Session III

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Stress Fractures in Athletes

Definition
A stress fracture occurs in the normal bone of a normal person with normal use and no injury. It may be partial through one cortex, or complete through both cortices. There are two main types: distraction and compression. The former are the more common in athletes. Fig 1 shows the runner's fracture in the lower end of the fibula, which has involved both cortices and is of the distraction type. Fig 2 shows the compression stress fracture that may occur in the neck of the femur, in this case in a girl of 20 who was a tennis player.

The difference between the two varieties is that one occurs from a bending strain on the bone and the other from a compression strain. In athletes, apart from the neck of the femur, the calcaneum is the only other bone commonly to be affected by a compression stress fracture.

Very often stress fractures may take not only weeks but months to be confirmed radiographically. Thus it is of the utmost importance to be able to recognize the lesion clinically.

How Stress Fractures Affect Athletes
In athletes who run, stress fractures are common in the metatarsal bones, the fibula and the tibia. More rarely the patella and femur are affected. In the upper limb, cricket, baseball, or other throwing may cause stress fractures of the humerus, javelin throwing affects the elbow, and tennis and similar sport may cause stress fractures of the ribs.

Symptoms
First the athlete will notice pain, usually after his sport has finished, which is a mild and slight ache. If sport is continued the ache will recur towards the end of the sport and, with further continued training, it starts earlier and earlier and continues to get worse until the sport is stopped. It is at this stage, when the athlete usually seeks advice, that the danger lies in failing to make the diagnosis clinically, because rest for two or three days will relieve the pain of the stress fracture and, unless correctly guided by the medical adviser, the athlete will return to sport. However, the pain will soon recur with renewed intensity; training will again be interrupted and the further rest will give the same pattern of relief. This cycle of pain and rest may ruin a whole season of sport.

Occasionally a stress fracture in certain bones, such as the metatarsal shafts or the fibula, will present suddenly with pain severe enough to stop the athlete, quite literally, in his tracks. Even so, it is often possible to elicit a history of a very mild ache for some while before the sudden onset.

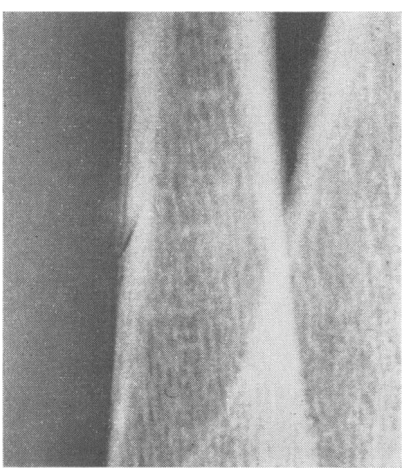

Fig 1 *A runner who sustained a stress fracture of the fibula. The crack in the outer cortex and the new bone formation is well seen three weeks after the onset. A slight haze of new bone on the medial side indicates the fracture is complete*

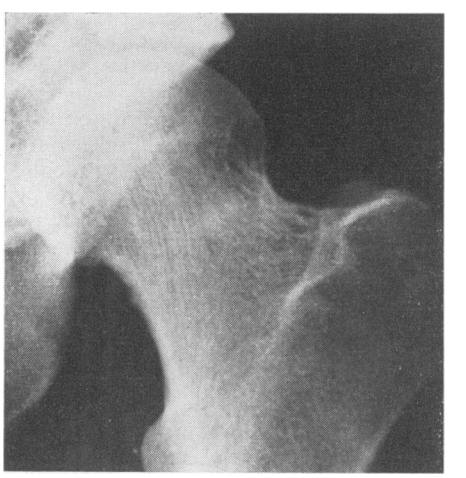

Fig 2 *The left femoral neck of a 20-year-old girl, a tennis player, shows internal callus formation and a very small amount of new bone on the inferior surface of the neck. This is a compression stress fracture and was treated by rest from sport only*

