Case Report

Femoral Neck Stress Fracture in Marathon Runners: A Case Report

Yusuwan K, MD[1], Chareancholvanich K, MD[2]

[1] Department of Orthopaedic Surgery, Chaophraya Yommarat Hospital, Suphanburi, Thailand
[2] Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Background: Femoral neck stress fracture (FNSF) accounts for 3% of all sports-related stress fractures. The most common cause is marathon running. The main types of FNSF are compression-sided, tension-sided, and displaced fracture. The most common symptom is groin pain. Plain radiograph is the first-line investigation, and the magnetic resonance imaging (MRI) is the second-line investigation. The location and displacement of the fracture guide the management. Early detection and diagnosis decrease the rate of fracture displacement and osteonecrosis of the femoral head.

Objective: To report two cases of FNSF that developed in two Thai marathon runners, and to review what is currently known about FNSF in this specific sports-related setting.

Materials and Methods: Two cases of FNSF are described, and a review of the literature relative to FNSFs in long-distance runners describes the role of imaging, management, and return to running.

Results: FNSFs are a rare injury, and marathon runners presenting with exercise-related groin pain should be evaluated. Management is based on fracture location and whether or not the fracture is displaced. The first case profiles a patient with delayed FNSF diagnosis. Fracture displacement was found two weeks after symptom onset, and total hip arthroplasty was performed. The second case describes a patient with early FNSF diagnosis that was treated conservatively with good outcome.

Conclusion: Although FNSF is a rare injury, it should be considered in marathon runners who present with exercise-related groin pain. Delayed diagnosis can adversely affect quality of life. Early detection and management of FNSF shows excellent results in terms of return-to-sport rates.

Keywords: Femoral neck stress fractures, Sport-related injuries, Stress fracture, Marathon runners, Long-distance running

J Med Assoc Thai 2019;102(Suppl.9): 95-9
Website: http://www.jmatonline.com

Different types of stress fractures can be observed in athletes, but femoral neck stress fractures (FNSFs) account for 3% of all sports-related fractures[1,2]. FNSF is a rare and serious injury that must be diagnosed and treated to avoid propagation and displacement of fracture, osteonecrosis of the femoral head, and the need for total hip replacement. Fifty percent of all athletes who suffer this injury fail to return to their sporting activities of choice, with rates as high as 60% among those who suffers a displaced fracture. Since the early 1990s, reports of FNSFs among athletes have been increasing, prompting the need for non-military medical staff to be more aware of FNSFs.

The most common cause of FNSFs in sports is marathon running, long-distance running, basketball, gymnastics, and ballet dancing[3]. The main risk factors are female gender and poor baseline physical capacity[1,4]. Fullerton & Snowdy classification is a commonly used classification that uses plain radiographs and bone scans to categorize femoral neck fractures into three types: tension, compression, and displaced[2]. Shin & Gillingham developed a 4-grade classification system to evaluate femoral neck fractures based on magnetic resonance imaging (MRI) findings[5].

Gradual onset of hip and/or groin pain are the common presenting symptoms, and the pain is aggravated by weight-bearing and its intensity decreases after rest[6]. Anterior groin pain is the most complaint (87%)[2], which pain at the thigh or gluteal area and can radiate to the knee[6]. A common finding from non-specific physical examination is tenderness upon palpation of the anterior part of the hip and the inguinal area (62%)[6]. A complete physical examination should be performed to exclude other conditions. The first-line imaging investigation for FNSF is plain radiographs. An anteroposterior view of the pelvis and a direct lateral view of the proximal femur should be requested[6,7]. The gold standard second-line imaging investigation for FNSFs is magnetic resonance imaging (MRI)[7]. MRI has 100% sensitivity, 100%

Correspondence to:
Chareancholvanich K.
Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Wanglang Road, Bangkoknoi, Bangkok 10700, Thailand.
Phone: +66-2-4197964, Fax: +66-2-4128172
E-mail: keerati.cha@mahidol.ac.th

How to cite this article: Yusuwan K, Chareancholvanich K. Femoral Neck Stress Fracture in Marathon Runners: A Case Report. J Med Assoc Thai 2019;102 (Suppl.9): 95-9.

specificity, and 100% accuracy for diagnosis of FNSFs.

