STRESS FRACTURES IN ATHLETES

by

K. E. DOWEY¹ and G. W. MOORE²

DURING the last decade there has been a growing interest in competitive sports with particular emphasis on keeping fit by jogging and marathon running. This has been made manifest by the increasing numbers of athletes who seek medical attention for lower extremity pain.

The differential diagnosis includes musculo-tendinous injury, tibial compartment syndrome, tenosynovitis, intermittent claudication of the athlete and stress fracture. A presumptive diagnosis of stress fracture is based on the history and physical findings. In the past, confirmation of stress fractures has been delayed until x-rays showed an abnormality, often from three weeks to three months after the onset of symptoms. We have found the radionuclide bone scan to be more sensitive, allowing earlier confirmation of stress fractures in athletes and thus avoiding prolonged disability.

PATIENTS AND METHODS

During the period March 1981-December 1983, 1277 athletes attended the Sports Injury Clinic at the Belfast City Hospital and within this group 35 stress fractures (2.7%) were recorded. There were 23 males (72%) and 9 females (28%). The age range was 16-50 years, the average age being 22 years. The series consisted of 28 middle- and long-distance runners, one high jumper, one netball player, one gymnast and one ballet dancer. The lower two-thirds of the tibia was the most frequently involved bone, with 18 (51%) stress fractures occurring at this site.

| Tibia | Fibula | Metatarsals | Pubic Arch | Total |
|-------|--------|-------------|------------|-------|
| 10    | 3      | 5           | 1          | 19    |
| 8     | 3      | 1           | 1          | 12    |
| 1     |        | 1           | 1          | 1     |
| 1     |        | 1           | 1          | 1     |
| 1     |        |             |            | 1     |
| 19    | 8      | 7           | 1          | 35    |

¹ Consultant Physician, Accident and Emergency Department, Belfast City Hospital.
² Consultant Radiologist, Belfast City Hospital.
CLINICAL ASPECTS

The athlete is most often a middle- or long-distance runner. He complains initially of insidious onset of an ache or soreness of the lower leg or foot. Most commonly the pain is localised to the medial aspect of the shin, the lateral aspect of the lower fibula or the mid forefoot. At first it is felt only at the end of a run but gradually it comes on earlier and earlier.

On physical examination tenderness can be elicited over the bone at the involved site. Although the tenderness may appear to extend along the periostium or tendinous structures for some distance either proximally or distally, there is usually a point of maximum intensity at the site of fracture. When the tibia is involved, a little oedema may be present early, and at a later stage a definite thickening of the subcutaneous surface can be appreciated.

DIAGNOSIS

Radionuclide scans were performed on 45 patients with lower limb pain, but with normal radiographs. All patients were injected with 555 MBq of Technetium MDP bone scanning agent two hours prior to the examination. The lower limbs were then imaged with a gamma camera. Views were taken as required to demonstrate the regions of interest and to localise any site of increased isotope uptake. Particular attention was taken to include the contra-lateral region and to exclude additional lesions at other levels. 26 of these scans were positive, confirming the clinical diagnosis of stress fractures (19 tibia, 5 fibula, 1 metatarsal and 1 inferior pubic ramus).

Retrospective correlation with subsequent radiographs indicated that those lesions which showed a localised area of increased uptake were more likely to produce radiographic changes later. Those lesions with a more diffuse pattern of lower intensity uptake, particularly the 'shin splint' variety in the tibiae were less likely to show later radiographic changes.

A total of only 9 stress fractures (6 metatarsals and 3 fibulae) out of 45 were diagnosed from the history, clinical findings and radiograph alone, and bone scans were not required in these cases. Thus radionuclide scan increased the number of stress fractures diagnosed from 9 to 35.

SPECIAL FEATURES

Stress fractures were noted to be multiple and/or bilateral in several cases. These were not always symptomatic at the time of examination, and possibly represent less severe lesions and other pre-existing lesions which had almost healed.

One 20-year-old middle-distance runner who represented his University sustained three consecutive stress fractures over a period of 11 months. In January 1983 the bone scan indicated a stress fracture of the lower third of the left tibia. He rested for six weeks and symptoms cleared. He presented again in July 1983 complaining of increasing pain in the right shin, and bone scan at this time confirmed the presence of a stress fracture in the lower third of the right tibia. Again he rested for six weeks but returned again at the beginning of December 1983 with recurrence of pain in
both legs but especially the right, and once again the bone scan was positive. On each occasion initial radiographs had been normal but later follow-up films indicated healing. Recurrence of symptoms in this patient may possibly be related to the fact that he displays a certain degree of lower limb malalignment, with increased external tibial torsion and foot hyperpronation.