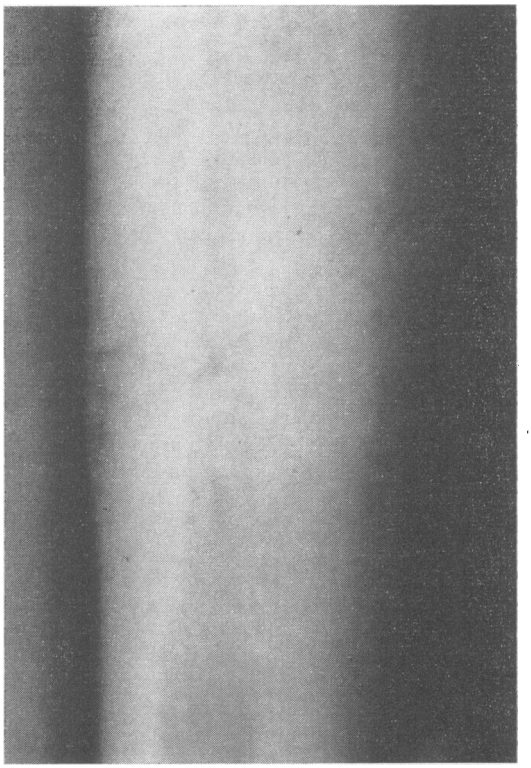

Fig 3 *A 'ballet dancer' type of stress fracture of the tibia, but in a footballer. On the anterolateral aspect a horizontal crack goes through the cortex and then extends obliquely upwards to make this fracture complete. Further sport did, in fact, displace this fracture. This type is dangerous*

It is probable that this type of onset indicates that a fracture through one cortex has suddenly become complete through both cortices.

The past history and general condition of the athlete are usually in no way remarkable, with the complete fitness associated with such patients.

Signs

Local swelling is sometimes seen, but with difficulty even in subcutaneous bones. Local tenderness and local swelling can always be felt, and often seems hard to the examining finger, but this does not indicate callus formation because it is at first only soft tissue reaction and the fracture hæmatoma; it will not show radiographically. Springing the affected bone may cause pain at the site of the stress fracture, but not necessarily so.

Investigations

All investigations of the blood and metabolism of the athlete will be normal. Biopsy, when it has been done, has shown only the normal physiological process of repair of a fracture. Radiographs are always slow to be confirmatory.

Treatment

Most stress fractures heal with rest only. Stopping the sport which causes the pain is usually sufficient, supplemented by elastic adhesive strapping, with which normal walking is usually pain-free, so that the week-end athlete may continue to work at his desk, provided he does not induce pain. Local injection of anæsthetics, hydrocortisone and other medicaments are futile; they only encourage the athlete to continue training, and thus to prolong his disability. Occasionally, stress fractures need urgent and specific treatment, particularly in ballet dancers (Burrows 1956) who develop stress fractures of the middle of the shaft of the tibia; if dancing is not stopped forthwith the tibia may break completely and displace with disastrous results thereafter (Fig 3). Occasionally, this type of stress fracture is seen in other athletes. The patella also requires immediate immobilization to prevent separation of the fragments, which would necessitate operation (Devas 1960*b*, Fig 4).

Prevention

Normally there is little to be done to prevent a stress fracture in runners, other than to ensure that normal training procedures are followed. It has been shown by Devas & Sweetnam (1956) that stress fractures of the fibula occur more frequently in winter in runners who train on hard

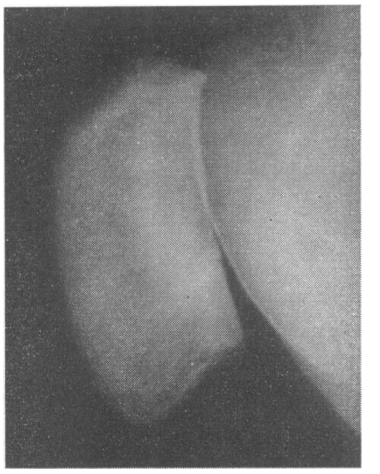

Fig 4 *The patella of a tennis player who got pain in his knee. When first seen the radiograph showed a hairline crack; a short while later separation occurred because he continued to walk with the knee unprotected, and operation was necessary*

pavements. Because the fibula is not a weight-bearing bone, the hardness of the surface must have an indirect relationship to the stress fracture and it can only be explained by the increased muscular activity to soften each footfall when running on a hard surface as opposed to one that is softer. This has been demonstrated experimentally by the same authors, and it can be shown that the fibula moves appreciably towards the tibia when strong muscle contracture of the calf occurs. There is little doubt that the more a bone is used the stronger it gets. Therefore, apart from thick, soft-soled shoes, which may be helpful, proper and correct training is essential.

