SIMULTANEOUS IPSILATERAL FRACTURE OF THE FEMORAL NECK AND SHAFT: REPORT OF 8 CASES*

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SUMMARY

Eight cases with fractures of the shaft and the neck of the same femur are described. Attention is drawn to the high incidence of undiagnosed fractures in cases where these two fractures occur concomitantly. It is emphasized that definitive treatment can only be planned after a full clinical and radiological examination. The mechanism and diagnosis of the concomitant fractures are described and the various methods of treatment are discussed.

The occurrence of concomitant fractures of the shaft and neck of the same femur poses a very real problem, not only with regard to the management of the two fractures, but especially because the hip fracture is very frequently missed initially, thereby prejudicing the end-result.

The combination of fracture of the shaft and the neck of the same femur is an unusual one. Dencker[1] in a report of 8 cases presenting with this condition, states that, since the first series published on this subject by Delaney and Street,[2] no more than about 40 cases are on record. Since Dencker's article, a further report of 6 cases was published in 1968 by Shatzker and Barrington.[3]

In our series 8 cases with this combination of fractures are presented. In 5 of the patients included in the series, the femoral neck fracture was noted at the initial examination, while in the remaining 3, the neck fracture was only discovered after a period of 6 months (case 1), 16 days (case 5), and immediately after initial reduction of the shaft fracture (case 2). The period of follow-up varied from 2 months to 5½ years.

CASE REPORTS

Case 1:

A 26-year-old Bantu male labourer was admitted to hospital on 24 February 1968, after having been pushed off a fast-moving train. Preliminary clinical examination showed bilateral femur shaft fractures. Mid-shaft fractures of both femurs were noted on the initial radiographs. After immobilization in a bilateral plaster spica, intramedullary nailing of the fractures was carried out on 5 March 1968.

The patient made a satisfactory recovery from the operation, but on several occasions during convalescence complained of pain in the right hip. The shaft fractures united within the normal time. He was discharged, walking with the aid of crutches, on 9 May 1968. Check radiography on routine follow-up examination showed solid union of the shaft fractures, but a previously undiagnosed fracture involving the basal region of the right femur neck was noted (Fig. 1). On 3 September 1968 a displacement intertrochanteric osteotomy was performed in an attempt to obtain union of the ununited fracture. Internal fixation was effected by means of a Wainwright spline and a plaster spica for a period of 3½ months. After discharge he returned to a sedentary job as a night-watchman. On 17 December 1968 he complained of a continuous pain in the same hip, aggravated by standing and walking. There was 35 mm of shortening of the right leg with a positive Trendelenburg sign on that side. Radiographs showed the presence of non-union at the osteotomy site.

Fig. 1. Case 1. Radiograph shows intramedullary nails immobilizing bilateral femur shaft fractures with hitherto undiagnosed fracture of the right femur neck (6 months after injury).

He was readmitted, the spline was removed and an autogenous fibular bone graft was inserted across the fracture site, with immobilization in a plaster spica. He was discharged after a further 3 months, and has since been lost to follow-up, after a disability period exceeding 10 months.

Case 2:

A 69-year-old Bantu male pensioner was admitted to hospital on 4 December 1969. He had fallen into a 7-ft (2·1 m) donga, the lateral aspect of the right thigh striking a boulder. He sustained a compound fracture of the right femur with a small puncture wound on the anterolateral aspect of the thigh (under which the proximal shaft fragment was easily palpable). The initial radiographs did not include the hip joint but confirmed the diagnosis of the shaft fracture. After resuscitation, a debridement of the compound fracture wound was carried out and the fracture reduced. The wound was sutured and the fracture immobilized on a Thomas's splint, employing skeletal traction via a Steinman's pin through the tibial tubercle. Immediate postoperative radiographs showed satisfactory reduction of the shaft fracture as well as the presence of a basal fracture of the femur neck (Fig. 2). The wound healed satisfactorily and 8 days later an open reduction and internal fixation with Knowles pins was performed. The shaft fracture was subsequently treated by Hamilton-

*Date received: 22 December 1970.

Russell traction. Union, however, did not occur and after 7 weeks the fragments were still mobile. An open reduction

Fig. 2. Case 2. Radiograph shows satisfactory reduction of shaft fracture with hitherto unrecognized fracture of neck of femur.

and internal fixation employing two compression plates was then carried out. Both fractures then united rapidly and he was discharged walking with the aid of crutches. When seen 4 months after the accident, there was no shortening of the affected limb. He was able to flex his right hip from 0° to 110° and his knee from 0° to 90°. There was no pain and his radiographs showed advanced bony union of both fractures.

