

## ORIGINAL ARTICLE

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## Early diagnosis of stress fracture of the lumbar spine in athletes

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**Abstract** Thirty-three athletes complaining of back pain of more than 1 months' duration and with normal radiography of the lower spine were all studied by scintigraphy and in 24 of them with single photon emission computerized tomography. A stress fracture was considered present if localized increased uptake was seen at a vertebral level. Scintigraphy showed increased uptake in 17 of 33 patients and single photon emission computerized tomography in 16 of 24 patients.

**Résumé** 33 athlètes se plaignant de lombalgies depuis plus d'un mois avec des radiographies normales de la colonne lombaire ont été étudiés. Tous ont eu une scintigraphie, et 24 un scanner. A été retenu comme signe de fracture de fatigue, l'existence d'une augmentation de densité à un niveau vertébral. La scintigraphie montrait une telle augmentation chez 17 des 33 patients et le scanner chez 16 des 24 patients. On conclut que même si la scintigraphie est normale, on ne peut pas rejeter le diagnostic de fracture de fatigue.

### Introduction

Stress fractures constitute 3–5% of all chronic sports injuries [5]. In the lumbar spine they tend to occur at the fifth vertebra although all the vertebrae may be affected [1, 3, 7, 8, 11, 14]. Stress fractures often go undetected because radiological findings are scarce. Localized sclerosis in the area of a fracture is only noted when the process is in an advanced stage. The natural course is

followed by the appearance of a lysis in the affected area. This can be clearly detected by radiological enhancement. However, proper treatment of stress fractures avoids the development of spondylolysis. Thus, early detection is very important [1, 7, 8, 10, 11].

Scintigraphy with technetium-99 m (Tc99) enables lumbar stress fractures to be detected before they are radiologically visible [3, 7, 8]. However, some authors have shown that the capacity to diagnose this entity is limited when only planar studies are made. Therefore, the use of single photon emission computed tomography (SPECT) is recommended. This does not only increase the sensitivity in detecting abnormal tracer activity, but also helps pinpoint the vertebrae where it is located [3, 12, 13].

The authors who advocate SPECT for diagnosing lumbar stress fractures, base their recommendations on experience with children and adolescents [3, 13]. Lumbar pain in these younger age groups stems mainly from the posterior arch of the vertebrae, contrary to adult cases, where the cause usually is located at the disc level [10]. However, sporting activities that involve lumbar spine hyperextension, the main cause of stress fractures, are performed by young people and adults, so that both age groups may be affected.

In order to confirm the value of planar scintigraphy and SPECT in early diagnosis of lumbar stress fractures, the present study considers a group of athletes who reported chronic lumbar pain and whose radiographic findings did not present abnormalities of the lumbar spine.

### Patients and methods

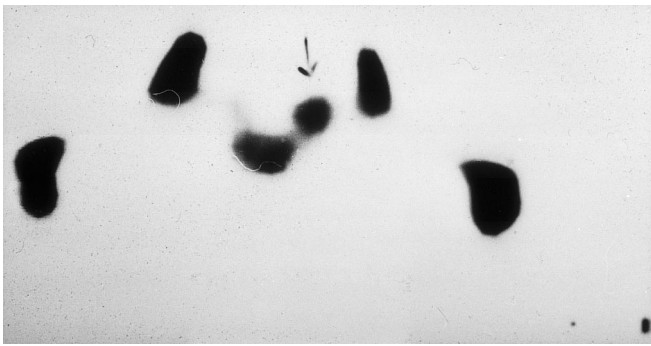
Thirty-three athletes complaining of sport-related lumbar pain were studied. The criteria for inclusion in the study were: (1) presence of lumbar pain of unknown origin for more than 1 month not alleviated by medical treatment; (2) anteroposterior, lateral and oblique radiographic enhancement not showing any abnormalities; and (3) no previous lumbar surgery.

The mean age of our patients was 21 years (ranging from 11 to 43). Sixteen of them were younger than 21 years and 17 were older. The distribution by sport was: 14 wrestlers, 3 basketball play-

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**Fig. 1** Single photon emission computerized tomography (SPECT) image in which a unilateral increased uptake of radio tracer is shown (arrows) at the level of the pars interarticularis of a lumbar vertebra

ers, 3 tennis players and the rest practiced other sports. In 20 of these cases the symptoms had lasted less than 3 months; in 8 between 3 months and 1 year; and in 5 for more than 1 year. A computerized axial tomography of the lumbar spine was carried out in 16 patients, with no abnormalities detected.