Specific Types of Stress Fractures in Athletes

The commonest stress fracture in athletes is of the metatarsal bone, after which comes the fibula, but the most important is the tibia.

Metatarsal Stress Fractures

March fractures are well known, their signs and symptoms well recognized. The bones are subcutaneous and can be palpated easily, and there should be no excuse for failing to diagnose this fracture within a day or two of its onset. Usually radiographical confirmation is never delayed more than three or four weeks. If too much activity is continued the bone may be displaced more than if rest is ensured, so any athlete suspected of a metatarsal stress fracture should rest until the diagnosis is confirmed or disproved.

The Fibula

The lower end of the fibula is a very common site for a stress fracture in runners, and the signs and symptoms are classical. It may take three weeks or longer for a stress fracture to show radiographically, particularly in those athletes in whom rest has been enforced from the onset of symptoms. The fracture usually occurs 3–4 cm above the tip of the lateral malleolus, but it may occur as high as the middle of the shaft. In runners it never occurs in the upper part of the fibula, which is where the parachutist sustains a fracture that is probably not a true stress fracture. The stress fracture of the lower fibula, the runner's fracture, takes a month to heal, and during this time no activity may be allowed that induces any discomfort or pain. Normally elastic adhesive strapping is sufficient. At the end of one month very gentle and very limited training may be started, best achieved by use of timed skipping, and if no pain occurs at the fracture site then or on the following day the training is increased and graduated for a further two weeks. If pain occurs during this period at least two weeks' rest from activity is indicated before training is started again.

The Tibia

This is perhaps the most important stress fracture because, although not the commonest, undiagnosed it may lose a potential champion his chance of success (Devas 1958).

The classical signs and symptoms are well known to the athlete under one or another term, such as shin soreness (Devas 1967). Towards the end of sport the shin becomes sore, there is a little swelling and perhaps in the evening swelling of the ankle is noticed. The next day there is no pain, sport is continued but again the shin becomes sore with continued activity. Very careful examination at this stage will reveal a point of tenderness, usually, but not always, on the anteromedial aspect of the shin in its lower third. Very rarely is the medial malleolus the seat of tenderness. It takes about one month for the fracture to show radiographically (Fig 5). If sport is continued the shin soreness prevents full achievement and spoils training. The athlete will seek various remedies and, when finally a radiograph is taken, the stress fracture will be very obvious; but by this time even walking will be painful.

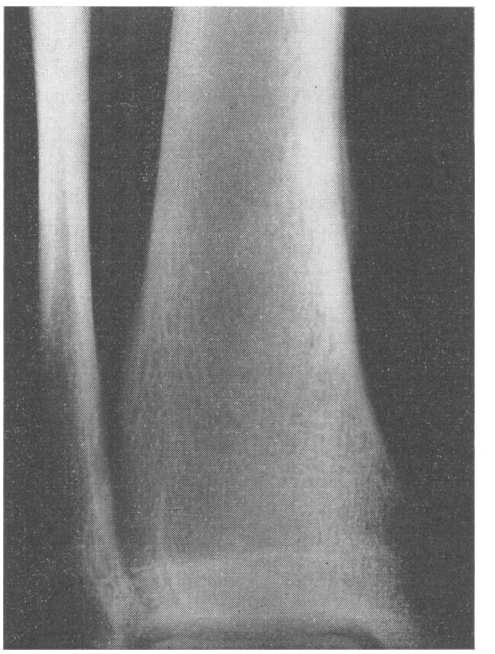

Fig 5 *The classical 'shin soreness' type of stress fracture some three weeks after onset, when the callus can just be seen to be forming on the medial aspect of the lower third of the tibia*

In the early diagnosed case six weeks' rest is usually sufficient (Fig 6) and then training may be started as for the fibula. In certain athletes, two or even three months may pass before union is secure, but on no account should any attempt be made to hasten return to sport by trying to 'run off' the pain or by other such methods.