Case 3

A 49-year-old Bantu male was admitted to hospital on 15 December 1969. He was employed as a pharmacist's delivery boy, and while driving a motor scooter, he skidded on a wet road and landed heavily on the right leg, sustaining a fracture of the right femur shaft as well as a 'degloving' injury to the dorsum of the right foot.

Initial radiographs of the femur did not include the hip area, but demonstrated a comminuted fracture of the midshaft region. A further anteroposterior radiograph, including the hip, showed a pertrochanteric fracture. (Fig. 3). After debridement of the foot wound, the fractures were immobilized on a Thomas's splint, employing skeletal traction through the tibial tubercle. On the fourth day, reduction and internal fixation by means of a Thornton pin

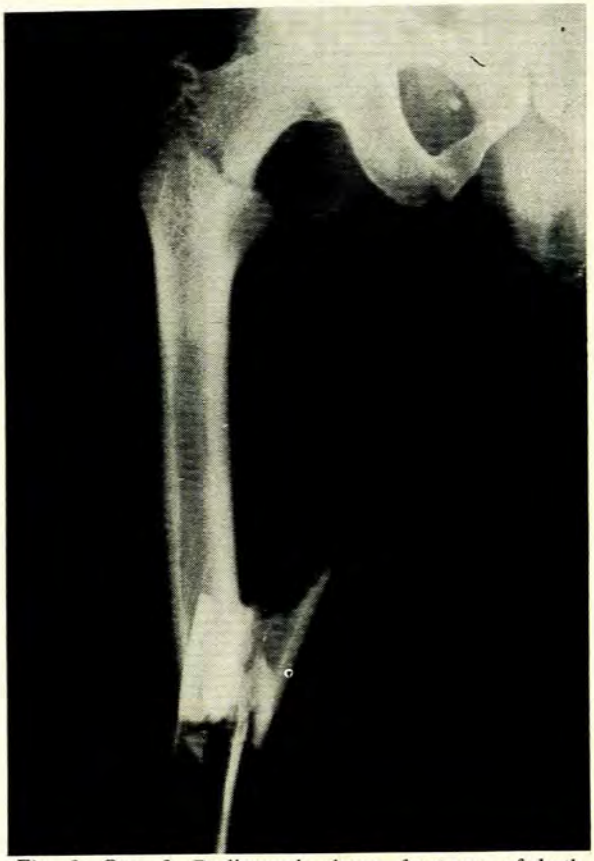

Fig. 3. Case 3. Radiograph shows fractures of both neck and shaft of the right femur.

and plate via a lateral approach was undertaken. Treatment of the shaft fracture was continued using Perkins's traction. Both fractures united satisfactorily. Routine follow-up examination showed 12 mm of shortening of the right leg, with flexion of the knee from 0° to 110° and his right hip from 0° to 120°. Radiographs showed satisfactory union of both fractures and he returned to his previous employment 6 months after the date of the injury.

Case 4

A 23-year-old White male was admitted to hospital on 4 July 1964. He had been travelling in a motor car which overturned, flinging him heavily against a tree stump. Initial radiographs, exhibiting the left femur shaft only, confirmed the clinical diagnosis of a transverse fracture of the midshaft area. Further radiographs of the femur, including the hip, showed, in addition, the presence of an undisplaced transcervical fracture of the femur neck.

The fractures were initially immobilzed on a Thomas's splint and 4 days later, via Henry's approach, the shaft fracture was reduced and plated. This was followed by reduction of the proximal fracture by means of a gentle Leadbetter manoeuvre, using a Smith-Petersen nail for internal fixation. Postoperatively, the limb was immobilized with light skin traction on a Thomas's splint.

Knee movements were started 4 weeks after the operation. Six weeks later, an obvious anterior bowing was found to have occurred in the midshaft region. Radiographs showed that the plate had lifted off the fracture site and that anterior angulation of 40° had taken place. The plate was removed, the fracture manipulated, and the limb immobilized in acceptable position in a plaster hip spica. Both fractures united satisfactorily and the spica was removed on 8 January 1965. The patient eventually resumed rugby playing and clinical examination 5 years later showed 12 mm shortening of the left leg, full passive movements of the hip, except for 15° limitation of internal rotation and 10° varus angulation at the site of the femur shaft fracture. There was no physical impairment of function and radiographs showed solid bony union of both fractures and a normal hip joint (Fig. 4).

Fig. 4. Case 4. Radiograph shows union of transcervical fracture with a normal hip joint.

