CRUCIATE LIGAMENT REPLACEMENT USING A MENISCUS

AN EXPERIMENTAL STUDY

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In 30 rabbits, the medial meniscus was used to replace the anterior or posterior cruciate ligament. The changes that took place were followed in histological sections, obtained both from the area of insertion into bone and from the intra-articular part of the graft.

There was a gradual differentiation to chondroid tissue, with subsequent calcific deposition and no appearance of normal ligamentous tissue. The strength of the graft after 52 weeks was only one-quarter of that of the normal ligament. Our results do not justify the use of the meniscus to replace a torn cruciate ligament.

Numerous techniques have been described for the replacement of an acutely or chronically ruptured cruciate ligament. The various methods aim to create a substitute for the torn ligament which is strong enough to withstand considerable forces and is also fully accepted by the joint. A number of investigators have reported satisfactory results after using the meniscus as a graft (Coleman 1956; Lindström 1960; Collins et al. 1974; Tillberg 1977).

We replaced the anterior or the posterior cruciate ligament by the medial meniscus in rabbits and examined by histology the changes that took place in both the intra-osseous and intra-articular parts of the graft.

MATERIAL AND METHODS

We used 30 six-month-old New Zealand white rabbits. Under general anaesthesia with Nembutal a medial parapatellar incision was made on one hind leg. The anterior cruciate ligament was excised in 15 animals and the posterior cruciate ligament in the other 15.

The medial meniscus was then carefully mobilised,

leaving it attached by either its anterior or posterior end, depending on the ligament that was to be replaced. The free end of the meniscus was trimmed to fit in a hole in a femoral condyle and fixed by a Bunnell type of suture, using strong synthetic material.

The technique of drilling the lateral or medial femoral condyle was that described by Tillberg (1977). A Kirschner wire was used as a guide, being inserted under direct vision through the intercondylar notch, and followed by a 5 mm cannulated drill. A second hole was made with a 2 mm drill, to intersect this tunnel and leave a bridge of cortical bone.

Loops of steel wire were used to draw the meniscal sutures through the holes and allow them to be tied over the bridge of cortical bone. The tension was judged and set after examination with the knee in different degrees of flexion. Postoperatively the limb was immobilised for three weeks in a plaster front slab at 50°. The animals were killed at intervals from the fourth to the 23rd postoperative week for histological examination of the grafts.

In two animals in which the anterior cruciate ligament was replaced, one at six weeks and the other at 52 weeks postoperatively, the strength of the graft was tested and compared with that of the normal anterior cruciate ligament of the non-operated side. An Instron type of machine was used to apply a continuously increasing tensile force with the knee in extension until the graft or the normal ligament ruptured.

RESULTS

Sections from the intra-osseous part of the meniscus showed that in the first few weeks there was a gradual differentiation from fibrous to chondroid tissue (Fig. 1).

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Fig. 1

Fig. 2

Fig. 3

Intra-osseous graft. Figure 1 – At six weeks, there is extensive fibrous differentiation and cartilage cell formation. Figure 2 – At 14 weeks there is clear evidence of differentiation to chondroid tissue. The first calcific deposits are seen. Figure 3 – At 23 weeks, ossification is well advanced and numerous vessels are seen. (Haematoxylin and eosin x 8).

This change became more pronounced between four and 14 weeks (Fig. 2). At 14 weeks the first calcific deposits were seen, initiating a gradually increasing process of ossification (Fig. 3). Sections taken from the intra-articular part of the graft showed similar changes (Fig. 4) but the process was considerably slower (Fig. 5).

The graft examined for strength at six weeks failed under a tensile stress of 1 kg at its intra-osseous insertion into the femoral condyle. The 52-week-old graft failed under a tensile stress of 3 kg at its undisturbed natural insertion into the tibia. The normal anterior cruciate ligaments of both non-operated knees failed at 13 kg at the tibial insertion.

DISCUSSION

The use of the meniscus as a substitute for a torn cruciate ligament has been recommended (Coleman 1956; Lindström 1960; Smillie 1970; Collins et al. 1974; Tillberg 1977). Walsh (1972), on the contrary, had disappointing results. We have found no reports of experimental studies on the fate of the meniscal graft.

Our findings were that normal ligamentous tissue failed to develop, but that on the contrary, there was a

Fig. 4

Fig. 5

Intra-articular graft. Figure 4 – At 14 weeks there is an abundance of cells and fibrous tissue with some evidence of chondroid differentiation. Figure 5 – At 23 weeks chondroid differentiation is well advanced and calcific deposits are seen (Haematoxylin and eosin x 8).

gradual differentiation of the meniscus through a stage of undifferentiated fibrous tissue to chondroid tissue on which calcium salts were later deposited.

This process was more pronounced in the intra-osseous part of the graft. After vascular infiltration, this part of the graft became completely incorporated; while in the intra-articular part of the graft differentiation to chondroid tissue with deposition of calcium salts took 23 weeks. The strength of the grafts was also unsatisfactory, with failure at 3 kg as against 13 kg for the normal anterior cruciate ligament. The use of a meniscal graft

has the advantages of a simple technique, and lack of biological rejection, but our results, taken with the fact that the meniscus is an important element of the knee (Fairbank 1948; Jackson 1968; Johnson et al. 1974; Walker and Erkman 1975; Krause et al. 1976; Noble and Erat 1980) leads us to conclude that the meniscus is not an appropriate substitute for a torn cruciate ligament.

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