Chronic groin pain can be a symptom of a complex condition that may be provoked by musculoskeletal disruption. Without early detection and accurate diagnosis, the condition may be aggravated and prolonged. Chronic groin pain typically is experienced by athletes who participate in sports that require running and repetitive cutting maneuvers, with most occurrences reported in soccer. Management of chronic groin pain can be challenging due to difficulty in identifying the cause of the symptoms. Muscle strain, athletic pubalgia, periostitis, osteoarthritis, cartilage injury, stress fracture, pubic symphysitis, nerve entrapment, and pathologies in the genitourinary system may all produce chronic groin pain. The morbidity from injuries associated with chronic groin pain may last from 2.5 to 48 months.

Once the main pathology causing the pain is identified by clinical assessment or diagnostic imaging (MRI, computed tomography, bone scintigraphy), treatment options can be considered. Verrall et al. reported that pubic bone edema is one of the main causes of chronic groin pain. Pubic bone edema is produced by a stress fracture that results from repetitive stress. The inflammatory response seen in the bone marrow is a sign of stress fracture. The purpose of this report is to present a case of a pubic stress fracture in a female collegiate lacrosse player and the conservative rehabilitation program that was successful in restoring normal function.

Key Points
- Pubic stress fracture is manageable with early detection and conservative rehabilitation; return to full participation can be achieved.
- Magnetic resonance imaging is an effective tool in detecting the bone edema as a result of the stress fracture.
- Athletes with pubis stress fracture may return to full participation without recurrent symptoms after a conservative rehabilitation.

Case History
A 21-year-old female collegiate lacrosse athlete (height = 164 cm, weight = 52 kg) who participated in Eastern Japan Division I reported occasional right hip discomfort during activity. She had no previous history of groin injury. Following promotion to a varsity level of competition, her training regimen intensified, and right hip pain became persistent. Clinical evaluation performed by an athletic trainer (AT) revealed moderate hamstring tightness and tenderness near the ischial tuberosity and the pubic ramus. Because the condition did not impede participation in practice activities, she was instructed to perform stretching exercises to address hamstring tightness. An AT monitored the athlete for any changes in symptoms while she continued to participate in lacrosse without restrictions.
One week after the initial evaluation, the athlete complained of pain in the area of the pubic bone. Palpation revealed intense tenderness over the symphysis pubis and the right pubic tubercle. The pain was increased by running and pivoting, and it intensified when she became fatigued. The athlete was referred to the team orthopedic physician, who ordered a T-2 weighted MRI. The MRI revealed edema in the right pubic bone (Figures 1 and 2). The condition was diagnosed as a pubic stress fracture.

After discussion, the athlete, physician, AT, and coaches agreed to have the athlete continue to participate with modified activity intensity and duration and intensity. A nonsteroidal anti-inflammatory drug was prescribed (loxoprohen, 60mg per day). The intensity and duration of practice activities were adjusted to a level that did not provoke any pain. She was able to participate in the next game, but she subsequently complained of pain during activities of daily living (ADLs). A rehabilitation program was initiated the following day. Participation in sport activities was completely restricted for 4 days, and a conservative rehabilitation program was continued for 7 weeks (Figure 3). After the initial 4 weeks of rehabilitation, the athlete was pain free during ADLs and a follow-up MRI revealed a significant decrease in the signal within the right pubic bone (Figures 4 and 5).

Rehabilitation

The short-term rehabilitation goals were to restore pain-free hip range of motion and to progressively advance to lacrosse-specific drills. The long-term goal was to return the athlete to full competition without pain. The rehabilitation involved gradual progression in the intensity and duration of exercises, which were performed 5 days a week for 7 weeks (Figure 6). The

**Initial Diagnosis/ First MRI**
- Limited Practice with NSAID
  - ↓ 1 week

**Game Day**
- Complete rest
  - ↓ 4 days
- Conservative Rehabilitation #1
  - ↓ 4 weeks
- Second MRI
- Conservative Rehabilitation #2
  - ↓ 3 weeks

**Back to full participation**

![Figure 1](image1.png) Transverse cut of the initial MRI showing high signal in the right pubic bone.

![Figure 2](image2.png) Coronal cut of the initial MRI.

![Figure 3](image3.png) Transverse cut of the MRI after 4 weeks of rehabilitation with significant decrease in the signal.