If this condition is detected early and the injury is undisplaced, the success rate of treatment is high. However, if the FNSF goes undetected, exacerbation can lead to a variety of adverse outcomes, including the need for total hip replacement and an inability to return to sporting activities. As high as 100% of patients can return to previous functional performance if undisplaced FNSF is detected and treated early. In contrast, as low as 0% of patients can return to previous function performance if osteonecrosis of femoral head develops and surgical management is required. Here, we report two cases of FNSF in long-distance runners.

Case Report

Case 1

A 55-year-old Thai male accountant who is recreational runner of approximately 30 kilometers per week with a total running distance of approximately 6,000 kilometers presented with 16 days of deep pain in his right thigh, which usually appeared after 14 kilometers of running. He reported no previous history of left hip pain. There was no history of trauma, smoking, alcohol abuse, steroid use, metabolic disorder, or any relevant diseases. His height is 163 cm, his body weight was 63 kg, and his BMI was 23.71 kg/m^2. He took analgesics with partial improvement in the early period after symptom onset. His pain then became more persistent, after which he was evaluated by a rehabilitation physician who suggested acupuncture that reduced his pain. One week later, he participated in a marathon in Japan that he had to abandon at the 2.5-kilometer mark due to pain. He visited a Japanese orthopedist, and physical examination revealed slightly decreased range of motion (ROM) of his right hip due to pain compared to the contralateral hip (flexion limited to 90°, extension 20°, external rotation 20°, internal rotation 10°, flexion-abduction 30°, and adduction 20°). Neurovascular examination of both lower extremities showed normal results. He was prescribed non-steroidal anti-inflammatory drugs (NSAIDs) as rescue pain medication that reduced his left hip pain. He then developed severe pain at the posterolateral area of the buttocks during the night, so he decided to return to Thailand the following morning. Radiographic examination, including plain lumbosacral spine x-rays (antero-posterior and lateral views), did not reveal any sign of fracture by a spine surgeon (Figure 1), and MRI of the lumbosacral spine showed no significant pathology of the spine or vertebral disc.

He was once again prescribed NSAIDs as rescue pain medication that reduced his left hip pain. A few days later, he revisited to an orthopedist due to onset of severe pain in his left hip. Radiographic examination, including plain radiograph of both hips (antero-posterior and left hip lateral cross table views), revealed a displaced fracture of femoral neck (Figure 2). The diagnosis was displaced FNSF at the left femoral neck base, which was classified according to Fullerton and Snowdy as a Type III, complete and displaced FNSF.

Surgical treatment was proposed, and total hip arthroplasty was performed. The patient was advised to take NSAIDs to control his pain. During the rehabilitation period, the patient underwent physiokinesis. At the 1-month follow-up, the patient was completely pain-free with full left hip ROM on clinical examination. He was able to walk with total weight-bearing without pain, and began an exercise program consisting of stationary cycling and walking. He then recommenced normal physical activity without complaint one month later. Postoperative radiograph showing appropriate position of the prosthesis is shown in Figure 3. CT scan was performed on the right hip screening for FNSF, and no fracture was observed (Figure 4).

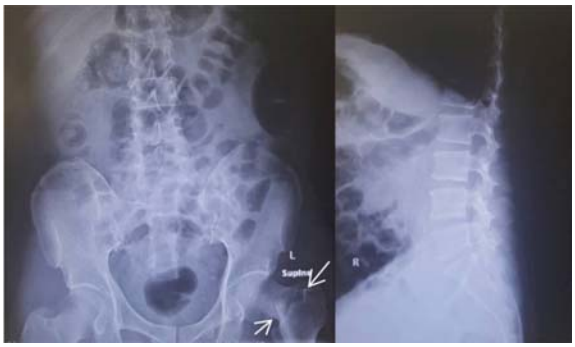

Figure 1. Radiographic examination of LS spine and neck fracture of left femur (arrows).

