SLIPPED UPPER FEMORAL EPIPHYSIS

A POTENTIAL FOR SPONTANEOUS RECOVERY

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Evidence is presented to support the contention that after slipping of the upper femoral epiphysis there is a potential for the bony epiphysis to grow back to its pre-slipped position. A suggestion is made as to how this recovery may occur.

Our knowledge of slipped upper femoral epiphysis is based mainly upon clinical observations on the one hand and radiological appearance on the other. Initially, therapeutic management was conservative, accompanied where necessary by a later diaphyseal osteotomy to correct deformity. The last 50 years have witnessed the emergence, and then often the disappearance or modification of, more interventionist endeavours which have included manipulative reduction, internal fixation and primary corrective osteotomy at metaphyseal or intertrochanteric level. The virtually untreatable and severely disabling complications of bone and cartilage necrosis which may follow have exerted a powerful restraining effect on surgical zeal; and the long-term review by Boyer, Michelson and Ponseti (1981) recording the good results of relative conservatism showed the great potential for spontaneous remodelling which can take place over the remaining years of growth. Clinical experience has shown the excellent functional results that can follow in-situ fixation by pinning or, in the presence of severe deformity, of epiphysiodesis and surgical remodelling of the neck (Herndon, Heyman and Bell 1963; Melby, Hoyt and Weiner 1980). Currently there is a trend to a more conservative approach which reaches its zenith in the work of Steel (1983) who has wide experience of non-operative management.

We report here an observation, which we cannot find previously recorded, of a tendency for the slipped upper femoral epiphysis to grow back to its pre-slipped position – a process of recovery (healing) and also of re-covering (of the exposed metaphysis). This process offers further encouragement to conservative surgeons.

MATERIAL

A study was made of serial radiographs of patients who had prolonged follow-up and whose radiographs were taken in a constant projection to allow comparability. Differing projections can easily simulate shifts in epiphysseal position and falsely mimic reduction of displacement (Griffith 1976).

Case 1. A boy aged 6 years 7 months complained of eight months of pain and limp. His radiographs showed he had sustained a slipped right upper femoral epiphysis (Fig. 1). An assessment by a paediatric endocrinologist showed him to be an otherwise normal child; a review of the

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Fig. 1
Fig. 2
Fig. 3

Case 1: Frog lateral views of the hip. Figure 1 – At presentation, showing a slip of the femoral capital epiphysis. Figure 2 – Five months after diagnosis and the start of treatment in a hip spica: the epiphysis is growing forward to cover the exposed metaphysis. Figure 3 – One year after diagnosis: epiphyseal growth has now virtually reversed the previous slip.

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Case 2: Frog lateral views of the hip. Figure 4 - The epiphyseal slip at the time of diagnosis. Figure 5 - After pinning. Figure 6 - Sixteen months later the pins no longer lie within the head. Epiphyseal growth has largely covered the previously exposed anterior metaphysis. Figure 7 - Two years after diagnosis the epiphyseal slip has been reversed by anterior growth of the epiphysis. The pins and pin tracks in Figures 5, 6 and 7 show the three projections to be comparable.

Case 3: Anteroposterior radiographs of the hip. Figure 8 - A severe slipped capital femoral epiphysis recently treated by valgus intertrochanteric osteotomy. One-third of the superolateral portion of the metaphysis is exposed by the slip. Figure 9 - One year after operation. Figure 10 - Three years after operation. Figures 9 and 10 show how the epiphysis has grown superolaterally to cover the neck once more, the constancy of the appearance of the plate and screws indicating that the three projections are comparable.

Case 4: Anteroposterior radiographs of the hip. Figure 11 - Operative radiograph. Figure 12 - Ten months after injury, the fixation pins have been withdrawn and there are appearances within the head and neck suggesting that there has been vascular compromise. Figure 13 - By 34 months after injury severe downward slipping of the femoral capital epiphysis has occurred. Figure 14 - Six months later, after a valgus subtrochanteric osteotomy has united: a portion of the superolateral metaphysis is shown to be uncovered. Figure 15 - Eight months later (four years after injury) epiphyseal re-covering is now complete.
literature revealed two children of similar age with slipped upper femoral epiphysis but there was no evidence of their endocrine state. Internal fixation at the age of six seemed most unattractive so it was decided to treat this child conservatively using Steel's protocol: a single hip spica was applied to the conscious child, who was then kept in bed for three months and given aspirin (Benorylate) 800 mg daily. The plaster was then removed and partial weight-bearing with crutches was allowed; the crutches were discarded after a further three months. A full range of painless hip movement was regained; some fleeting pain in the left hip did not persist nor did any epiphyseal displacement develop there.

