total replacement is the appropriate surgical treatment.

We suggest that the orderly movement of the femur on the tibia in flexion and extension protects the joint with anteromedial osteoarthritis from developing fixed deformity. Therefore the factor which determines whether a particular knee deteriorates from unicompartmental to general degeneration may be the state of its...
anterior cruciate ligament. This hypothesis would accord with our findings and those of Hernborg and Nilsson (1977).

Furthermore, it would explain why secondary involvement of the lateral compartment after medial unicompartmental arthroplasty is rarely seen (Marmor 1979; Scott and Santore 1981; Shurley et al 1982; Bae, Guhl and Keane 1983; Inglis 1984; Knutson, Lindstrand and Lidgren 1986; Cartier and Cheaib 1987; Deschamps and Lapeyre 1987; Goodfellow et al 1988). Timely correction of the varus deformity by prosthetic replacement of the eroded medial plateau before the cruciate ligament has stretched or ruptured should protect that structure and, if our conjecture is correct, protect the lateral compartment from degeneration.

Conclusions. The pattern of cartilage and bone erosion in medial unicompartmental osteoarthritis, with an intact anterior cruciate ligament, constantly spares the posterior part of the tibial plateau. The site and extent of the erosion can be determined from lateral radiographs which may be diagnostic of anteromedial osteoarthritis of the knee.

The authors would like to thank Mr Paul Cooper who meticulously photographed each specimen.

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REFERENCES


