MENISCAL PATHOLOGY AND OSTEOARTHRITIS OF THE KNEE

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The relationship between meniscal tearing and degenerative joint disease was studied by macroscopic examination of 115 knees at necropsy. The incidence of meniscal pathology was 57 per cent. There was no overall difference in the severity and distribution of tibiofemoral degeneration, whether the meniscus was torn or normal. We found little evidence that degenerative meniscal tears cause osteoarthritis or vice versa.

Until recently, the importance of the menisci was unrealised. Fairbank in 1948 stated that the menisci transfer a significant proportion of the load across the knee joint. Subsequent work has emphasised the functions of the menisci and counselled against their unnecessary removal (Johnson et al. 1974; Seedhom, Dowson and Wright 1974; Shrive 1974; Maquet, Van De Berg and Simonet 1975; Walker and Erkman 1975). In 1942 Bennett, Waine and Bauer noted fibrillation in the area of the knee that "lacked the protective covering of the meniscal ring" and also meniscal fraying in subjects who died in their second decade, although such changes were unusual until the fifth decade of life. Fairbank (1948), Jackson (1968), and Johnson et al. (1974) have shown that degenerative arthritis may commonly follow meniscectomy. The co-existence of severe osteoarthritis with untrorn menisci and vice versa was mentioned by Noble and Hamblen in 1975. They also showed the common occurrence of degenerative lesions of the posterior horn of the meniscus in middle age and later. However, Dandy and Jackson (1975) have made a plea for the early diagnosis and removal of "damaged menisci" to prevent articular cartilage damage and this attitude is expressed by Smillie (1971), Wilson (1976) and Turek (1977). The principal of "If in doubt take it out" persists and accordingly many normal menisci may be removed unnecessarily, as Noble and Erat (1980) have shown.

Despite the increasing practice of arthroscopy, many orthopaedic surgeons are still concerned about leaving a tear of the posterior third of the meniscus, fearing that it may lead to osteoarthritis. Moreover, the use of arthroscopy is unlikely to be universal in the foreseeable future and not all authors have found at arthroscopy that arthroscopic diagnosis was more accurate than that based upon clinical features (Gillies and Seligson 1979).

The 98 per cent accuracy in the diagnosis of a torn meniscus reported by Ireland, Trickey and Stoker (1980) with the combination of arthrography and arthroscopy does not entirely solve the problem. We share Goodfellow's (1980) view that even if meniscal tears are detected with 100 per cent accuracy, it does not follow that they are necessarily the cause of the patient's symptoms.

What is the incidence of osteoarthritis in knees with meniscal lesions, and is that incidence higher than the incidence in knees where the meniscus are normal? Also what evidence is there that meniscal lesions do lead to osteoarthritis? In an attempt to answer these questions, we studied the relationship between meniscal lesions and degenerative joint disease in 115 knees from amputation or necropsy subjects.

MATERIAL AND METHOD

One hundred and fifteen knees from subjects of necropsy or from amputated limbs were examined for osteoarthritic changes and meniscal pathology; the causes of death were those randomly found in a general hospital and the amputated limbs had been removed because of peripheral vascular disease. Fifty-three per cent of all the subjects were under the age of 65 years and 61 per cent were men. There was no evidence of significant ligamentous insufficiency in the 115 knees. The degenerative changes of the articular surfaces were examined by the naked eye for the following three grades of lesion: fibrillation of the superficial layer without apparent depression of the articular surface (this change was highlighted using Indian ink, as described by Meachim in 1976); erosion of the superficial layers of articular cartilage (but not down to bone); and gross osteoarthritic changes, that is loss of articular cartilage with bone. Osteophytes were frequently noted, but were not used to ascribe articular lesions to any one of these grades.

The tibiofemoral articulation was divided into four areas. On the femoral side, the area that articulated with the meniscus was called '"runner", whereas the remainder was called "notch". On the tibial side, the articular surface beneath the meniscus was referred to as the "submeniscal area", while the remainder was the "mesial area". The meniscal pathology was described in the manner used previously by Smillie (1978) and by Noble and Hamblen (1975).

The tibiofemoral articulation in those knees where the meniscus was abnormal was compared with those where it was normal. The incidence of degenerative changes when the meniscal tear was stable was compared with those when it was unstable. It was considered unstable if the torn meniscus, or part of it, could be displaced towards the joint centre, thus interfering with the smooth tibiofemoral movements. When meniscal and articular lesions co-existed in the same tibiofemoral compartment it was noted whether the two lesions were anatomically related to or were remote from one another.

Two knees were encountered that had previously undergone surgical medial meniscectomy.
RESULTS

Tibiofemoral joint changes. The incidence and distribution of fibrillation and erosion of the tibiofemoral articulation are shown in Figures 1 and 2 respectively. Fibrillation in the mesial area was present in 98 per cent of medial compartments and in 93 per cent on the lateral side. All seven per cent of the lateral plateaux without mesial fibrillation were the seat of a discoid meniscus (Fig. 3).