Case 5

A 55-year-old White female was a front-seat passenger in a car which was involved in a head-on collision on 9 May 1969. She was admitted to hospital in a gravely shocked state and, on examination, was found to have sustained a fracture of the left femur, extensive lacerations of the face, and a dislocation of the right second metacarpophalangeal joint. Radiological examination of the femur, which included the hip, showed a comminuted fracture of the shaft, at the junction of the middle and lower thirds. No fracture in the hip region was noted (Figs. 5 and 6). A massive blood transfusion was needed

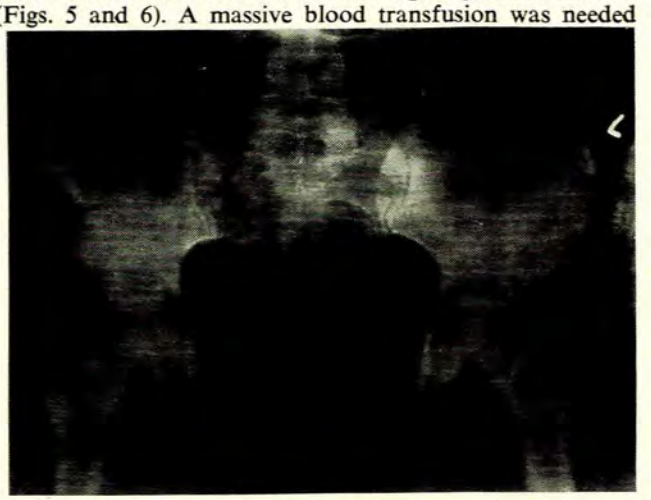

Fig. 5. Case 5. See text.

Fig. 6. Case 5. See text.

in order to resuscitate the patient who was grossly anaemic. The lacerations were then sutured and the femur fracture was immobilized on a Thomas's splint, employing skin traction. The patient's condition remained grave for 10 days. It was extremely difficult to treat her effectively on the Thomas's splint, because of her highly emotional state. On 25 May 1969 an intramedullary nail was inserted across the fracture, using two screws to fix the large fragment.

Postreduction X-rays, taken the following day, showed the nail to be holding the fracture acceptably, but a Pauwel's type III fracture of the femur neck was also noted (Fig. 7). Ten days after the operation, the patient suffered a pulmonary embolus and her condition deteriorated markedly. She responded well to anticoagulant therapy. Three months later she was allowed up on a weight-bearing caliper. Follow-up radiological examination of the hip showed ischaemic necrosis of the capital fragment. On 28 May 1970 a Thompson's prosthesis was inserted via a 'Southern' approach (Fig. 8). She made a satisfactory recovery and, when seen last on 28 September 1970, she experienced very little pain in her hip and was walking with the aid of a stick. There was a good range of flexion and extension of the hip with slightly limited rotation, and 15° abduction contracture. The legs were equal in length.

Case 6

A 30-year-old Bantu male was admitted to hospital on 23 August 1970. He had been crossing a road on foot when he was knocked down by a motor car which struck the medial aspect of his left thigh. On clinical examination, there was a closed fracture of the midshaft region of the left femur. Radiographs confirmed the latter finding, but showed in addition a pertrochanteric fracture of the shaft femur (Fig. 9). Under a general anaesthetic, a manipula-

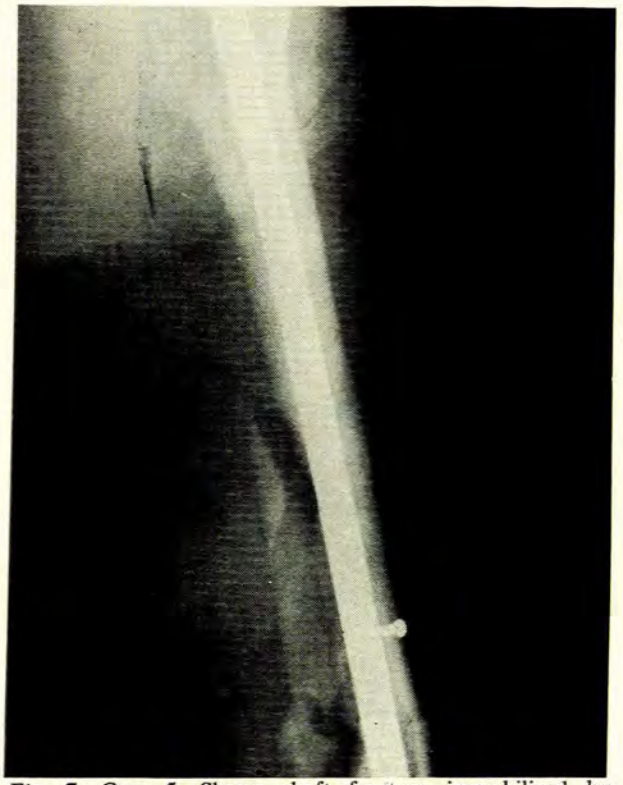

Fig. 7. Case 5. Shows shaft fracture immobilized by means of intramedullary nail and screws with hitherto undiagnosed fracture of neck of femur.

