INTRACAPSULAR FRACTURES OF THE NECK OF THE FEMUR

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Fractures of the upper end of the femur are commonly divided into intra-articular and extra-articular groups. The intra-articular fracture is in turn divided into subcapital and transcervical types (Watson-Jones 1955, Key and Conwell 1961, Aston 1967, Ralston 1967, Apley 1968, Murray 1969). There appears to be some confusion as to the precise line of fracture in this common injury. The term “subcapital” is used for fractures occurring immediately below the femoral head, while “transcervical” refers to a fracture passing across the neck midway between the head and the greater trochanter. Some authors use subcapital as the only description whereas others adopt both terms.

In view of the frequency of these fractures it is essential to have a clear picture of the fracture lines for the proper understanding of complications such as avascular necrosis and of the problems of internal fixation. Such knowledge is also essential for comparison with fractures produced experimentally, when there is often doubt as to what resembles a typical clinical example.

Laboratory studies on the experimental production of fractures have shown that in long bones the fractures that occur at the proximal and distal ends reflect the underlying developmental anatomy (Kleneman 1969). In the neck of the femur transcervical fractures did not appear to fit in with this generalisation. There was no anatomical reason which could explain why they should occur in this situation. A detailed investigation of intra-articular fractures of the femoral neck was, therefore, done to clarify the situation.

METHOD

Twenty femoral heads removed at operation for primary prosthetic replacement were studied. The age range was forty-eight to ninety-three years. Seven of the patients were men

Fig. 1
A slab radiograph showing the typical appearance of a femoral head after fracture.

Fig. 2
Fig. 3
A slab radiograph showing the line of an impacted fracture of the femoral neck in Figure 2, and in Figure 3 radiographs of the same specimen showing apparent variation of the position of the fracture line with changes of rotation.
and thirteen women. Sections one centimetre thick were cut in the coronal plane of the neck with a band-saw and were radiographed on fine grain film with a technique suited to preserve detail.

A similar section was made of a necropsy specimen of an undisplaced fracture that had been pinned. In addition a careful macroscopic study was made of a further thirty femoral heads.

FINDINGS

The femoral head showed a very constant pattern of fracture. The head was separated clearly from the neck except for a spike of calcar femorale which varied in length from 2.5 centimetres to being flush with the rim of the head. The radiographs showed the fracture line passing from the epiphysial scar, which was clearly seen in every specimen, on the superior aspect of the neck along the ascending trabeculae to the calcar (Fig. 1). The same pattern is illustrated by the relatively undisplaced impacted fracture (Fig. 2).

DISCUSSION

From the above observations there is no doubt that the line of a subcapital fracture is constant. That no transverse cervical fracture was seen in this series indicates that it is very rare, if indeed it ever occurs.
Although femoral neck fractures can be produced in the isolated laboratory specimen by vertical loading on the head while the neck is subjected to axial compression at the same time (Hirsch 1965), it is more likely that the mechanism in life is as suggested by Kocher (1896), who produced fractures in cadavers by either a direct blow on the greater trochanter or a blow in the long axis of the femur with simultaneous lateral rotation of the extremity. He believed that the head was firmly fixed by the anterior capsule and the ilio-femoral ligaments while the neck rotated posteriorly. The posterior cortex of the femoral head then impinged against the posterior rim of the acetabulum, and the neck buckled. It is likely that the presence of the epiphysial scar and the strong ascending trabeculae act as foci of stress concentration; hence the constancy of the fracture line.

In addition, comminution of the posterior surface of the neck was also present in about half the patients, as has been shown by a number of investigators (Linton 1944, Scheck 1959, Banks 1962).

It is probable that the origin of the sub-group of transverse cervical fractures has been from wrong interpretation of radiographs. In Figure 3 the apparent variation of the fracture line with different degrees of medial rotation can be seen. These radiographs were of the same specimen shown in Figure 2. An example of an apparently transcervical fracture is shown in Figure 4, but that it was a subcapital fracture is clearly seen in the photograph of the specimen removed at operation (Figs. 5 and 6). The presence of an epiphysial scar in a ninety-two-year-old woman is also of interest, because Garden (1961) stated that the epiphysial scar disappears with age. The proximal limit of the fracture line lay precisely at the level of the old epiphysial scar in each specimen.

In view of the constancy of the fracture line it is probable that avascular necrosis is related to the initial degree of displacement of the fracture. Of the three main groups of arteries to the femoral head the lateral epiphysial vessels are the most important. These vessels supply two-thirds or more of the head—mainly the part derived from the capital epiphysis. They are closely applied to the postero-superior aspect of the neck and they enter the bone near its junction with the articular surface. This is the site where the fracture occurs and it is not surprising that the incidence of ischaemic necrosis diagnosed histologically is variously recorded as 66 to 84 per cent (Phemister 1934, Sevitt 1964, Catto 1965, Sevitt and Thompson 1965). Displacement of the fracture is very likely to injure the vessels (Fig. 7).

On the basis of the above observations it is suggested that the subdivision of intracapsular fractures of the upper end of the femur into subcapital and transcervical varieties is inaccurate and confusing. The type of fracture which occurs is constant and of the two terms commonly used subcapital is probably the more suitable.

SUMMARY

1. A study of fifty femoral heads removed at operation for primary prosthetic replacement showed a remarkable constancy of the fracture line.

2. It is suggested that two sub-groups of this fracture—subcapital and transcervical—have been described as a result of radiological interpretation without consideration of the effects of varying degrees of rotation.
REFERENCES


