Double take—fracture fishing in accident and emergency practice

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Abstract

Objective—To investigate conditions where, after initially negative plain x rays following trauma, there subsequently proves to be fracture, and to explore ways in which the management might be improved.

Design—A 16 month prospective study. Patient details were collected from accident and emergency (A&E) review clinics and returns, A&E ward admissions, correspondence from other services, and discussions at a weekly clinicoradiological conference. The inclusion criteria comprised A&E trauma patients with normal initial plain x rays and proven fractures on subsequent imaging for the same patient event.

Setting—A large A&E department seeing 65 000 new attendances per annum with full back up services.

Results—55 cases were identified: 41 fractures were identified on subsequent plain x ray, six on bone scan, six on CAT scan, and two on MRI scan. The commonest regions involved were the wrist, pelvis/hip, ankle/foot, and leg. Follow up had not been arranged at the initial attendance in 17 instances and between two and 135 days were required for definitive fracture recognition. All but nine patients required alteration in treatment because of fracture detection.

Conclusions—Clinical suspicion of fracture at initial A&E attendance should prompt organised follow up even in the face of normal plain x rays. Consideration should be given to alternative imaging techniques which may have a higher resolution than plain x rays. Close corroboration between A&E and radiology departments has benefits in patient care in this group of patients and may lead to a reduction in functional disability and litigation.

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Keywords: fractures; x ray diagnosis; accident and emergency department; missed diagnosis.

Radiology plays an important role in the identification of fractures in acute trauma patients in accident and emergency (A&E) practice. However, previous reports have highlighted potential shortcomings with plain x rays. The difficulty in the case of scaphoid fractures has been widely publicised, and the more widespread use of bone scans in this condition has been advocated.¹ Similarly, the problem in

evaluating occult femoral neck fractures is also well known and the value of computerised axial tomography (CT) and magnetic resonance imaging (MRI) has been explored.² Delayed diagnosis may lead to increased functional disability and litigation. Against this background a 16-month prospective study of proven fractures not visible on initial plain x rays was carried out in a large A&E department to estimate the incidence and spectrum of delayed fracture recognition and to examine ways in which the overall management might be improved.

Methods

The inclusion criteria selected for patients in the study group was as follows:

- A&E attendees with a recent history of trauma.
- Plain x rays taken at the first attendance with the following stipulations:
 - (1) correct views for the particular fracture concerned
 - (2) good quality films
 - (3) reported as normal by a consultant radiologist
- A definite fracture seen on subsequent diagnostic imaging:
 - (1) for the same injury
 - (2) no history of interim trauma
 - (3) reported as a fracture by a consultant radiologist.

Senior staff in the A&E department (consultants and senior registrars) and radiologists attending a weekly A&E clinicoradiological conference (trauma radiologist and radiology trainees) were informed of the study and recruited as case collectors. A list of patients fulfilling the inclusion criteria was compiled by liaison with the principal investigator from the following sources:

- (1) Daily A&E review clinics staffed by senior A&E staff seeing all booked return patients;
- (2) Unbooked return patients to the A&E department all of whom are seen by senior staff if at all possible;
- (3) Patients admitted to the A&E ward run by senior staff;
- (4) x rays brought to the weekly conference by A&E seniors and radiologists;
- (5) Correspondence letters from other departments on patients who had attended the A&E department;
- (6) Informal feedback from colleagues from other specialities about patients who had attended the A&E department.

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Table 1 Age characteristics of patients in the study group

Age group	Number of patients
≤ 5	4
6-16	10
17-30	11
31-50	9
61-65	6
≥ 66	15
Range	1-94 years
Mean	41 years
Male:female	6:5

Table 2 Delays from initial A&E presentation to definitive fracture diagnosis

Delay in days	Number of patients
0-7	6
8-14	15
15-30	17
31-50	12
> 50	5
Mean	27
Range	2-135

Results

During the study period 67 822 new patients were seen in the A&E department, 10 014 of whom were diagnosed as having a fracture at the first attendance. A total of 57 patients fulfilling the inclusion criteria for the study was trawled from this caseload. Further cases undoubtedly did slip through the net but were outside the scope of the collection methods. From these 55 patients, case notes and x ray

folders were retrieved and examined three months after the end date of the study and analysed for 27 relevant variables.

