STRESS FRACTURES OF THE NECK OF THE FEMUR

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INTRODUCTION

THE FIRST recorded case of stress fracture of the femoral neck was described by Blecker in 1905. Since then, many isolated cases have been reported, but it was only in the past decade that any large series emerged. In 1962 Jeffrey described eight patients with spontaneous fractures of the neck of the femur, and pointed out that two distinct varieties of the condition occur. Fatigue or stress fractures occur in young active adults after strenuous and prolonged exercise, in addition to spontaneous fractures in elderly patients without a history of strenuous physical activity. It was with this second variety that his paper was concerned. Four of his eight cases had previously been subjected to radiotherapy for pelvic neoplasms and have been rejected by some authors as true stress fractures.

Ernst (1964) reported thirteen cases in young military recruits in training and he drew attention to the difficulty of pinning the fractures and the slowness of the lesions to heal. Devas (1965) reviewed fifty-one cases from the literature and added thirty-two fractures occurring in twenty-five patients. Half of the patients were over sixty-five years of age and the fractures were often associated with osteoporosis, rheumatoid-arthritis or steroid therapy. Blickenstaff and Morris (1966) reported a series of forty-one femoral neck fractures occurring in thirty-six young men during the first eight weeks of basic military training.

CLASSIFICATION

Devas (1965) described two types of stress fracture of the femoral neck.

(a) The transverse type in which the fracture line develops at right angles to the lines of stress, and displacement is common. This lesion is seen more often in older patients. The first radiological sign is a crack in the superior surface of the femoral neck.

(b) The compression type in which the first radiological sign is internal callus near the lower border of the femoral neck. Subsequently, a crack is demonstrable radiologically but there is little tendency to displacement. This type usually tends to occur in younger patients.

Blickenstaff and Morris (1966) introduced an alternative classification.

(a) Those with only endosteal callus, periosteal callus, or both without overt fracture line.

(b) Those with a fracture line in the calcar region or across the neck, but without displacement.

(c) Those in which displacement occurs.

PRESENT STUDY

The purpose of this paper is to report a further 13 stress fractures of the femoral neck occurring in 12 patients, and to draw attention to the aetiological factors and the histological findings in this condition.
## TABLE 1
### STRESS FRACTURE OF THE FEMORAL NECK

| Case | Sex & Age | Symptoms                  | Length of History | Associated Diseases                  | Displacement | Treatment                          | Result   |
|------|-----------|---------------------------|-------------------|--------------------------------------|--------------|------------------------------------|----------|
| 1.   | F. 69     | Pain and limp             | 1 month           | Osteoporosis ++                       | None         | Crutches, non-weight-Bearing       | Excellent|
| 2.   | F. 81     | Pain in hip               | 6 weeks           | Osteoporosis ++                       | Minimal      | Bed-rest                           | Good     |
| 3.   | F. 71     | Pain and limp             | 5 months          | Osteoporosis +                        | Considerable | None                               | Good     |
| 4.   | F. 71     | Discomfort                | 6 months          | Osteoporosis + Previous intertrochanteric fracture | Moderate     | Walking-stick                      | Good     |
| 5.   | F. 56     | Pain and stiffness        | 9 months          | Thyrotoxicosis. Mild osteoporosis.    | Considerable | Raise to shoe                      | Good     |
| 6.   | F. 66     | Pain in hip               | 2 months          | Rheumatoid-arthritis - no steroids    | Considerable | Austen-Moore prosthesis           | Good     |
| 7.   | F. 56     | Pain in bed               | 3 days            | Rheumatoid-arthritis - no steroids    | Moderate     | Bed-rest                           | Good     |
| 8.   | F. 54     | Pain in left hip          | 10 weeks          | Mild osteoporosis Rheumatoid-arthritis - no steroids | Mild         | Subtrochanteric osteotomy         | Poor     |
|      | F. 59     | Pain in right hip         | 5 weeks           |                                       | Mild         | Austen-Moore prosthesis           | Good     |
| 9.   | M. 39     | Pain in hip               | 2 years           | Genito-urinary T.B.                   | None         | None                               | Excellent|
| 10.  | M. 58     | Pain in hip               | 3 weeks           |                                       | Considerable | Charnley's replacement Arthroplasty | Excellent|
| 11.  | F. 79     | Pain in hip               | 3 years           | Osteoporosis ++                       | None         | Traction                           | Good     |
| 12.  | E. 73     | Pain in hip               | 4 months          | Rickets in childhood - varus deformity of femoral necks. Diabetes | None         | Blade plate                        | Good     |
Age and Sex

