REGENERATION OF MENISCI AFTER TOTAL KNEE REPLACEMENT
A REPORT OF FIVE CASES

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Regeneration of menisci after partial and total meniscectomy has been well documented. It may also occur after polycentric knee replacement, and five such cases are described. The mature regenerated meniscus consists of a collagenous core and shows extensive cartilaginous differentiation on its surface.

Regeneration of meniscus after partial or total meniscectomy has been described (Fisher 1936; Bruce and Walmsley 1937; Smillie 1944). In man and in the experimental animal, regenerated menisci which are composed of dense fibrous tissue and which extend into the joint space from the synovial membrane have been observed after excision.

Formation of new menisci has been described after polycentric knee replacement (Wigren, Kolstad and Brunk 1978). This paper reports five cases of Manchester knee replacements which were examined at varying times after operation (from 10 days to 30 months) and in which regenerated menisci were found. The relevant clinical and operative details are shown in Table I.

CASE REPORTS

Case 1. A woman aged 66 years had a Manchester replacement carried out in December 1975, because of erosive rheumatoid arthritis of the right knee. The operation was uneventful, but shortly afterwards she developed bronchopneumonia and died 10 days later. At post-mortem the knee was examined and two menisci were found (Fig. 1). There was a longitudinal tear in the posterior part of the lateral meniscus. Histologically these menisci were composed of fibrin undergoing early

Table I. Clinical and operative findings

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Prosthesis</th>
<th>Time before exploration</th>
<th>Reason for exploration</th>
<th>Findings at exploration</th>
<th>Histology of meniscus</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>66</td>
<td>F</td>
<td>RA</td>
<td>Manchester</td>
<td>10 days</td>
<td>Autopsy. Death from bronchopneumonia</td>
<td>Medial meniscus. Torn lateral meniscus</td>
<td>Fibrin with early organisation. Inflammatory cell infiltrate</td>
<td>Conversion to Walldius arthroplasty</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
<td>F</td>
<td>OA</td>
<td>Manchester</td>
<td>10 months</td>
<td>Posterior femoral subluxation</td>
<td>Abnormal tracking, medial meniscus only</td>
<td>Collagen core. Surface cartilage differentiation. HDP fragments</td>
<td>Conversion to Sheehan arthroplasty</td>
</tr>
<tr>
<td>3</td>
<td>72</td>
<td>F</td>
<td>RA</td>
<td>Manchester</td>
<td>30 months</td>
<td>Loose medial femoral component. Increasing varus deformity</td>
<td>Grooved medial tibial component, lateral meniscus only</td>
<td>Collagen. Foci of fibrocartilage. HDP fragments with surrounding giant cell reaction</td>
<td>Conversion to Sheehan arthroplasty</td>
</tr>
<tr>
<td>4</td>
<td>64</td>
<td>F</td>
<td>RA</td>
<td>Manchester</td>
<td>29 months</td>
<td>Severe valgus deformity</td>
<td>Loose lateral tibial component. Medial and lateral menisci</td>
<td>Collagen. HDP fragments with surrounding giant cell reaction. Small amount of fibrocartilage</td>
<td>Conversion to Sheehan arthroplasty</td>
</tr>
<tr>
<td>5</td>
<td>68</td>
<td>F</td>
<td>RA</td>
<td>Manchester</td>
<td>16 months</td>
<td>Loose medial femoral component</td>
<td>Loose medial femoral component. Medial and lateral menisci</td>
<td>Not available</td>
<td>Insertion of larger femoral component</td>
</tr>
</tbody>
</table>

HDP=high-density polyethylene


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Case 1. Figure 1—Menisci after removal showing a longitudinal tear in the posterior part of the lateral meniscus. Figure 2—The meniscus consists of dilated capillaries in a loose stroma, with occasional fibroblasts and fairly numerous lymphocytes, plasma cells and macrophages (haematoxylin and eosin, ×100).

Case 2. Figure 3—The meniscus excised from the medial compartment of the knee. The gross anatomy is similar to that of a normal meniscus, with irregular projections, particularly on its convex border. Figure 4—Histological section of the meniscus showing dense fibrous tissue with cartilaginous differentiation. This cartilage shows vertical splitting and the dark outline is fibrinoid material (haematoxylin and eosin, ×30). Figure 5—Histological section showing organised fibrin at the free edge of the meniscus (top right) black granular calcified debris (centre) and apparent clefts (left and bottom). The intervening material is young fibrous tissue (haematoxylin and eosin, ×65). Figure 6—The section observed by polarised light microscopy shows that the clefts seen in Figure 5 contain brilliantly birefringent particles of high-density polyethylene (haematoxylin and eosin, ×65).
organisation with a considerable chronic inflammatory cell infiltrate (Fig. 2).

