Stress fracture of the pelvis represents one rare differential diagnosis among the manifold causes of low back pain in female athletes. We report a case of fatigue stress fracture of the pelvis in a 24-year-old female athlete as an unusual differential diagnosis of low back pain that should be taken into consideration. According to the literature the incidence of low back pain in athletes ranges from 1% to 30% and is influenced by sport type, gender, training intensity, training frequency and technique. In some cases, no specific pain generator is found, which makes diagnosis and treatment difficult. The frequency of the injury and the treatment options are discussed, based on published studies.

**Keywords**: insufficiency fracture; fatigue fracture; athlete; low back pain.

**INTRODUCTION**

Stress fractures of the sacrum are an uncommon cause of low back pain (LBP) in athletes (29,31). Reported rates of LBP in athletes range from 1% to 30% (6,16,22,40). They are influenced by sport type, gender, training intensity, training frequency and technique (6,12,24). In some cases, no specific pain generator is found, which makes diagnosis and treatment difficult. Thus, it is important to identify less common causes of LBP in athletes, such as stress fracture of the sacrum (10,14,24).

Stress fractures are reportedly observed in 2-4% of athletes (25,33,38). They are primarily seen in the tibia and femur as well as in the metatarsals (39). Fatigue stress fractures occur in a much younger patient population than insufficiency fractures; the mean age typically reported is in the 20’s and 30’s (28). Long-distance running is the most frequently reported cause of sacral stress fractures in athletes (2,23,33,39) and seems to be more common in female athletes (6,14,24).

The female athlete triad of eating disorders, dysmenorrhea and osteopenia represents an increased risk for developing a stress fracture (26). However, the triad is not necessarily present in young female athletes who are diagnosed with sacral fractures (39).

We present the case of a 24-year-old female long-distance runner who sustained a fatigue stress fracture of the sacrum. Additionally, we reviewed the literature from 1988-2008 using MEDLINE to identify risk factors and treatment options for sacral stress fractures.
CASE REPORT

A 24-year-old woman reported ongoing pain in her lumbar spine and sacrum. The pain was mainly located around the right sacroiliac joint, without any radiation toward the legs. She was exercising twice a day (16 kilometer runs every day). Until her first presentation in our clinic, she did not have any significant clinical history. An adequate trauma could not be remembered: she reported increased training in preparation for the coming season.

The patient mentioned that she had suffered from bulimia years ago. Now she controlled her weight by exercising consistently. She denied any history of menstrual irregularities. Her family history was negative for metabolic bone disease.

Inspection revealed a young woman, with a body mass index of 21. Physical examination demonstrated pressure pain around the right sacroiliac joint, pain on hip extension, and rotational pain around her lumbar spine. Muscle tone, reflexes and sensory function were normal. There were no leg abnormalities, no pelvis or sacral obliquity and no radicular symptoms. She reported no static pain, but aggravation of pain while jumping. She reported that she could no longer perform any physical activity. At the first visit we obtained a radiograph of her lumbar spine and pelvis (fig 1), which did not show any visible fracture. The radiograph however showed an asymmetrical transitional anomaly (mega-transverse process on the left side).

A conservative therapy using non-stereoidal anti-inflammatory drugs and physiotherapy was initiated. Due to persistent pain over a two-week period, the patient was referred to MRI and Technetium 99m bone scintigraphy. The bone scan revealed significant uptake on the right wing of the sacrum (fig 2).

The coronal T2-weighted MRI demonstrated a vertically oriented sacral fracture of the right wing (fig 3a, b). The sacroiliac joint was not affected.

The laboratory studies were normal concerning calcium, phosphorus, bone alkaline phosphatase, parathyroid hormone, and 25-hydroxyvitamin D.

Conservative treatment was started with partial weight-bearing on the right lower extremity for 6 weeks with appropriate physiotherapy. Then we initiated an increase in load, limited only by pain at the sacrum. Throughout rehabilitation, exercises with reduced load on the sacrum were advised.