Table I summarises the main clinical features of the twelve patients in the present series. There were ten females, all of whom were post-menopausal; the youngest was fifty-four years old and the average age was sixty-seven years. The two male patients in the series were aged thirty-nine and fifty-eight years respectively.

Length of History

The duration of symptoms before presentation at hospital varied considerably in different individuals from three days to three years, with an average of seven months. In most instances, the symptoms became more severe before referral to hospital.

Symptoms

Pain was the presenting symptom in every case. In some patients, the pain was of moderate severity, while other patients described a mild ache or discomfort. Two patients complained of limp associated with the pain. Pain was usually of gradual onset, and there was a history of trauma in only one patient (Case 4). This was a 71-year-old woman, who had a previous intertrochanteric fracture which had healed satisfactorily on Russell traction. There was no evidence of fracture of the femoral neck in any of the X-rays taken during the five-month period after the accident, but a film taken at the end of the fifth month revealed slight resorption of bone on the upper surface of the femoral neck (Fig. 1a). However, an X-ray taken ten months after the initial injury (Fig. 1b) showed a new fracture line with surrounding callus, and the patient stated that for the last five months she had had pain in the hip which she attributed to the original fracture.

Radiological Findings

In all cases a fracture line was discernible at some stage during the period of observation, but on occasions this was only a minute crack in the superior aspect of the femoral neck (Fig. 2). In other cases, the predominant feature on the initial X-ray was marked internal callus near the lower border of the femoral neck, although a fracture line was usually also demonstrable on the initial X-ray (Fig. 3). In seven in-

Figure 1a
stances the fracture line was traverse to the lines of stress of the femoral neck; in another two cases the fracture was almost transverse; in four cases it was definitely oblique to the lines of stress.

The degree of deformity varied widely. In six cases there was moderate or considerable displacement; in three there was minimal displacement; in four cases there was no shift.

Associated Diseases

In seven of the female patients, X-ray of the bony skeleton revealed a mild or moderate degree of osteoporosis, and three women suffered from mild rheumatoid arthritis. None of these patients was on steroid therapy. Case 5 had previous thyrotoxicosis, which had been
managed medically, and she was euthyroid at the time she developed hip symptoms. Case 12 had marked bowing of the shafts of both femora and varus deformity of the femoral necks, secondary to rickets in childhood. One of the male patients (Case 9) was under treatment for genito-urinary tuberculosis at the time the diagnosis of stress fracture of the femoral neck was made. The bony skeleton was otherwise apparently normal.
Differential Diagnosis

Metastases in the femoral neck was the main condition which had to be ruled out. In one patient (Case 10) it was necessary to perform open biopsy to exclude serious bone pathology. Other cases have been encountered which are initially considered as possible instances of stress fracture of the femoral neck, but were eventually excluded because the patients were found to have other bone pathology, such as fibrous dysplasia.

Treatment

There was only one case of bilateral fractures in the series (Case 8). This patient presented at the age of fifty-four with a ten-week history of pain in the left hip, and x-rays revealed a stress fracture of the femoral neck with a mild degree of displacement (Fig. 4a). A subtrochanteric osteotomy was performed but the patient continued to have symptoms, which seemed to result from non-union at the osteotomy site. The stress fracture healed satisfactorily. At the age of 59 years she developed a stress fracture of the right femoral neck (Fig. 4b) which was successfully treated with an Austen-Moore prosthesis. Another patient treated by prosthetic replacement also had a satisfactory outcome. One patient had open biopsy performed to exclude a secondary deposit, followed by insertion of a Charnley's low-friction replacement arthroplasty. In case No. 12 a blade plate was inserted for an undisplaced basal stress fracture causing severe symptoms.

Eight cases managed on conservative lines, which ranged from bed-rest to the use of various weight-relieving devices, made a good or excellent recovery as judged by the patient's symptoms, in spite of a moderate degree of varus deformity in some cases on referral to hospital.