![Figure 4](image4.png) Coronal cut of the MRI after 4 weeks of rehabilitation.
athlete completed all 35 rehabilitation sessions with an AT during the morning hours normally devoted to practice sessions. Unrestricted upper extremity training was performed, and joint mobilizations were administered to maintain mobility of the hip joint. The mobilization directions and amount of the force application were based on the athlete’s pain responses. Reduced hip range of motion in internal and external rotation has been associated with chronic groin injury in Australian football players. A moist heat pack was administered prior to the performance of rehabilitative exercises to reduce spasticity of the adductor muscles.

The first week of rehabilitation emphasized open-chain core stabilization exercises. Jogging on an artificial turf field was permitted for a maximum of 10 minutes at the end of the second week. During the fourth week of rehabilitation, the athlete was allowed to participate in team warm-up drills, which included walking lunges and leg swings. The athlete was also allowed to participate in team passing drills, which involved ball release and catching while jogging. Beyond the fourth week, the athlete was symptom-free during performance of ADLs. A follow-up MRI confirmed reduction in bone edema, and the physician granted permission for return to modified play, i.e., limited cutting maneuvers and sprints. The intensity and duration of the lacrosse-specific drills were progressed on the basis of the athlete’s subjective perceptions of fatigue and pain.

During the fifth week of the rehabilitation program, the athlete fully participated in passing and shooting drills. During the sixth week, she was allowed to participate in an offensive role in team scrimmage activity. She was allowed to participate at full intensity the next week, without any restrictions. She had regained full hip range of motion, and passive stretching of the adductor muscles was pain-free.

After return to full participation, performance of a Valsalva maneuver occasionally elicited discomfort in a fatigued state, but it did not affect sport performance and it diminished between practice sessions. Cryotherapy, passive stretching, and hold-relax stretching were continued throughout the season. Daily evaluation by an AT throughout the season included assessment of hip range of motion, soft tissue tightness, and any change in the athlete’s ratings of pain. The patient was able to participate in every practice for the remainder of the season and maintained a high level of performance in the varsity team. Progression of the athlete’s rehabilitation program is summarized in Figure 6.

<table>
<thead>
<tr>
<th>Week 0</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>Core Strengthening Exercise</td>
<td>Start Jogging (~10 min.)</td>
<td>Jogging or Bike (~20 min.)</td>
<td>Start On-Field Exercise</td>
<td>Join Warm-Up Drills</td>
<td>Start Non-Contact Drills</td>
<td>Start On-Field Agility Exercise</td>
</tr>
</tbody>
</table>

Figure 5  Case overview.

Figure 6  Rehabilitation progression over seven weeks.
Discussion
Early detection and conservative rehabilitation of a pubic stress fracture can permit return to full participation without adverse consequences. MRI confirmation of edema within the pubic bone identified the cause of chronic groin pain. Some physicians may order plain radiographs or a technetium-99 bone scan for initial diagnostic evaluation of chronic groin pain. Matheson et al. reported that the radiographic evaluation has a very low sensitivity for diagnosis of stress fracture and that a technetium-99 bone scan is the single most useful diagnostic imaging procedure. The orthopedic physician who managed the reported case chose to use MRI because it was readily available.

Most research on chronic groin pain has been focused on the male athletic population, but female athletes appear to be more susceptible to stress fracture in the pelvis and hip than the male athletes. Lower bone mineral density (BMD) in female athletes, compared to that of male athletes, may increase the risk of stress fracture. No menstrual dysfunction or eating disorder was involved in this case, but assessment of BMD, menstrual function, and dietary habits should be considered when evaluating a female athlete who is suspected of having a stress fracture.

The conservative management of the reported case involved activity modification, daily evaluation by an AT, and gradual progression in the intensity and duration of the athlete’s training regimen. Such conservative management of stress fractures in athletes has been reported to achieve satisfactory outcomes in the majority of cases.

Conclusion
After 4 weeks of conservative management for a pubic stress fracture, a substantial decrease in pubic bone edema was confirmed by MRI. Return to full participation in lacrosse was achieved after 7 weeks of rehabilitation. The athlete continued to play for the remainder of the season without recurrence of symptoms to a level that had any adverse effect on performance.

Acknowledgments
The authors would like to acknowledge Waseda University Sports Medicine Clinic for assistance in rehabilitation and data collection.

References

Yuri Hosokawa is a graduate athletic training student in the Health, Human Performance, & Recreation Department at the University of Arkansas, Fayetteville, AR.

Gretchen D. Oliver is an assistant professor in the Kinesiology Department at Auburn University, Auburn, AL.

Joe Piccininni, EdD, CAT(C), The University of Toronto, is the report editor for this article.