A valve

An explanation of the formation of popliteal cysts

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Popliteal and, to a lesser extent, calf cysts are a common manifestation in patients suffering from rheumatoid arthritis. They may, however, be found in association with any chronic knee effusion. Morrant Baker (1877) described cysts in the popliteal fossa and calf. Particular note was made that popliteal cysts were accompanied by knee joint pathology and that, in those subjected to dissection, a communication was found to exist between the posterior aspect of the knee and the cyst. Although a communication existed, the fluid could not be pressed from the cyst into the knee joint. Both Morrant Baker (1877) and Adams (1840) suggested that there must be a valvular opening between the cyst and the knee. Jayson and Dixon (1970) recorded the pressures obtained in the knee joint and in popliteal cysts. They found that the pressure in the cyst was always higher than that in the knee. We have injected radio-opaque dye into popliteal cysts, and have demonstrated that it does not pass into the knee joint, although the reverse is the rule.

It is thus apparent on clinical, experimental, and radiological evidence that a valvular mechanism exists between the posterior aspect of the knee joint and the popliteal cyst.

In an attempt to find an anatomical explanation for this valve-like effect, fifty unselected knees were examined *post mortem*. In nineteen of these knees a defect was found in the posterior capsule, forming a communication between the knee joint and the normally existing bursa found deep to the medial head of the gastrocnemius. This bursa often formed a composite bursa with that associated with the semimembranosus tendon—called the gastrocnemius semimembranosus bursa (Wilson, Eyre-Brook, and Francis, 1938).

The opening in the posterior capsule was constant in position. It was always found deep to the medial head of the gastrocnemius high up in the posterior capsule opposite the medial femoral condyle. On its medial side is the tendon of the semimembranosus muscle. To obtain a clear view of this opening, the

edges of which were usually smooth, the knee had to be flexed a little and the medial head of the gastrocnemius strongly retracted laterally. It is significant that in only one knee was there any evidence of macroscopic pathology, and that in none was there an indication that this opening had been produced by a rupture of the posterior capsule.

The true nature of the opening does not become apparent, however, until the posterior capsule is viewed from the inner aspect of the knee. In each specimen the posterior joint capsule was removed *in toto* and then examined as if viewed from the inside of the joint. It was seen that the opening is not just a simple communication, but that its lower aspect has a valvular arrangement (Fig. 1).

It is concluded that this opening in the medial aspect of the posterior capsule is an anatomical feature and not acquired, and that it occurs in roughly 40 per cent. of adult knees.

Discussion

The development of popliteal cysts has been subject to some controversy. Billroth (1875) and Lewin (1952) thought that they were due to true herniations. Hall and Scott (1966) and Myles (1971) thought that they were the result of synovial leaks. These explanations, however, do not fully explain the constant anatomical features of popliteal cysts. It seems more probably that, as the knee pressure rises as the result of effusion and muscular contraction, that fluid is pumped *via* the normally existing valve into the normally existing bursa. The pressures developed in the knee joint are known to rise up to ten times during muscular contraction (Caughey and Bywaters, 1963). This valvular opening allows fluid to pass into the gastrocnemius or gastrocnemius-semimembranosus bursa, but not in the reverse direction (Fig. 2).

One of two possibilities now exist. If the rise in pressure is slow or intermittent, the bursa may gradually expand and its walls may become thickened to form a popliteal cyst. If the rise in pressure is rapid, then the normally thin wall of the bursa may burst,

FIG. 1 Communication in the medial side of the posterior capsule as viewed from the inside of the knee joint. The valvular arrangement is clearly seen

(A) During movement and muscular activity the pressure in the knee joint rises and fluid passes from the joint into the bursa
(B) When activity ceases and the knee pressure falls, the fluid cannot return to the knee because of the valvular nature of the opening

FIG. 2 A mechanism to explain the formation of popliteal cysts

leading to the well-known clinical phenomenon found in rheumatoid patients who experience sudden acute pain in the back of the knee and calf, followed by tenderness and swelling. If a slow leak occurs a calf cyst may be formed.

It is significant that this valvular opening was found in 40 per cent. of adult knees examined. This figure corresponds to the incidence of 40 per cent. of popliteal cysts in rheumatoid patients awaiting synovectomy (Taylor, 1969).

Summary

Fifty unselected knees have been examined *post mortem*, and in nineteen a valvular opening in the posterior capsule was found. This valve is constant in position, high up in the medial aspect of the posterior capsule, deep to the medial head of the gastrocnemius tendon.

It is concluded that this valvular opening, which is clearly seen only when the capsule is examined from its inner aspect, is present in 40 per cent. of normal adult knees. Its presence offers an explanation for the formation of popliteal cysts.

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