The Femur

Compression stress fractures in the lower part of the femur do occasionally occur (Devas 1963), and the longitudinal stress fracture, such as (usually) occurs in the tibia, may also be seen (Devas 1960*a*). This is a variety of the oblique stress fracture running upwards, and may extend to several inches up the shaft. However, the neck of the femur in athletes engaged in heavy sports sustains either a compression stress fracture (Fig 2) or, occasionally, a distraction stress fracture of the femoral neck which may displace and must be treated in hospital; such fractures are more commonly seen in recruits unused to heavy training. The compression stress fracture of the femur merely requires rest, but internal fixation should be used for a fracture that threatens to displace.

The Patella

Normally the patella is rarely affected, but both longitudinal and transverse stress fractures may occur. On diagnosis the leg must be immobilized in a plaster cast in extension to prevent separation of the fragments (Fig 4). The lateral part of the patella may break off in a longitudinal fracture, and this may have to be excised, because once displaced it will not reduce (Devas 1960*b*). In the younger athlete a bipartite patella may cause symptoms and prevent training because of avulsion of the smaller portion of the patella. Excision of the fragment will return the athlete to full sport.

The Ribs

A stress fracture of the upper ribs gives pain down the arm and very rarely causes local pain at the site of the fracture except on palpation (Devas 1963). Tennis and similar sport will cause these fractures. Again the diagnosis is initially on clinical grounds, confirmed later by radiography; rest from any activity that causes the pain will allow sport to be started in four weeks.

The Humerus

Any throwing sport may cause a stress fracture of the humerus, and although it has been described in the literature in baseball players (Wilmoth 1930, Bingham 1959, Brogden & Crow 1960, Adams 1965), I do not believe that it was recognized as a stress fracture. Again, a careful

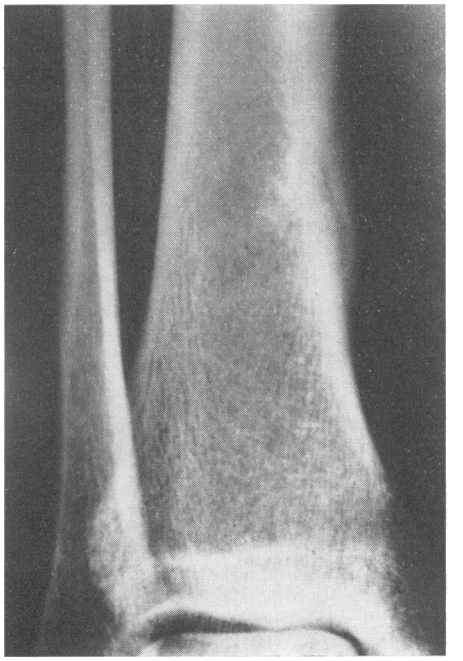

Fig 6 *The same patient as in Fig 5 two months after the onset of symptoms. The fracture has almost healed but the crack through the cortex now shows up, very much better. Radiographic changes are always slow*