Histological Findings

In two cases, excision of the head and neck of femur and histological examina-
tion were carried out five weeks and eight weeks after the onset of symptoms. Histologically, the material showed areas of denser bone corresponding to the region of the stress fracture. Here there was some increase of rather dense collagenous fibrous tissue between th bone trabeculae. There was a scarcity of recent callus formation and very little evidence of healing of the fracture site. There was no active proliferation of osteoid tissue as occurs in a repairing fracture site. Appearances were in keeping with a slow migration of the femoral neck into the head, with a reactive proliferation of fibrous tissue and a few osteoblasts along pre-existing bone trabeculae.

**DISCUSSION**

The term “Stress fracture” is preferable to “Fatigue fracture” because, as Devas (1967) pointed out, there is no factual evidence of pathology in bone corresponding to fatigue in metal where the term “Fatigue fracture” is used. It would seem that a fracture may occur (a) in apparently normal bone under prolonged or excessive physical strain, (b) in weak bone under normal stress and (c) in bone at a mechanical disadvantage, i.e., a varus femoral neck.

There has been much speculation as to why stress fractures should occur in healthy young adults. Blickenstaff and Morris (1966) pointed out that bone subjected to repeated submaximum stresses may be the seat of excessive osteoclastic activity, with initial osteoporosis and subsequent callus formation. Henschen (1936) believed that these fractures were the result of displacement of the crystalline molecular structure of bone by repeated rhythmic movements. The radiological changes are the result of a stress reaction, and the appearance of a fracture line is part of the reaction or process rather than a single momentary act.
Although the condition has now been well documented in healthy young adults, e.g., military recruits, it is almost unknown in adolescence. Devas (1963) reported a case in an undernourished child of fourteen years. According to Wolfe and Robertson (1945), stress fractures of the femoral neck seldom occur before closure of the capital epiphysis.

There would appear to be an incidence of 10 to 25 per cent of stress fracture in the other femoral neck in patients who have had one side affected (Devas 1965, Blickenstaff and Morris 1966). Patients should, therefore, be advised to report immediately any discomfort in the opposite hip so that an early diagnosis may be possible. Avoidance of excessive strain is also advisable, even in the younger group with apparently normal bones.

Some authors advise internal fixation in all cases where a crack can be identified. Devas (1965) recommends surgical intervention in those cases where the fracture line is transverse to the lines of stress, as displacement is more likely in these cases. The importance of using pins of the Moore or Newman type is stressed because of the danger of avascular necrosis of the femoral head, particularly in younger patients, if a trin nail is used.

In the present small series, there was surgical intervention in five of the thirteen hips and, where prosthetic replacements were used, the results have been good. In the eight hips where conservative treatment was instituted the results have been good, irrespective of the degree of displacement. No further displacement occurred during the period of treatment and, clearly, surgical intervention is not always necessary. It should be remembered that even if some displacement has occurred and the fracture is obviously healing when first seen, operation may not be required.

**SUMMARY**

Pain was the presenting symptom in the thirteen stress fractures of the femoral neck occurring in twelve patients reviewed. Osteoporosis and rheumatoid-arthritis were important predisposing factors. The overall prognosis was good and, in particular, patients treated conservatively had a satisfactory outcome.

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**REFERENCES**

BLECKER, A. (1905). *Med. Klin.*, Berl. 1, 305.
BLICKENSTAFF, L. D. and MORRIS (1966). *J. Bone Joint Surg.*, 48A, 1031.
DEVAS, M. B. (1963). *J. Bone Joint Surg.*, 45B, 528.
DEVAS, M. B. (1965). *J. Bone Joint Surg.*, 47B, 728.
DEVAS, M. B. (1967). *Brit. Med. J.*, i, 235.
ERNST, J. (1964). *J. Trauma.*, 4, 71.
HENSCHEN, B. (1936). *Arch. Klin. Chir.*, 186, 98.
JEFFREY, C. C. (1962). *J. Bone Joint Surg.*, 44B, 543.
WOLFE, H. R. I., and ROBERTSON, J. M. (1945). *Lancet* 2, 11.