At the 6-month follow-up, the patient had no tenderness over the sacrum and a normal gait. Her athletic activities returned back to initial levels and she is still pursuing long-distance running.
DISCUSSION

In most cases, the symptoms of low back pain are due to degenerative structural abnormalities such as degenerative disc disease, spondylolisthesis or sacroiliac joint dysfunction (5). Nevertheless, in rare cases no specific cause of pain is identified. Therefore, awareness of less common causes, such as fatigue stress fractures of the sacrum, is essential (9,10,19).

The sacrum is the keystone to the arch of the pelvis and its functions. It transfers the weight of the entire upper body to the pelvis (1,34). If the forces to the pelvis are too strong, stress fractures can develop. Those that suffer from fatigue stress fractures of the sacrum are typically women involved in long-distance running (fig 4) (6,14,24). In combination with the female athlete triad (negative energy balance, menstrual irregularity and reduced bone mineral mass) or other contributing factors such as lower bone density, low dietary calcium intake or hormonal irregularities, these factors suggests that women are more likely to sustain a fatigue fracture (1,6). Other non-gender-related predisposing factors for a fatigue stress fracture are leg-length discrepancies, weakened supporting...
musculature, any recent increase in activity and biomechanical alterations (41).

Stress fractures may be divided in two further subgroups: insufficiency fractures and fatigue fractures (1,28,34). These fracture types can result from intrinsic and extrinsic factors. Intrinsic factors, such as hormonal dysfunction, can lead to weakness of the bone and decreased bone quality (1). Extrinsic factors would be synonymous to adequate trauma or repetitive microtrauma, which induce bone remodeling. Repetitive cyclic stress leads to enhanced rates of osteoclastic activity, linked to enhanced osteoblast activity and the development of new bone (24,43). Lack of rest and thus time for new bone to accumulate results in weakening of the bone and subsequent fracture (43). Thus, fatigue fractures occur when normal bone is subjected to abnormal stress (28). A consistent risk factor seems to be the rapid increase in level of activity (24), as in our reported case.


Table I. — Selected representative papers with characteristics of sacral fatigue stress fractures

<table>
<thead>
<tr>
<th>Gender</th>
<th>Activity</th>
<th>Age (years)</th>
<th>Number of patients</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>running</td>
<td>31-32</td>
<td>2</td>
<td>Atwell et al. (2)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>28</td>
<td>1</td>
<td>Bottomley et al. (6)</td>
</tr>
<tr>
<td>M</td>
<td>basketball</td>
<td>20</td>
<td>1</td>
<td>Crocket et al. (7)</td>
</tr>
<tr>
<td>M</td>
<td>running</td>
<td>26</td>
<td>1</td>
<td>Czarnecki et al. (8)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>20-21</td>
<td>3</td>
<td>Eller et al. (12)</td>
</tr>
<tr>
<td>F</td>
<td>fitness</td>
<td>25</td>
<td>1</td>
<td>Featherstone et al (13)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>35</td>
<td>1</td>
<td>Gerrard et al. (14)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>14</td>
<td>1</td>
<td>Grier et al. (17)</td>
</tr>
<tr>
<td>F</td>
<td>running, gymnastic</td>
<td>15-16</td>
<td>2</td>
<td>Haasbeek et al. (18)</td>
</tr>
<tr>
<td>M</td>
<td>running</td>
<td>35-42</td>
<td>2</td>
<td>Holtzhausen et al. (22)</td>
</tr>
<tr>
<td>M</td>
<td>military recruit</td>
<td>18</td>
<td>1</td>
<td>Lechevalier et al. (26)</td>
</tr>
<tr>
<td>M</td>
<td>running</td>
<td>48</td>
<td>1</td>
<td>Major et al. (‘97) (29)</td>
</tr>
<tr>
<td>M(3), F(1)</td>
<td>running</td>
<td>18-49</td>
<td>4</td>
<td>Major et al. (‘00) (30)</td>
</tr>
<tr>
<td>F</td>
<td>running, volleyball</td>
<td>17-21</td>
<td>3</td>
<td>McFarland et al. (32)</td>
</tr>
<tr>
<td>M</td>
<td>running</td>
<td>40</td>
<td>1</td>
<td>Schils et al. (35)</td>
</tr>
<tr>
<td>M</td>
<td>military recruit</td>
<td>18-20</td>
<td>3</td>
<td>Volpin et al. (40)</td>
</tr>
<tr>
<td>F</td>
<td>running(6), soccer(1), basketball(1)</td>
<td>19-45</td>
<td>8</td>
<td>Johnson et al. (25)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>26</td>
<td>1</td>
<td>Haun et al. (20)</td>
</tr>
<tr>
<td>F</td>
<td>volleyball</td>
<td>16</td>
<td>1</td>
<td>Shah et al. (36)</td>
</tr>
<tr>
<td>F</td>
<td>running, bicycling</td>
<td>20</td>
<td>1</td>
<td>Haller et al. (39)</td>
</tr>
<tr>
<td>F</td>
<td>hockey player</td>
<td>20</td>
<td>1</td>
<td>Slipman et al. (38)</td>
</tr>
<tr>
<td>M</td>
<td>tennis player</td>
<td>46</td>
<td>1</td>
<td>Silva et al. (37)</td>
</tr>
<tr>
<td>M</td>
<td>running</td>
<td>36</td>
<td>1</td>
<td>Alsobrook et al. (1)</td>
</tr>
<tr>
<td>F</td>
<td>running</td>
<td>22</td>
<td>1</td>
<td>Knobloch et al. (25)</td>
</tr>
</tbody>
</table>
fracture of the pelvis. Characteristics of these fractures are given in table I by reference to selected representative papers.