Table 1 shows the age characteristics of the 55 patients in the study group. The grade of doctor seeing the patient at first presentation to the A&E department was a senior house officer (SHO) in 46 cases, a senior registrar in four, and a consultant in five. The injury occurred on the day of initial attendance in 34 cases, on the previous day in nine, two days before in seven, three days before in three, and 10 days before in two. The mechanism of injury included falls (38), road traffic accidents (6: motorcycle 4; pedal cycle accidents 2); sports injuries (10); crush injuries (3); assault (1); and a bad military parachute landing (1).

A comment noting clinical suspicion of fracture was recorded in 38 case notes. Initial treatment included admission in eight instances; application of plaster of paris in 14; support bandage in 24; analgesia alone in three; aspiration of a joint in one; and no specific treatment in five. Follow up arrangements as decided at initial consultation was as follows: 28 were given A&E review clinic appointments and one a fracture clinic appointment; one was sent for review to his family doctor; eight were admitted; three were asked to return to the A&E department if symptoms persisted; and 14 were given no formal follow up advice.

The time to definitive follow up, defined as the delay between initial presentation to the A&E department and the time of positive diagnosis of a fracture by repeat diagnostic imaging, ranged from two to 135 days. The distribution of delays is illustrated in table 2.

Table 3 shows the mechanism and location of fracture recognition. These are divided into those in the left hand column where follow up had been arranged at initial attendance at the A&E department and those in the right hand columns where no formal follow up had been arranged. Of the 17 patients not given follow up arrangements, 12 returned to the A&E department with persisting pain and five were referred back by their family doctor.

The commonest symptoms prompting repeat imaging were persisting pain (36 patients) and restriction of joint movement (six cases). The commonest signs were persisting tenderness (37 cases), decreased range of movement (eight cases) and swelling (six cases).

The anatomical distribution of fractures is illustrated in table 4.

The imaging mode involved in definitive fracture recognition was plain x ray in 41 instances, bone scan in six cases; CT in six cases (including one CT arthrogram), and MRI in two cases. Representative examples are shown in figs 1 and 2.

The alteration in treatment resulting from fracture detection included instigation of a new plaster of paris in 11 patients and a splint or support bandage in 12 others. Five patients required operative intervention, comprising two therapeutic arthroscopies, two dynamic hip screws, and one hemiarthroplasty of the hip. A further three patients required admission for bed

Table 3 Point of fracture detection

Follow up arranged	Fractures found	Follow up not arranged	Fractures found
A&E review clinic			
First review clinic	15	GP referral back to A&E	5
Second review clinic	7	Returned in pain to A&E	12
Third review clinic	6		
Fracture clinic	1		
Admissions			
A&E wards	6		
Orthopaedics	1		
Medical	2*		

* One patient with follow up arranged through her GP was subsequently admitted to Care of the Elderly where a fracture was found.

Table 4 Anatomical distribution of fractures

Wrist	24	Scaphoid	15	Waist	7
				Tubercle	3
				Distal pole	3
				Proximal pole	2
		Distal radius	8	Undisplaced	7
				Intra-articular	1
		Lunate	1		
Pelvis/hip	9	Neck of femur	4	Undisplaced	3
				Displaced	1
		Greater trochanter	1		
		Pubic ramus	2		
		Sacrum	1		
		Coccyx	1		
Ankle/foot	7	Ankle	4	Lateral malleolus	2
				Talar dome	2
		Calcaneum	1		
		Foot	2	Metatarsal	1
				Proximal phalanx	1
Tibia	7	Shaft	4		
		Lower	3		
		Upper	1		
Miscellaneous		Lower femur	1		
		Distal humerus	1		
		Radial head	1		
		Clavicle	1		
		Rib	1		
		Lumbar spine	1		
		Transverse process	1

Plain x ray (left) showing healing fracture of the left tibia taken three months after a crush injury between a boat and a pontoon in a 37 year old male. Initial x ray (right) was normal and the patient was thought not to have a fracture. The patient was referred back to the A&E department for x ray by his general practitioner with continuing tenderness and a palpable mass. The injury was initially treated with support bandage. Outcome was good with six weeks of plaster of paris treatment following diagnosis of fracture.

Bone scan showing high uptake across the pertrochanteric line in keeping with a pertrochanteric fracture in a 94 year old female performed five days after a fall. The patient had initial normal x ray and was admitted to the A&E ward for mobilisation. Mobilisation was unduly slow so bone scan was done. The patient had a repeat x ray at 10 days and subsequently had a dynamic hip screw for a displaced basicervical fracture. Outcome was good.

rest. Only nine patients had no alteration in treatment, the remaining patients having physiotherapy or having their existing plasters or support bandage treatment prolonged.