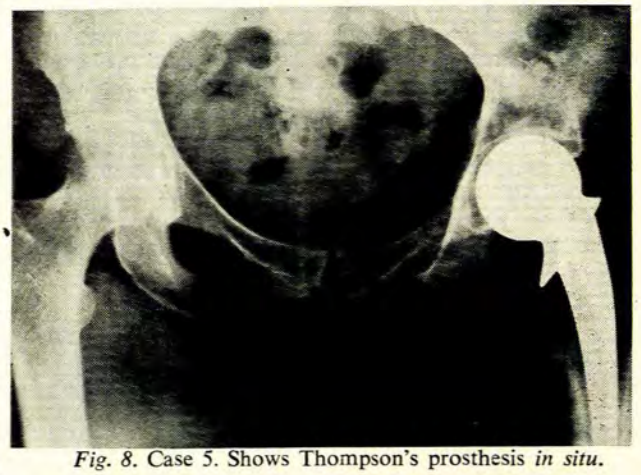

Fig. 8. Case 5. Shows Thompson's prosthesis *in situ*.

Fig. 9. Case 6. Shows fractures of shaft and neck of left femur (taken on admission).

tion was undertaken and the limb immobilized on a Thomas's splint, employing skin traction. Postreduction radiographs showed the two fractures to be satisfactorily reduced.

Examination one month after injury showed 35 mm shortening of the affected limb. The leg was still being treated on the Thomas's splint with an acceptable position of the fractures. Radiographs showed that bony union was progressing satisfactorily.

Case 7

A 26-year-old White male traffic officer was admitted to hospital on 8 September 1970. While on patrol on his motorcycle, he had been involved in a head-on collision with a car. His recollection of the accident was somewhat hazy, but he remembered striking the vehicle head first and that his legs swung over his back and struck the roof of the car. On admission, clinical examination showed an open fracture of the right femur shaft with a puncture wound on the lateral aspect of the right thigh, together with very extensive lacerations. He was concussed. Radiological examination showed a fracture of the midshaft region of the right femur shaft as well as a pertrochanteric fracture of the right hip (Fig. 10).

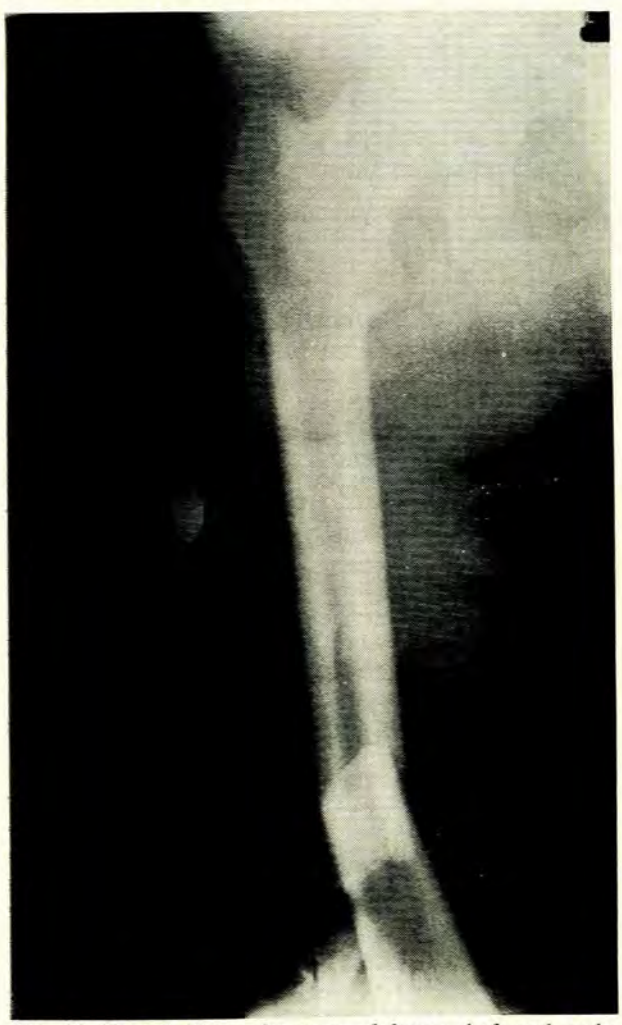

Fig. 10. Case 7. Shows fractures of femur shaft and neck (taken on admission).