**Case 2.** A woman aged 64 years had a Manchester replacement in March 1977, for osteoarthritis of the left knee. After operation the knee was stiff and was manipulated at two weeks. The patient gradually began to complain of increasing pain in the anteromedial aspect of the knee, associated with a feeling of instability. She was examined under the image intensifier 10 months after operation and posterior subluxation of the femur on the tibia was demonstrated. When the knee was explored all the components were found to be firmly fixed, but there was a groove at the posterior part of each tibial component where the femoral components had subluxed posteriorly. A meniscoid structure measuring four centimetres by two centimetres which encircled and partly overlapped the medial tibial component and was firmly attached to the capsule at its periphery was found in the medial compartment (Fig. 3). No meniscus had been formed in the lateral compartment.

Histologically this meniscus consisted of a dense hypocellular collagenous tissue core showing fairly extensive cartilaginous differentiation on both surfaces (Fig. 4). On one surface the regenerated meniscus showed vertical splits with a thin fibrinoid covering. At the free edge of the meniscus there was a considerable amount of organising fibrin and the immediately underlying cellular fibrous tissue contained fragments of calcified debris and cleft-like spaces (Fig. 5). Polarised light microscopy showed that these clefts contained birefringent fragments of high-density polyethylene (Fig. 6).

**Case 3.** A woman aged 72 years had bilateral Manchester knee replacements for rheumatoid arthritis in 1977. Three months after operation on the right knee she developed pain and increasing varus deformity. In May 1979, because of further clinical deterioration the knee was explored. At operation none of the components was obviously loose, but both femoral runners were deeply embedded in bone and surrounded by osteophytes, which had worn two deep grooves in the medial tibial component. In the lateral compartment was a large meniscus (Fig. 7) which histologically was composed of collagen with an extensive giant cell reaction to flakes of high-density polyethylene. Occasional foci of fibrocartilage were seen.

**Case 4.** A woman aged 64 years had bilateral Manchester arthroplasties in 1977 for rheumatoid arthritis. In July 1979, because of increasing pain and valgus deformity of 40 degrees, the left knee was explored. At operation the lateral tibial component was found to be loose and displaced posteriorly. Both compartments of the knee contained menisci (Fig. 8) which were composed of collagen and fibrin, and contained a focal giant cell reaction around fragments of high-density polyethylene; a small amount of fibrocartilage was also present.

**Case 5.** A woman aged 68 years had a right Manchester arthroplasty in 1977 for rheumatoid arthritis. Before operation she had a flexion deformity of 35 degrees and a varus deformity of 20 degrees. Good correction was achieved at operation, but later radiographs showed loosening of the medial femoral component. At a revision operation in March 1979 (Fig. 9) two menisci were found and excised (Fig. 10) and a larger sized femoral medial component was substituted.

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**Fig. 7**
Meniscus excised from the lateral compartment of the right knee in case 3.

**Fig. 8**
Menisci excised from the left knee in case 4.

**Fig. 9**
Case 5. Figure 9—Photograph of the operated right knee. The medial femoral component is loose and menisci are seen in both compartments. Figure 10—Menisci excised from the right knee.
DISCUSSION

The mechanism by which these menisci have regenerated is uncertain, but no part of the normal meniscus is likely to have remained after the operation. It seems probable that the fibrinous menisci in case 1, must have been preceded by a film of blood collecting in the space between the edges of the femoral condyle and the high-density polyethylene tibial plateau. This space occurs after the Manchester replacement because the height of the femoral runner separates the edge of the femoral condyle from the tibial component. The resulting fibrin was in the process of forming fibrous tissue, but there was no evidence of fibrocartilage. The more mature menisci in subsequent cases contained definite areas of fibrocartilage arising from a dense collagenous tissue core. There was no opportunity to examine any other post-mortem specimens, but nine other knees with Manchester replacements have been explored at Harlow Wood Orthopaedic Hospital. These patients all had pain, instability, an increasing deformity, and at least one year had passed since the initial operation; no evidence of meniscus formation was found in these joints.

Menisci may form immediately after operation as suggested in case 1, but disintegrate as a result of movement during rehabilitation. But in the other cases the structures were strong enough to withstand the abnormal forces imposed by habitual subluxation or increasing deformity. It is not possible to draw further conclusions at present. However, it is of considerable interest that fibrous menisci can form after polycentric knee replacement and have the same shape as a normal meniscus. This seems to imply that after regeneration the shape of a meniscus is determined by anatomical factors.

The authors wish to thank Mr G. Newton of Derbyshire Royal Infirmary for allowing us to report cases 3, 4 and 5, and Mr J. P. Jackson of Harlow Wood Orthopaedic Hospital for permission to include case 2.

REFERENCES