The overall incidence of submeniscal fibrillation and/or erosion on the lateral side was 67 per cent, as compared with 18 per cent on the medial side. This was largely due to changes beneath the posterior third of the lateral meniscus. Fibrillation was frequently (39 per cent) found beneath the most posterior part of its undersurface, just before it became attached to the tibia (Fig. 4). In 28 per cent of tibiae there were discrete erosions, like pits, in that position (Fig. 5). In the notch area fibrillation was much more common than erosion and either of these changes were four times as common on the lateral aspect of the medial condyle than they were on the medial aspect of the lateral femoral condyle. An early example of notch fibrillation is shown in Figure 6.

The changes in the runner area were equally distributed on both femoral condyles, and the incidence of fibrillation and erosion were similar (eight per cent and 10 per cent respectively).

Meniscal pathology. The overall incidence of meniscal pathology in one or both menisci was 57 per cent. Both menisci were abnormal in 17 per cent of the knees and the medial meniscus was abnormal in 38 per cent of the knees, and the lateral in 28 per cent. The details of meniscal pathology are illustrated in Table I, from which it is seen that the meniscal pathology in this study consists almost entirely of horizontal cleavage lesions.

Figure 1—Tibiofemoral joint fibrillation in 115 knees. Figure 2—Tibiofemoral joint erosion in 115 knees. Figure 3—Mesial fibrillation found on the medial side only (highlighted by Indian ink); a discoid meniscus was found on the lateral side.

Figure 4—Erosion and fibrillation beneath the posterior third of a normal lateral meniscus. Figure 5—Two discrete pits beneath posterior third of a lateral meniscus. Figure 6—Early notch fibrillation.
**Notch changes.** Erosion with or without fibration of the notch area of the medial femoral condyle was encountered in 54 per cent of the 115 knees (Figs 1 and 2). The medial meniscus was abnormal in only 34 per cent of those knees where notch changes were observed, an incidence which was slightly lower than the overall incidence of abnormal medial menisci (38 per cent) in the series (Table I).

**Runner changes.** There was fibration with or without erosion of the runner areas in 36 per cent of knees (Figs 1 and 2). Only 33 per cent of these were associated with an abnormal meniscus and only 31 per cent of all the cases with a torn meniscus had runner changes associated with them.

**Changes beneath the posterior third of the lateral meniscus.** Although either fibration or erosion was found beneath the posterior third of the lateral meniscus in 67 per cent of the knees (Figs 1 and 2), the meniscus was abnormal in only 25 per cent of these cases, which is very similar to the overall incidence of an abnormal lateral meniscus in the entire series (28 per cent; Table I).

### Table I. Meniscal pathology

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Medial (per cent)</th>
<th>Lateral (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior HCL*</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Posterior HCL</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Total meniscus HCL</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>HCL and parrot-beak tear (unstable)</td>
<td>15 (10)</td>
<td>5 (1)</td>
</tr>
<tr>
<td>Bucket-handle tear</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Discoid meniscus</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Total pathology</td>
<td>38</td>
<td>28</td>
</tr>
</tbody>
</table>

* HCL = Horizontal cleavage lesion

**Articular status.** In the medial compartment, the articular surface was normal in only 34 per cent of those cases in which the meniscus was normal (Table II). When the meniscus was torn, the articular changes were as frequently remote from the anatomical position of the meniscus as they were adjacent or related to it (44 per cent and 42 per cent respectively). When the lateral side was similarly examined a normal articulation was found to be more common when the meniscus was torn, than when it was normal (Table III). Articular surfaces that were normal, apart from mesial fibrillation, were quite frequently found to coexist with grossly abnormal menisci (Fig. 7).

It was invariably noted in those cases of gross osteoarthritis where associated meniscal tearing had resulted in loss of meniscal substance that the articular cartilage related to the meniscal remnant was better preserved than that of the remainder of the articulation.

Gross osteoarthritic changes of the medial tibiofemoral joint were encountered in the two medial meniscectomies of this series, with complete eburnation of the tibial surfaces. However, the articular surfaces on the lateral side were much better preserved, with only fibrillated cartilage in one case (Fig. 8) and more eroded articular cartilage in the other (Fig. 9), although both the lateral menisci were the seat of large horizontal lesions.

The status of the tibiofemoral articulation in all those cases where the meniscus was normal examined (Table IV). Evidence of fibrillation with or without erosion was found in 61 per cent of the medial tibiofemoral compartments and in 71 per cent of the lateral compartments. In seven per cent of compartments a normal medial meniscus was associated with gross osteoarthritic tibiofemoral degeneration.

### Table II. Status of articular cartilage with medial menisci

<table>
<thead>
<tr>
<th>Status of meniscus</th>
<th>Articular status (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Normal</td>
<td>34</td>
</tr>
<tr>
<td>Torn</td>
<td>14</td>
</tr>
</tbody>
</table>

### Table III. Status of articular cartilage with lateral menisci

<table>
<thead>
<tr>
<th>Status of meniscus</th>
<th>Articular status (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Normal</td>
<td>28</td>
</tr>
<tr>
<td>Torn</td>
<td>33</td>
</tr>
</tbody>
</table>

**Fig. 7**

Gross horizontal cleavage lesions of both menisci associated with tibial articular surfaces that are normal apart from some mesial fibrillation.
There were only 14 (12 per cent) of the 115 knees with an unstable tear, but osteoarthritic changes related to the unstable portion were encountered in 10 of the 14 (71 per cent) and the relevant joint compartment showed normal articular surfaces in only one of the 14 (seven per cent).