Under general anaesthetic, a wound toilet and primary suture of the thigh wound was carried out and the limb was immobilized on a Thomas's splint, employing skeletal traction via a Steinman's pin through the tibial tubercle. Examination three weeks later showed good alignment of of the limb on the Thomas's splint with a shortening of 25 mm of the affected limb. Radiographs showed the fractures to be in an acceptable position. The wound had healed completely.

Case 8

A 42-year-old White female was a front-seat passenger in a car which was involved in a head-on collision. She was admitted to hospital and, on clinical examination, was found to have sustained a transverse shaft fracture, as well as a pertrochanteric fracture of the left femur neck (Figs. 11 and 12). She could not recall her injury but a severe contusion of the knee on the same side led to the presumption that her knee had struck the dashboard of the car.

An open reduction and intramedullary nailing of the shaft fracture was carried out. At the same time an attempt was made to reduce the femoral head fracture and to immobilize it by means of 2 Knowles pins (Fig. 13). The position of the hip fracture was not acceptable and the intramedullary nail was removed together with the Knowles

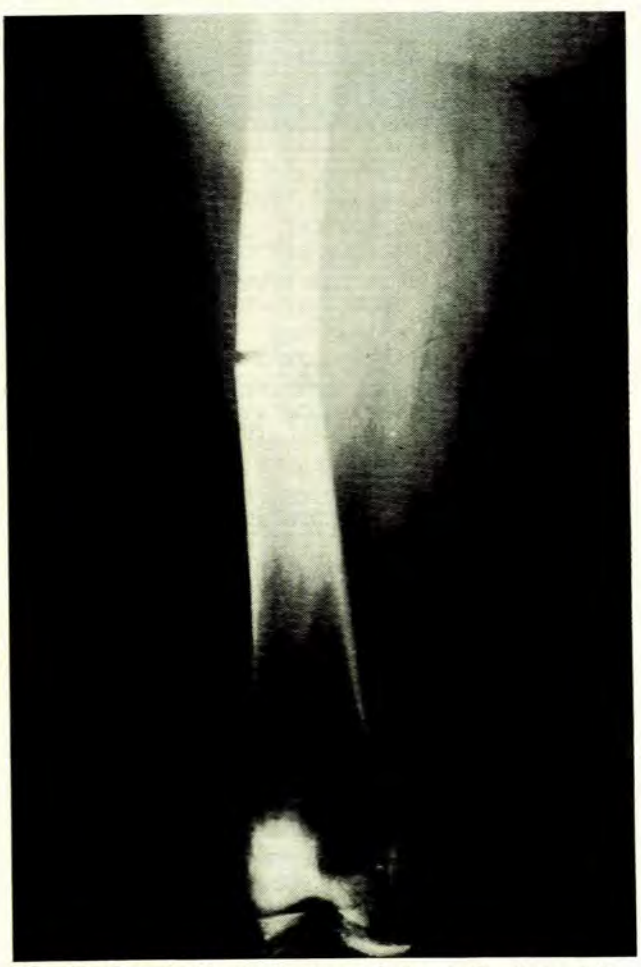

Fig. 11. Case 8. Shows fracture of the shaft of the left femur.

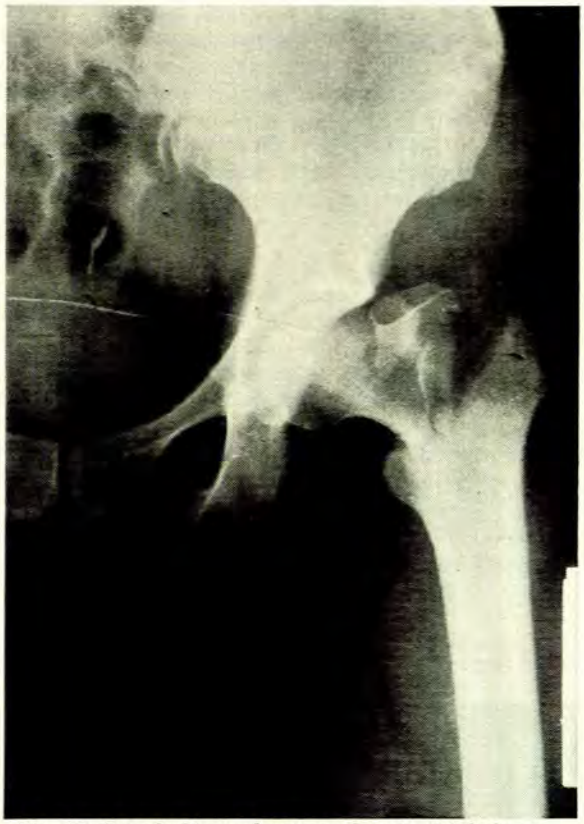

Fig. 12. Case 8. Shows fracture of neck of left femur.