Another 35-year-old jogger training for the Belfast Marathon presented in early April of that year complaining of bilateral shin pain. Bone scan indicated that there were stress fractures of the lower thirds of both tibiae. On further questioning it was apparent that, although he was a highly motivated individual, he followed a relatively undisciplined training regimen, having increased his weekly mileage over the previous 4-6 weeks much too rapidly.

DISCUSSION

Stress fracture was first described in soldiers by a German army physician Breithaupt in 1855 and could be defined as a partial or complete fracture of bone due to inability to withstand stress that is applied in a rhythmic, repeated manner. Devas divides stress fracture into three groups. The first is the compression type, in which stress is directly transmitted to the bone with resultant collapse of the normal architecture. The second group he calls the distraction type, due to repeated bending of the bone away from the cortical margin at which the injury appears. The third group is related to muscle exertion. He describes this as the ‘shin splint’ variety due to violent and repeated muscular contraction, which not only produces a periosteal tear but also causes microstress fractures along the periosteal margin of the tibia.

We found only one of the compression type. It occurred in the ballet dancer and was located in the upper third of the tibia. The other 18 involved the middle and lower thirds of the tibia and were of the ‘shin splint’ variety, all occurring in runners. Those involving the fibula and located just above the tibio-fibular syndesmosis were of the distraction type, strong muscular activity drawing the fibula towards the tibia.

More than half of all fractures were located in the tibia, and this is similar to the observation may by Orava et al. In common with other writers on the subject, we found that most of our patients were middle- or long-distance runners. In Garrick’s series of 23 athletes with bone pain and positive radionuclide images, only six had positive radiographs. Similarly we have noted that out of the total of 35 stress fractures only 9 could be detected on straight radiographs.

It has been suggested that early treatment may prevent the development of radiographic changes in patients with stress fractures. The importance of early detection and treatment is related to the fact that undiagnosed stress fractures can progress to complete fractures with displacement. The best treatment for all stress fractures is rest from any activity which causes pain. Rest allows the reparative phase of remodelling to catch up with the resorptive phase. Plaster of Paris is not indicated except for those unusual cases where multiple fractures are present or where there is significant pain with ordinary daily activities. When there is no longer any pain or tenderness at the fracture site, the patient is allowed to start gentle training, which is gradually increased to full training over 4 to 6 weeks, provided there are no further symptoms. The prognosis is generally good and complications are rare.
SUMMARY

Between March 1981 and December 1983, 35 stress fractures were diagnosed in 1277 athletes attending the Sports Injury Clinic. A total of 31 (88%) fractures occurred in middle- and long-distance runners. The most frequently involved sites were the middle and lower thirds of the tibia, as displayed in 18 cases (51%). 26 patients who presented with lower leg pain and normal radiographs were found to have positive radionuclide scans confirming the diagnosis of stress fracture, while only 9 patients were diagnosed as having stress fracture by radiograph alone. Stress fracture in the athlete is a unique injury demanding a high degree of suspicion on the part of the sports medicine physician, coach or trainer. Early and accurate diagnosis and treatment is essential to avoid prolonged disability and to enable early return of the athlete to his or her activity.

REFERENCES

1 Devas MB. Stress fractures. London and New York: Churchill Livingstone, 1975: 19-27, 113-116.
2 Devas MB. Stress fractures of the tibia in athletes or 'shin soreness'. J Bone Joint Surg (Br) 1958; 40: 227-239.
3 Orava S, Puranen J, Ala-Ketola L. Stress fractures caused by physical exercise. Acta Orthop Scand 1978; 49: 19-27.
4 Ryan AJ. Leg pain in runners. Physician Sports Med 1977; 5: 42-53.
5 Clancy WG. Lower extremity injuries in the jogger and distance runner. Physician Sports Med 1974; 2: 47-50.
6 Brubacker CE, James SL. Injuries to runners. Amer J Sports Med 1974; 2: 189-198.
7 Garrick JG. Radionuclide imaging for painful stress fractures. Presented at the 43rd Annual Meeting of the American Academy of Orthopaedic Surgeons, New Orleans, 1976.
8 Willcox JR, Moniot AL, Green JP. Bone scanning in the evaluation of exercise-related stress injuries. Radiology 1977; 123: 699-703.
9 Geslien GE, Thrall JH, Espinosa JL. Early detection of stress fractures using 99m Tc-polyphosphate. Radiology 1976; 121: 683-687.