**DISCUSSION**

The almost invariable finding of tibial mesial fibrillation points to the protective effect of the meniscus upon the underlying cartilage. That all the exceptions on the lateral side (seven per cent) were in cases of discoid meniscus, where the entire tibial articular surface was covered by the meniscus, lends support to this. Whereas the overall incidence of mesial fibrillation on the medial or lateral side was 98 per cent, that of mesial erosion was only seven per cent, suggesting the non-progressive nature of mesial fibrillation.

The protective function of the menisci even when they are degenerate is borne out by the consistent association, in knees with advanced osteoarthritis, of remnants of menisci with the best preserved or the greatest amount of remaining articular cartilage and also by the occurrence of bare eburnated bone in association with meniscectomies. Noble et al. (1982) have shown that damaged menisci can continue to function.

The 67 per cent of submeniscal fibrillation with or without erosion on the lateral side, as compared to 18 per cent on the medial side, was almost entirely due to changes beneath the posterior third of the lateral meniscus, the aetiology of which is still obscure. However, the incidence of meniscal pathology associated with these changes was almost identical to that in the entire series, which is hardly strong evidence for cause and effect. Similarly the finding of only 34 per cent abnormal medial menisci in the knees that showed notch changes compared with a 38 per cent incidence of abnormal medial menisci in the entire series does not support a causal relationship between osteoarthritic changes and meniscal pathology. We came to the same conclusion when we examined the significance of runner changes.

It was striking to find normal articular cartilage in only a third of the compartments containing a normal meniscus, and to discover that gross osteoarthritic changes could co-exist with a normal meniscus, whereas normal articular cartilage could be associated with marked meniscal tears. In a study combining cadaver examinations and observations at arthroscopy Casscells (1978) demonstrated that 52.5 per cent of the knees with intact menisci showed varying degrees of degeneration in the adjacent condylar surfaces. He also noted normal articular surfaces in association with torn menisci and emphasised that when articular and meniscal pathology co-existed, that of the meniscus was often much milder, suggesting that the articular lesion preceded that of the meniscus. We also found that in the knees where meniscal

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**Table IV. Status of articular cartilage with normal menisci**

<table>
<thead>
<tr>
<th>Status of tibiofemoral articulation</th>
<th>Medial (per cent)</th>
<th>Lateral (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>Fibrillation and/or erosion</td>
<td>61</td>
<td>71</td>
</tr>
<tr>
<td>Gross tibiofemoral degeneration</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>
tears co-existed with fibrillation or erosion of the tibiofemoral joint, those articular changes were situated remotely from the meniscus as often as they were related to it.

It could be argued that this study is limited in that the meniscal pathology consisted almost entirely of horizontal cleavage lesions. However, both Smillie (1978) and Noble and Erat (1980) have shown that these constitute over 50 per cent of all meniscal lesions. Moreover Zippel (1964) and Pfeil (1966) have estimated that at least 90 per cent of all meniscal tears are essentially degenerative. As few surgeons, if any, would suggest that bucket-handle tears and unstable peripheral tears do not require resection and would agree that they are easy to recognise at arthroscopy or arthrotomy, then it is tears of the posterior third about which we are concerned. Analysis of our own data (Noble and Erat 1980) shows that most tears of the posterior third are horizontal cleavage tears. As recently as 1975 Dandy and Jackson made "a plea for early diagnosis and removal of damaged menisci" in the belief that posterior tears cause chondromalacia of the femoral condyle. Unfortunately they did not identify horizontal cleavage lesions as a diagnostic entity, although at arthroscopy they found degenerative changes more frequently with posterior tears than with bucket-handle tears. However, unlike our study their material is selected; the subjects would not have had an arthroscopy unless they had pain or other symptoms. It is genuinely difficult to know whether some symptoms are due to articular changes or due to posterior horizontal cleavage lesions, whose incidence is so common that presumably not all cause symptoms (Noble and Hamblen 1975; Noble 1977).

It was only in the relatively small subgroup of 14 cases with an unstable tear that we were convinced of a causal relationship between osteoarthritic changes and a meniscal tear. It is our belief that it is those tears with loose unstable attachments or portions that obviously require resection. Otherwise we can find little evidence from this study that leaving menisci with stable posterior horizontal tears will necessarily cause osteoarthritis. By reference to the literature (Fairbank 1948; Huckell 1965; Gear 1967; Jackson 1968; Tapper and Hoover 1969; Johnson et al. 1974) and by observations of material in this study it is quite clear that meniscectomy may cause osteoarthritis.

In conclusion, there is little evidence that meniscal tears cause osteoarthritic, or vice versa, whereas it is well established that meniscectomy leads to osteoarthritis. Remnants of degenerate menisci may still have a protective effect upon the underlying articular surface. The frequent occurrence of fibrillation or erosion beneath the posterior third of the lateral meniscus merits further investigation.

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REFERENCES