Fig. 13. Case 8. Shows attempt at reduction of neck of left femur with unacceptable position of fragments and Knowles pins. Intramedullary nail *in situ*.

pins. An open reduction of the fracture was then effected and the reduction maintained by means of a Smith-Petersen pin and plate. She was kept in traction using a Thomas's splint until consolidation of her shaft fracture had occurred when she was allowed up and about on a weight-relieving caliper (Fig. 14).

Follow-up examination carried out 5 months later showed 35 mm shortening of the affected limb. Her wounds had healed satisfactorily and she was walking with the aid of crutches and taking partial weight on the affected limb. Passive hip movements were within normal limits except for flexion (0 - 90°) and she was unable to flex her knee past a right-angle. Radiographs showed that union was progressing satisfactorily.

DISCUSSION

Diagnosis

In spite of the relatively small series of cases reported to date, there is no doubt that this particular combination of fractures is not altogether uncommon. In this era of intensive resuscitation, faster-moving vehicles on more crowded roads, and the increase of more violent industrial accidents, an even greater incidence may be predicted. For these reasons, all those engaged in treating multiple injuries should constantly be aware of the possible existence of additional masked injuries in the presence of more obviously dramatic and pressing emergencies—another example being the presence of cervical vertebral injuries masked by more obvious head and maxillofacial injuries.

Schatzker and Barrington[3] put this point across very lucidly: 'The clinician confronted with a patient with multiple injuries directs his attention to the more serious and life-threatening injuries. The obvious deformity begs for recognition. Even the most junior surgeon recognizes shortening and external rotation of the leg as signs of femoral neck fractures. However, when this deformity is masked by another due to fracture of the same femoral shaft, only the surgeon who is aware of this complication and thoroughly assesses the patient and radiographs will make the correct diagnosis.' The elementary test of comparing Bryant's triangle will, in a fair percentage of cases, unmask the proximal injury, while in those cases where displacement of the hip fracture has not taken place, palpation of the trochanteric area may elicit tenderness and thus suggest the possibility of a proximal injury coexisting with a more obviously recognizable shaft fracture.

Probably the most important diagnostic aid is the careful examination of good quality radiographs of the whole femur, with careful attention being paid to the hip region, the knee and the pelvis. It is interesting to observe the averages of the percentages of missed hip fractures in 4 of the previously published series together with this series of 8 cases.[1-4] In a total of 32 femurs, the neck fracture was only diagnosed on admission in 15 instances. Another diagnostic pitfall, viz. the combination of a shaft fracture together with a dislocation of the same hip, has been well documented.[5]

Definitive treatment of shaft fractures of the femur should, therefore, not be undertaken until a careful clinical examination as well as examination of adequate radio-

Fig. 14. Case 8. Shows fracture of neck of left femur immobilized by Smith-Petersen pin and plate.

graphs of the hip and knee have been carried out. Only then can the dislocation of the hip, fracture-dislocation of the hip and fracture of the patella be discovered at a time when they can be treated more efficiently. It is, perhaps, pertinent that Dencker,[1] who, in a series of 8 cases, missed the femur neck fracture in only 1 case, attributes his improved diagnosis compared with the other series to the fact that it is a routine practice in Sweden to examine the adjacent joints radiographically in all cases of fracture of the long bones.

However, Kimbrough[4] states that inadequate radiographic examination cannot be blamed for the failure to recognize these injuries, because in 3 of 4 patients in which the diagnosis was overlooked in this series, the hip fracture was discernible in retrospect on the original radiographs. The principle of examining radiographically the adjacent joints in the event of long bone fractures is by no means confined to Sweden alone, but it is possible that its importance is not sufficiently impressed upon radiographers. This statement will be well borne out by the fact that in the present series, most of the cases where the femur neck fractures were diagnosed at first examination had to be sent back for views of the hip because these had been omitted when the initial radiographs were taken.

Another diagnostic method which, undoubtedly, assists in the diagnosis of the entire extent of the femoral injury is preliminary radiological scanning, using an image intensifier in the event of multiple injuries.

