Bone Scanning in the Adductor Insertion Avulsion Syndrome ("Thigh Splints")

N. David Charkes, N. Siddhivarn, and Carson D. Schneck

Division of Nuclear Medicine and Department of Anatomy, Temple University Medical School Philadelphia, PA; and Nuclear Medicine Service, W. Army Hospital Fort Dix, New Jersey

Shin splints is a defined clinical entity resulting from extreme tension on muscles inserting on the tibia, resulting in periosteal elevation which is detectable by bone scanning. The clinical equivalent in the thigh has been described. We found scintigraphic changes in the femurs of seven short, female, basic trainees at the Fort Dix Army base, most of whom were referred for stress fractures elsewhere in the lower extremities. The scan findings were generally noted in the upper or mid femurs, always involved the anteromedial cortex, and were bilateral in five of the seven subjects. The abnormalities were linear and suggested periosteal elevation, and did not have the typical appearance of stress fracture. Since the findings correspond to the insertion of one or more adductor muscle groups, the descriptive term "adductor insertion avulsion syndrome" or "thigh splints" is proposed for this entity.


The term "shin splints" refers to a specific clinical syndrome defined by the Committee on the Medical Aspects of Sports of the American Medical Association as "pain and discomfort in the leg from repetitive running on hard surfaces or forcible, excessive use of foot flexors; diagnosis should be limited to musculotendinous inflammations, excluding fracture of ischemic disorder" (1). Signs and symptoms include pain, tenderness, swelling, and warmth of the skin overlying the attachment of the involved muscle(s) to the tibia (2). Bone scans show linear, longitudinal uptake along the periosteal surface of the affected tibia cortex (3–7). Roentgenograms are initially normal (2,6) and typical scintigraphic findings of stress fracture (focal oval, fusiform, or circumferential uptake (8,9) are absent.

In 1981, Ozburn and Nichols described a stress syndrome similar to shin splints in the thighs of military recruits, almost all female (10). Clinical findings corresponded to the area of insertion of the adductor brevis and longus muscles, along the medial proximal third of the femoral shaft. Bone scans were found to be the "most sensitive and effective diagnostic aid" in differentiating the adductor syndrome from stress fracture, but no scans were published. In one case, the scan was said to demonstrate "increased periosteal reaction at the upper one-third of the medial aspect of the femur".

In reviewing the bone scans of military recruits referred to the Nuclear Medicine Section of the W. Army Hospital at Fort Dix, NJ, for suspected stress fractures since 1980, we were struck by the appearance of the femurs in seven of these subjects, namely, a reaction along the medial periosteal surface identical to classic shin splints except for location. Analysis of the findings suggests that they represent avulsion of one or more adductor groups at their insertion, the syndrome described by Ozburn and Nichols.

METHODS

Bone scans were made 3 hr after the i.v. administration of 20 mCi technetium-99m ([99mTc]MDP) methylene diphosphonate, using a whole-body gamma camera system in both anterior and posterior projections. Spot images of the pelvis and lower extremities were also made. Images were interpreted without knowledge of the clinical findings.

In the seven study subjects, the image of the involved femur was measured from the tip of the greater trochanter to the intercondylar notch, as well as the length and location of the linear periosteal abnormality. These measurements were then transferred proportionally to a diagram of the femur showing the insertion of the adductor muscles, taken from a standard anatomy textbook (11).

RESULTS

Seven subjects, all female, were found to have linear accentuation of the antero-medial aspect of the diaphy-
The femoral abnormalities in the bone scans of these seven trainees are identical to those seen in the shin splint syndrome, except for location (3–7). Early reports of bone scintigraphy in athletes evaluated for leg pain described linear, longitudinal tracer uptake along the periosteal surface of the tibia (3–5), different from the abnormalities seen in stress fracture (8,9). Holder and Michael prospectively studied ten athletes with clinical findings of shin splints by three phase bone scintigraphy, and in each case found linear tracer uptake at the attachment of the soleus muscle/tendon complex (6), an interpretation supported by subsequent cadaveric, electromyographic, and operative investigations (12). Rupain and associates later showed, in a large series of athletes with leg pain, that shin splints can be reliably distinguished from stress fracture scintigraphically in most cases, with only ~10% indeterminate (7). It seems likely that the abnormalities in our trainees are the femoral equivalent of classic tibial shin splints, and are almost certainly the result of avulsion of one or more muscle groups related to striding.