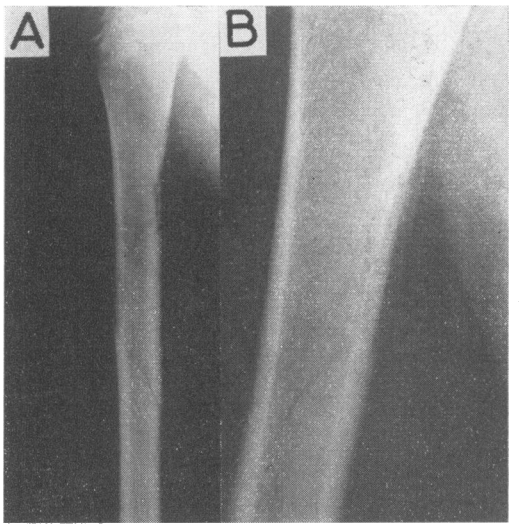

Fig 7 A, *a 16-year-old cricketer had aching in his arm with fielding practice and similar throwing activities. After one throw severe pain occurred and his arm fell useless to his side; the stress fracture had become complete.* B, *the magnified view shows that the fracture had been present for some time; there is callus medially. One year later at follow up the arm and the radiograph were normal*

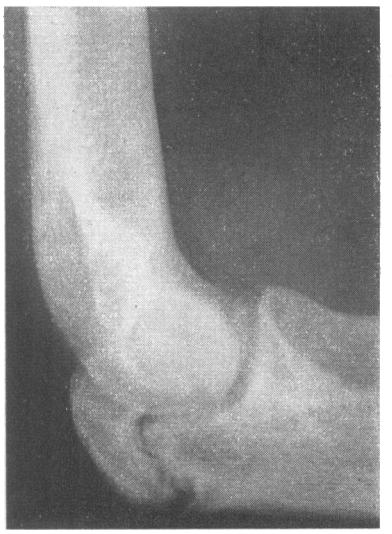

Fig 8 *The olecranon in a javelin thrower aged 18. The fracture has extended right through the central part. This sort of fracture might best be treated by early internal fixation*

history will reveal that the athlete felt a sudden acute and very severe pain in the upper arm which caused the limb to drop useless to his side, and that, over the previous weeks, there had been an increasing but slight ache. The stress fracture has started in one cortex and the weakened bone with continued use has suddenly broken completely (Fig 7A, B). Simple splinting and rest of the part until clinical union has been achieved are all that is necessary.

The Ulna and Elbow

The ulna and elbow are taken together because, particularly in the javelin thrower, the lesion is, as it were, of the whole joint (Waris 1946, Herzmark & Klune 1952). The javelin thrower's elbow is a fracture through the olecranon. The example shown (Fig 8) is unusual in its severity, but the whole elbow sustains far more injury than is usually recognized in this particular sport. Avulsion fractures of the epicondyles can occur, particularly of the lateral epicondyle, and the loss of time from sport may be very considerable. Again rest is usually all that is necessary, although a case may be made out for early internal fixation of the fractured olecranon.

Stress Avulsions

In those in whom the epiphyses are not yet closed, avulsions are not uncommon. Perhaps all stress fractures of the patella should be included under this title, because it is a sesamoid bone. The anterior superior iliac spine, the anterior inferior iliac spine, the rectus attachment and the lesser trochanter can all be avulsed in the region of the hip. It is too controversial to go into the etiology of Osgood-Schlatter or Larsen-Johansson lesions here, but I believe them to be simple avulsions. The ischium can be affected in certain sports, particularly hurdling, from the pull of the hamstrings in the position of extreme flexion of the hip as occurs with the leading leg in hurdlers.

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Knee Injuries in Athletes
[*Abridged*]

There are certain athletic injuries of the knee-joint with serious implications for future function if they go unrecognized, misdiagnosed or untreated in the acute stage.

Rupture of Medial Ligament

The vital and vulnerable single structure of the knee-joint in contact games is the medial ligament. American football appears worst because it seems to condone tackles designed to rupture this ligament. But it can happen in the British games, in a tackle, when the scrum collapses or when an opponent falls against the outer side of the outstretched leg. The seriousness of the injury lies, first, in that it is so easily missed or misdiagnosed and, secondly, in the concomitant damage to other important components of the joint. The injury is missed because the medial capsule is torn, permitting the products of injury to gravitate into the calf with resultant absence of swelling. Furthermore, and in contradistinction to displaced meniscus tears, the patient is able to walk by bracing the quadriceps. An inexperienced casualty officer unfamiliar with the implications of the mechanism, and in the absence of positive