Mechanism

Dencker[1] quotes Heise[6] as stating that femoral shaft fracture with fracture of the neck of the same femur is most commonly caused by traffic accidents. This was confirmed in the present series (7 out of 8 cases). The only other cause in the 5 series reported was a fall from a height. Heise[6] goes on to say that the violence usually affects the femur in the direction of its long axis, the shaft fracture occurring first and followed by the fracture of the neck.

Schatzker and Barrington[3] add that the pathomechanics of this double fracture suggest that it is a distinct clinical entity which should be anticipated from an analysis of the mechanism of injury. They are in agreement with Heise's statement that the double fracture usually results from longitudinal compression, (they specify the knee striking the dashboard following a head-on collision), but add that the events which occur at the femur neck depend on whether the hip is abducted or adducted at the moment of impact. In event of adduction (as in the passenger sitting with his legs crossed), longitudinal compression will cause the femoral head which is well out of the acetabulum to dislocate posteriorly or to undergo fracture-dislocation; while in abduction, the femoral head is well seated in the acetabulum and cannot dislocate and if all the energy has not been dissipated in shattering the femur, a fracture-dislocation of the hip joint or fracture of the femoral neck results.

When one reviews the additional injuries present in the cases presented in the 4 previous series, it is interesting to note the frequency of associated knee injury: 10 cases out of a total of 24. These figures, I believe, substantiate the importance attached to the mechanism of longitudinal compression.

Management

The end-result obtained in this type of injury depends to a large extent on how soon the correct diagnosis is established. This statement is well borne out by the experience gained by Kimbrough.[4] Of the 4 cases in his series whose proximal injury was undiscovered initially, the end-result was prejudiced in at least two. In the present series, 2 of the 3 patients in whom the diagnosis was initially missed, developed varying degrees of disablement which were directly attributable to the late discovery of the proximal injury. No hard and fast rule can be laid down for the treatment of individual fractures. When planning definitive treatment of the fractures, factors such as the age of the patient, the site and nature of the shaft fracture, whether the shaft fracture is open or not, and the variety of hip fracture, should determine the method to be adopted.

In reviewing the literature and with the experience gained in the present series, it appears that the best results are to be obtained when treatment of the hip fracture receives priority. Bearing this in mind, the following methods may be employed:

(a) *Treatment by traction only*. This method is ideally suited to cases where the neck fracture is of the pertrochanteric or spiral subtrochanteric variety with the shaft fracture of a comminuted or spiral type in a youthful, fit patient. It may also be employed when a femur neck fracture, which is suited to treatment by traction (i.e. pertrochanteric), exists together with a transverse open shaft fracture which would, otherwise, have been suitable for treatment with an intramedullary nail.

This method was employed in two cases in the present series (cases 6 and 7). Although it is too soon to report fully at this stage, and both patients' fractures are uniting satisfactorily, complications appear unlikely. Both cases, however, show shortening on comparing Bryant's triangle on the two sides, which is considered to be a disadvantage of this method. Kimbrough[4] employed traction only in 2 of the 5 cases reported in his series. In both cases, the distal fractures united satisfactorily, but in one the neck fractures did not unite, and eventually required bone-grafting, abduction osteotomy and internal fixation.

The precise type of traction used depends on the type with which the surgeon is best acquainted, and various methods can be employed. The traction is best applied by means of a Steinman's pin through the tibial tuberosity employing either a Thomas's splint with a Pearson knee piece, or by the Perkins method in which early knee movement is possible. Skeletal traction, employing a Kirchner wire through the tibial tubercle with the hip flexed to 90° with 15° internal rotation of the hip as described by Kimbrough,[4] may also be used. The traction should be maintained until clinical and radiographical evidence of consolidation of both fractures has occurred.

(b) *Hip spica.* This method was not considered as a means of definitive treatment in any of the cases in the present series, but could, theoretically, have been employed in similar cases to those described as amenable to treatment by traction only. Its use would, however, perhaps have precluded early knee movement with *resultant knee stiffness.* It was employed at a later stage in case 4, where delayed union of the shaft fracture occurred, and in spite of the fact that it was maintained for 6 months, a good functional end-result was obtained; the range of knee movement returning to 0 - 110° six years after the injury.