Usually patients do not present with pathognomonic symptoms. The physical examination discloses various types of low-back pain (table II) (1,5,11,29).

General imaging of an athlete with low back pain starts with a series of plain anterioposterior and lateral radiographs. Due to bone geometry, soft tissue formation and overlying bowel gas, plain radiographs usually will not reveal a sacral stress fracture (33). Furthermore, these fractures rarely produce a visible callus (31). In some cases, radiographs show a transitional anomaly such as a mega transverse process articulating with the sacrum; this may influence stress transmission from L5 to S1, particularly if the transitional anomaly is asymmetrical, as in the patient reported here (3).

Radioisotope bone scan is a very sensitive diagnostic tool; it shows increased focal uptake over a sacral wing in athletes with a fatigue fracture (1). However, it can also be misinterpreted as sacroiliac joint dysfunction, sacroiliitis or malignancy because of a similar bone scan pattern, especially if the diagnosis does not match the clinical symptoms (43).

MRI of the pelvis is a sensitive tool which has the advantage of demonstrating oedema, which regularly occurs around acute fractures sites (33). CT imaging is an excellent technique for documenting the presence of sacral stress fractures; it carries the added benefit of documenting the location and extent of the fracture (17). However, the CT findings are subtle and can be overlooked if not considered in the context of a differential diagnosis (5).

Techniques such as magnetic resonance imaging (MRI), computed tomography (CT) or bone scintigraphy are more effective when used to demonstrate a suspected fatigue stress fracture of the sacrum. MRI and CT in combination can reveal the characteristic lucency and thickening in the cortical bone, as well as focal sclerosis in the cancellous bone (30). Obviously, multiple diagnostic tools are necessary to achieve the right diagnosis.

There are different treatment philosophies to manage a fatigue stress fracture of the sacrum (1). Nevertheless, standard guidelines are missing. There are suggestions that range from non-weight-bearing rest to painless walking (18,23), followed by gradual increase in the level of activity (13,15,19,26,35), to preferential early rehabilitation such as light-weight-bearing exercise (19,33,43). Every variety of treatment in between has been attempted, with varying levels of success (1). Several patients described in previous reports returned to their base level of activity after 4-6 weeks (33). These inconsistent strategies imply uncertainty concerning treatment due to the rarity of this injury. Notably, stress fractures typically heal with rest (23,36-38).

Thus, from the medical viewpoint, it is necessary to establish the correct diagnosis to implement an appropriate treatment.

REFERENCES