Scintigraphy was performed 3 h following intravenous injection of 20 mCi (720 MBq) Tc99m in adult patients, and 0.2 mCi per kg of body weight to those under 18 years. Single plane images, in anterior and posterior projections, were taken (750,000 counts per image) with an Apex 409 Ag (Elsint) gamma camera equipped with a high resolution collimator. In 24 patients SPECT was also performed, using a rotating gamma camera. Images were reconstructed by filtered retroprojection.

## Results

Planar scintigraphy suggested stress fractures, showing increased radio tracer uptake, in 17 of the 33 cases (51.5%). Of the 16 patients under 20 years old, 10 presented an increased uptake (62.5%) and six normal images (37.5%). Of the 17 patients over 20 years, scintigraphy showed increased uptake in 7 (41.2%) and normal uptake of the tracer in 10 (58.8%). A total of 28 affected vertebrae were detected in the 17 patients with raised scintigraphic uptake. This was distributed into: 2 at L2, 7 at L3, 7 at L4 and 12 at L5. Seven of the 17 patients had more than one vertebrae with increased tracer activity.

Increased uptake of the radio tracer was detected in 16 of the 24 patients studied with SPECT (66.6%). In all the cases in which planar scintigraphy was "positive" and SPECT was also carried out, SPECT showed increased uptake. However, of the 16 cases in which planar scintigraphy was normal, SPECT was positive in eight. Of the 16 cases positive with SPECT, in 8 localization was unilateral, considering as such the involvement of only one of the pedicles or vertebral interarticular surfaces (Fig. 1).

## Discussion

Lumbalgia of unknown origin is a common problem in athletes [16]. Some authors indicate that a course of pro-

longed lumbar pain without familial aetiology should lead us to suspect the presence of a stress fracture [6]. Sometimes these fractures go undetected due to the lack of symptoms [12]. Sometimes they are never diagnosed, since the natural course seems to favour spontaneous healing in many cases [9]. Usually, however, a lumbar stress fracture is followed by spondylolysis with the persistence of causal factors [4, 8, 9, 11, 14]. This course can be altered through appropriate treatment at an early stage, avoiding, in most cases, progression toward lysis [2, 11]. Thus, early diagnosis is essential.

In advanced cases the presence of a stress fracture may be detected radiologically through the appearance of localized sclerosis uni- or bilaterally in the posterior arch of a vertebrae. In the initial stage of the fracture, however, radiology does not permit diagnosis because the findings are completely normal. Thus, there are many patients reporting lumbar pain but presenting normal radiographic images, which over time show signs of spondylolysis in further radiographs are done [8, 14]. Since the aim of our study was to detect stress fractures during the pre-radiologic stages, we only included patients whose X-rays did not show abnormalities that justified their lumbar pain.

Different authors have recommended the use of bone scintigraphy for early detection of lumbar stress fractures [3, 7, 8]. Localized increased tracer activity over a vertebra can not be considered specific for stress fractures. With the absence of a concrete pathology (neoplasms, infection, arthropathy, etc.), presence is highly suggestive of a fracture. In this sense, half of our patients presented a scintigraphic increased uptake which enabled us to diagnose stress fractures and commence an appropriate treatment.

SPECT is more sensitive than planar scintigraphy for detecting the lesion [3, 13, 15]. In our series 8 of 16 patients, in whom planar scintigraphy was normal, showed increased activity with SPECT. Similarly, Bellah et al. [3] found raised tracer uptake with SPECT in 14 of 47 patients whose planar scintigraphy did not show abnormal uptake. Although SPECT has been recommended for detecting lumbar stress fractures in adolescents [3, 13], our study shows that it is equally useful in a young adult population.

The differences in prevalence of the topographic localization of the fractures observed in our series coincide with those reported by other authors. The most affected vertebrae being L5, then L4, followed by the rest of the lumbar vertebrae [7, 8, 11]. At the same time it is noteworthy that half our patients whose SPECT findings were positive presented a unilateral lesion. This makes clinical diagnosis more difficult. The presence of unilateral lesions, of variable prevalence, has been emphasized by other authors [7, 11]. On the other hand, it is equally significant that 7 of the 17 patients with positive scintigraphy presented more than one affected vertebrae. Although it is impossible to ascertain which of these was responsible for the patient's clinical symptoms, it suggests that the presence of a stress fracture does not nec-

essarily have to be symptomatic in all cases, a fact mentioned previously by others [9, 12].

Our findings lead us to propose that when we have a patient with persistent lumbalgia and radiographs without pathologic abnormalities, a SPECT may provide the stress fracture diagnosis in some patients. When this technology is not available, planar scintigraphy may be useful in many cases, and if positive, a SPECT will not be necessary. However, in cases of normal planar scintigraphic findings a stress fracture may can be ruled out until the SPECT is performed.

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