Exercise-related bone pain in the thigh and groin is well known clinically in both athletes and military

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**DISCUSSION**

**TABLE 1**

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age, sex</th>
<th>Pain history</th>
<th>Location in femur</th>
<th>% of femoral length</th>
<th>Adductor muscle(s)</th>
<th>Gluteus magnus</th>
<th>Roentgenograms of femur</th>
<th>Stress fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18 F</td>
<td>R foot</td>
<td>R upper, mid</td>
<td>44%</td>
<td>Brevis, longus</td>
<td>Yes</td>
<td>Periost. elev.</td>
<td>Tibias, R metatarsal, ankles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L upper, mid</td>
<td>44%</td>
<td>Brevis, longus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>22 F</td>
<td>R groin</td>
<td>R upper</td>
<td>15%</td>
<td>Brevis</td>
<td>Yes</td>
<td>Periost. elev.</td>
<td>Knees, ankles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>upper ½</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>31 F</td>
<td>L hip</td>
<td>L no</td>
<td>—</td>
<td>—</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R upper</td>
<td>30%</td>
<td>Pectineus, brevis</td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>24 F</td>
<td>R ankle</td>
<td>L no</td>
<td>28%</td>
<td>Magnus</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R lower</td>
<td>33%</td>
<td>Magnus</td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>18 F</td>
<td>R groin</td>
<td>R upper, mid</td>
<td>25%</td>
<td>Longus</td>
<td>No</td>
<td>ND</td>
<td>Tbijas, metatarsals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L upper, mid</td>
<td>16%</td>
<td>Longus</td>
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</tr>
<tr>
<td>6</td>
<td>17 F</td>
<td>L groin</td>
<td>R mid</td>
<td>—</td>
<td>Brevis, longus</td>
<td>No</td>
<td>ND</td>
<td>Knees, ankles, L acetabulum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L mid</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>18 F</td>
<td>L leg</td>
<td>R upper, mid</td>
<td>25%</td>
<td>Brevis, longus</td>
<td>No</td>
<td>ND</td>
<td>Knees, tibias</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L upper, mid</td>
<td>33%</td>
<td>Brevis, longus</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*No whole-body scan.

† ND = not done.
recruits (8,13–15). Stress fractures commonly involve the femoral neck (8) or shaft (14), or the junction of the ischium and inferior pubic ramus (16). None of the features of these disorders or of pelvic avulsion injury (15) was present in our subjects.

In 1981, Ozburn and Nichols reported on 14 military recruits with groin pain related to marching and relieved by rest, and an antalgal (waddling) gait. Roentgenograms of the pelvis were normal, but showed periosteal reaction confined to a small, upper-third segment of the medial femoral shaft, corresponding to the insertions of the adductor brevis and longus muscles (10). Signs included increased adductor tone and tenderness, and severe pain on active resistance to hip adduction and external rotation. All trainees except one were females <67 in. tall (mean 63.7 in.), in good or excellent physical condition. The syndrome was felt to be related to an overly long marching step in a short-statured individual.
The subjects of this report were similar in many respects to those in Ozburn and Nichols' series. All were short females (mean height 64.0 ± 0.6 in.) and roentgenograms, when available, showed periosteal elevation in the affected femur. The bone scans all showed a linear periosteal reaction along the anteromedial aspect of the femur, usually in the upper and/or middle portion of the shaft, corresponding to an adductor insertion. In two subjects the scan abnormalities were virtually superimposable, in keeping with a common pathogenesis. In four subjects subtle linear cortical accentuation was also noted laterally, at the same level as the adductor abnormality. Unlike the Ozburn and Nichols recruits, ours generally did not present with groin pain, but rather with symptoms related to one or more stress fractures elsewhere in the lower extremities. However, one individual developed adductor symptoms after kicking a soccer ball (Case 2), indicating that mechanisms other than striding can cause the syndrome.

In striding, the adductor muscles are maximally active just prior to toe-off (17,18), and exert an anteromedially directed vector pull upon the linea aspera (Fig. 4). A lengthened stride would cause excessive adductor contraction and tend to strip the femoral periosteum in the vector plane. This may explain why the periosteal reaction projected anteromedially. The more consistent involvement of the upper adductor muscles may be a function of their relatively horizontal course.

The findings we report almost certainly are the result of avulsion of the insertion of one or more adductor groups, probably from forced striding. In one case the avulsion was sports-related. Since the mechanism of injury seems to be closely related to that which produces classical shin splints, the descriptive term “adductor insertion avulsion syndrome” or “thigh splints” seems appropriate for this scintigraphic abnormality.

REFERENCES