Follow-up radiographs were taken to exclude further epiphyseal displacement which, to our delight, did not occur. We were surprised to see the displaced epiphysis apparently regain its normal position, again covering the previously exposed metaphysis (Figs 2 and 3).

A search of the hospital records was then made to see if this phenomenon was commonplace. We found a number of records where the radiological follow-up was adequate as far as time and projection were concerned to demonstrate these changes. Three further representative cases are described below.

Case 2. A girl aged 8 years suffered a slip of the femoral capital epiphysis (Fig. 4) and was treated by in situ pinning (Fig. 5). Despite the fact that the pins either backed out or lost their grip because of growth, no further displacement occurred. Follow-up radiographs (Figs 6 and 7) showed complete covering of the previously exposed anterior metaphysis.

Case 3. A boy aged 11 years sustained a severe slipped capital femoral epiphysis. He was treated by traction for one month and then an intertrochanteric valgus wedge osteotomy was performed and fixed intern- ally (Fig. 8). The osteotomy united and within three years the epiphysis once again covered the previously exposed superolateral metaphysis (Figs 9 and 10).

Case 4. A boy aged 11 years sustained a comminuted displaced transcervical fracture of the upper end of the femur (Fig. 11), which was treated by pin fixation. The fracture united but some ischaemic necrosis of the neck and head followed. Over the next three years there was a progressive downward slipping of the femoral head (Figs 12 and 13) which was treated by valgus subtrochanteric osteotomy (Fig. 14). During the next year lateral epiphyseal growth covered the previously exposed superolateral metaphysis (Fig. 15).

**DISCUSSION**

Radiographs, our principal source of information concerning slipped upper femoral epiphysis, are exclusively concerned with the bony component of the femoral head; we remain uninformed of events in the radio-translucent tissues. Whereas some histological studies have been made of cellular changes within the displaced physis, there is very little material which details the topography of the displaced epiphysis. Lacroix and Verbrugge (1951) have recorded such a specimen and we are fortunate to be able to illustrate an histological preparation of a second example (Fig. 16). Both specimens reveal that when the bony epiphysis displaces it does so within its enclosing cartilaginous case, which is composed of

[Fig. 16]
Photomicrograph of a transverse section of the upper end of the femur of a person who had sustained a slipped upper femoral epiphysis. Posterior displacement of the epiphysis is shown. (We are indebted to Dr I. V. Ponseti for the use of this illustration.)

[Fig. 17]
Schema of the epiphyseal end of a growing bone. E, bony epiphysis; P, physis; Og, ossification groove; PC, perichondrium; the star is the area of the marginal germinative zone. The histological appearance of the rectangular inset is represented on the right (after Hért 1972).
articular cartilage on the surfaces which face the hip joint and of physeal cartilage, facing the neck of the femur. These two cartilaginous tissues join peripherally in an area which resembles the point of a crescent; in the normal bone this cartilage abuts the ossification groove (Fig. 17) and has been the target of much study by those interested in the normal growth in circumference of the epiphyseal growth plate. We find the hypothesis of Hért (1972) convincing: he pays particular attention to a marginal germinative zone of the epiphyseal plate (Fig. 17) which is found in this area. Hért showed the cartilage cells in this zone to be mitotically active and believes they are mainly responsible for the growth in circumference both of the physis and also of the nearby segment of the cartilaginous epiphysis, which in turn enables the base of the bony epiphysis to expand.

We envisage that when the upper femoral epiphysis slowly displaces it is accompanied by the radiolucent marginal germinative zone of the epiphysis and some of the tissue formerly occupying the ossification groove. Figure 16 shows the "corner of the crescent" to be elongated and maintaining contact between the anterior edge of the bony epiphysis and the site it occupied before slipping. The cellular basis for continuing peripheral expansive growth of the physis and the cartilaginous and bony epiphysis is maintained, as our follow-up studies reported here testify. That this growth is circumferential is shown by the growth of epiphyseal bone in both anteroposterior and lateral x-ray projections.

The physis is known to remain open for a variable length of time after slipping – 9 to 18 months, according to Melby et al. (1980). Our material shows it to be open while the re-covering process takes place but is inadequate to allow us to form any conclusions as to what factors determine epiphyseal closure. While it remains open it is presumably contributing to growth in length of the neck; we show here that associated cells continue to proliferate and allow continuing growth in width of the bony epiphysis. Here again we can only guess at the factors which encourage a restitution of the anatomical status quo ante, but such renewed covering does take place and is very likely to be to the functional advantage of a hip joint deranged by epiphyseal slip.

REFERENCES