(c) *Intramedullary nailing of shaft and internal fixation of femur neck fracture.* This method was used to the exclusion of all other methods by Delaney and Street[2] in their series of 4 cases in which the neck fractures were all discovered within 2 weeks of injury. It was also employed by others[1,3] in cases of a similar nature. It was not employed by Kimbrough.[4] The method was originally employed by Delaney and Street, who discovered a fracture of the neck of the femur on the postoperative radiographs of a patient who had had an intramedullary nail inserted for a fracture of the shaft of the femur. Not many possibilities as to treatment of the fracture of the neck were then applicable, and, because of the good result obtained in their first case, they continued to employ this method. This method was employed initially in case 8 but, because of the displacement of the hip fracture, the Knowles pin and Küntscher nail were removed, and the neck fracture was then immobilized with a pin and plate, and treated with traction until union was complete. This method is ideally suited to cases which present with a transverse shaft fracture in the middle and upper third of the femur with a transcervical fracture of the neck. The presence of the intramedullary nail in the shaft presents a technical problem when inserting the nails to fix the neck fracture, but these can be inserted to the sides of the intramedullary nail without much difficulty.

Various types of hip nails were employed in the series reviewed. Delaney and Street[2] used Knowles pins, whereas Dencker[1] employed Nyström nails. In one case treated by Dencker, an open reduction of the shaft fracture was done and then an intramedullary nail was introduced through the distal shaft fragment. The nail was of such a length as to fall short of the intertrochanteric area, thus obviating the obstruction in this area to a tri-flanged nail employed to fix the neck fracture.

In the event of a displayed fracture of the neck of the femur, initial instrumental reduction through an exposure giving access to the anterior part of the neck can be used before fixation, thus obviating the necessity of an intact shaft in order to effect a manipulative reduction.

(d) *Internal fixation of the neck of the femur fracture and plating of the shaft fracture.* This method was employed in cases 2 and 4 in the present series. Case 4 sustained a transverse fracture of the shaft of the femur and, in addition, a transcervical fracture of the neck of the femur. The shaft fracture was reduced by means of a plate and the neck fracture was fixed by a Watson-Jones nail. This method was not successful, however, as the plate started to bend after knee flexion was instituted and it was necessary to remove the plate and to immobilize the limb in a hip spica which, eventually, resulted in sound union. Case 2 in the present series was an open reduction and plating of the femoral shaft fracture, and was undertaken as a delayed procedure when it was noted that an acceptable reduction could not be maintained with skeletal traction.

The only other mention of this method is reported by Schatzker and Barrington,[3] who treated a case of fracture of the neck of the femur and the shaft with a Smith-Petersen pin with a long plate immobilizing both fractures.

This method could possibly also be of value in the event of fractures of the lower third of the femur shaft complicating fractures of the neck of the same femur, especially in elderly patients where early ambulation is desired. The plate should be stronger than the conventional ones, allowing at least 3 and preferably 4 screws in each fragment.

(e) *Internal fixation of the neck fracture and traction of the shaft fracture.* This method was employed in case 3 in the present series. Its main use is in cases where a hip fracture requiring internal fixation and a shaft fracture unsuitable for internal fixation coexist. This state of affairs is encountered in spiral or badly comminuted shaft fractures, shaft fractures involving the lower third of the shaft, or in the event of the shaft fracture being compound.

Here again, the precise method of traction employed will depend on personal taste, but it is thought that the Perkins method, with its early knee movement, is best suited.

(f) *Immobilization of both fractures by a single intramedullary* nail. Dencker[1] employed this method in 2 cases, both of which sustained neck fractures of the pertrochanteric variety. One of these patients died shortly afterwards of fat embolism; the other patient made a satisfactory functional recovery but exhibited a 20 mm shortening of the affected limb on examination.

CONCLUSIONS

One of the most notable impressions gained in dealing with this particular combination of fractures in the present series was the number of operations required in order to

obtain a satisfactory end-result in each case. Six of the 8 patients treated required at least two general anaesthetics for either closed or open reduction of the fractures and the remaining 2 cases (cases 6 and 7), have not been followed up for a sufficient period to preclude them from having further operations in the future.

Missing the proximal fracture does not seem to be the only contributing factor in each case. In spite of the early diagnosis of the entire injury in 3 cases they still required 2 or 3 operative procedures each. This high number of operative procedures substantiates the impression that the methods employed in the present series were not entirely satisfactory. Only one patient can be claimed to have had a satisfactory course as regards length of time in hospital and the number of operative procedures.

It would appear, therefore, that internal fixation of the neck fracture and traction for the shaft fracture or alternatively intramedullary nailing of the shaft fracture with accurate, stable pinning of the neck fracture, are the best methods. In a young patient with a pertrochanteric or intertrochanteric fracture of the hip, coexisting with a shaft fracture which can be managed satisfactorily by traction, traction seems to be a perfectly satisfactory method. It is too soon, unfortunately, to report on the efficacy of this method (employed in cases 6 and 7). However, no problems have been encountered thus far.

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