Discussion

Plain x rays currently form the mainstay of diagnostic imaging used in A&E practice.³ However, initial plain radiography has its limitations. Delays in fracture diagnosis may lead to increased functional disability.⁴ Missed orthopaedic injuries remain the leading cause of malpractice claims in emergency medicine.⁵

In this study we examined the incidence (with limitations caused by the logistics of collecting methods) and spectrum of fractures not visible on initial adequate plain x rays in a representative A&E practice. The true incidence is undoubtedly greater than that shown. Nevertheless, the problem is highlighted and some of the strengths and failings of the system in dealing with the problem are shown.

The value of a readily accessible system for planned follow up of A&E patients in the form of A&E review clinics (28 fractures found) is illustrated. Clinical responsibility for patients with a differential diagnosis of soft tissue injury or fracture traditionally rests with the A&E department until referral can be made to the orthopaedic service when a fracture has been clearly demonstrated. Review clinics provide a useful method of dealing with this important group of conditions. Education of SHOs (46 patients seen at first attendance) at the start of their A&E posts on the appropriate referral of clinically suspicious categories of injuries to these clinics will reduce the number of patients (17) not sent for follow up. Follow up clinics should optimally be manned by senior staff, as findings on repeat x rays in the study were often subtle and decisions regarding the appropriateness of alternative and often costly imaging may have to be made. In the study, definitive fracture diagnosis took anything between two and 135 days. This level of service is possible in larger departments and provides a useful forum for audit and feedback for A&E staff, but in smaller units a definite decision may have to be made at an early stage to refer on to fracture clinics.

Patients returning to the A&E department with persisting symptoms (17 in the study) are best seen by senior staff who can plan further management at this opportune time and decide on the suitability of alternative imaging. If possible, patients should be encouraged to return to A&E departments during normal working hours when senior staff are more available and when full imaging facilities are accessible.

The benefit of an A&E ward run by senior A&E doctors for admission of patients for further observation and investigation is shown (six fractures diagnosed). This service proved especially useful for the difficult group of x ray negative hip/pelvic injuries in the elderly, who are unable to mobilise—a group difficult to place with other services. Those who could not be mobilised after a period of observation had other imaging, and six fractures were found.

The benefit to patient care of radiographic audit has been shown before.⁶ Most of the 55 cases were discussed at the weekly clinicoradiological conference which provided a useful forum for discussion and definitive opinion on x rays, together with advice on the appropriateness of further imaging. Informal audit of both departments was implicit in this arrangement.

Certain anatomical regions yielded the highest numbers of fractures. Careful follow up is advised in injuries to the wrist, pelvis/hip, ankle/foot, and the leg. Though the problem of occult fractures of the scaphoid is well known,

the study highlighted distal radial fractures (eight in the study), particularly undisplaced fractures, as an area for particular vigilance. Two toddler's⁷ fractures were identified and patients in this group should be followed up by repeat x ray at two weeks if still not weight bearing. Two troublesome ankle injuries were resolved by therapeutic arthroscopies following MRI demonstration of osteochondral talar dome fractures.

Fourteen fractures were picked up on imaging modes other than plain x ray. The superiority of other imaging techniques has previously been shown in the case of bone scanning for scaphoid fracture,⁸ and a role for magnetic resonance imaging⁹ and bone scanning¹⁰ has been advocated in the A&E setting. These techniques are becoming increasingly available in A&E. In our study we found bone scan useful in scaphoid fractures and fractured neck of femur: CT in neck of femur and scaphoid fractures, and MRI in ankle fractures.

CONCLUSIONS

Negative initial plain x rays are not always conclusive evidence of the absence of a fracture in A&E trauma patients. Persistent organised review by experienced A&E staff with direct involvement of the radiology department in the face of continuing clinical suspicion will help to detect these occult fractures. Other imaging

techniques should be considered in consultation with the radiologists. The responsibility for patients in this group rests with the A&E department until a fracture is positively identified. Review clinics run by A&E senior staff, a follow up protocol for junior A&E staff, and clinicoradiological meetings and audit will help to reduce disability in these patients and reduce the likelihood of litigation.

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