Figure 2. Radiographic examination of both hips, and left hip lateral cross table (arrows).

Case 2

A 30-year-old Thai male with pemphigus valgaris who was a physically active non-smoking, non-drinking recreational runner complaining of deep pain at the left groin at the 4th kilometer of a 10.5-kilometer run. He has no allergies to medications, but he reported usage of prednisolone 20 milligrams per day for 45 days for treatment of pemphigus valgaris exacerbation. He reported no history of trauma at the left hip or at any other site. He had antalgic gate of left hip for 1 week after the run which made him discontinue due to pain. His height was 172 cm, and his body weight was 68 kg (BMI: 22.98 kg/m^2). Clinical examination revealed no deformity or shortening of either lower extremities, excellent capillary refill and pulse, and normal neurological examination. His left hip motions were complete, and comparable with

the contralateral hip. However, his symptom started and increased with load. The iliopsoas test and those for labral pathologies were negative. No pathology of his contralateral hip was found. Calcium level test and all blood tests were normal. Serum vitamin D level was within normal limits. Plain radiographs were performed, including antero-posterior and lateral views of the hips, and no lesions were observed (Figure 5).

MRI of both hips (Figure 6) showed a left femoral neck stress fracture at the medial side with surrounding bone edema, but without cortical bone involvement. The patient was diagnosed as incomplete compression-side FNSF, with Type II Fullerton and Snowdy classification. The patient was treated conservatively and advised to rest with limited weight-bearing on crutches. Ambulation was progressed from non-weight-bearing to toe-touch weight-bearing to partial weight-bearing until the patient was pain-free at his left hip for 6 weeks. At the 3-month follow-up, radiographic examination revealed union of the FNSF at his left hip (Figure 7).

Discussion

The management of FNSFs depends on the location, femoral neck width (complete or >50% femoral neck width; incomplete or <50% femoral neck width), and displacement of femoral neck fracture. Conservative treatment is the first-line management strategy for incomplete compression and incomplete atypical tension fractures[1]. Surgery is required in patients with complete compression fracture, complete tension fracture, and displaced fracture[4]. Surgical management was used to avoid displacement and osteonecrosis of the femoral head in incomplete tension fractures[4,8]. Although complete FNSF was diagnosed, bed rest was ordered before surgery because the fracture was impacted from the pelvis by ipsilateral hip abductor muscle force[4,8].

The first case profiled in this report had a Type III fracture (complete displacement of FNSF) of left hip by Fullerton & Snowdy classification. The diagnosis for this case was delayed by more than 2 weeks. The results of delayed surgery for displaced FNSFs include a high rate of postoperative osteonecrosis of the femoral head and failure of fixation[9,10]. Johansson, et al reported that 30% of 10

Figure 3. Postoperative radiograph after total hip arthroplasty of left hip.

Figure 4. CT scan of right hip in coronal and sagittal views.

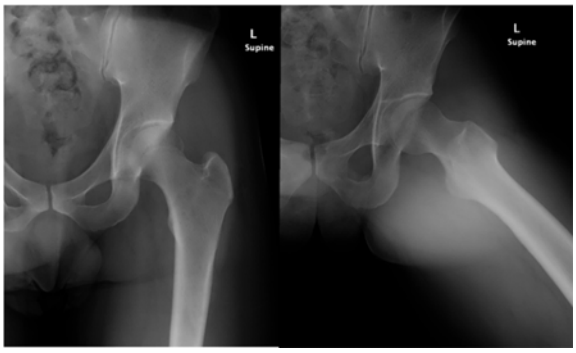

Figure 5. Radiographic examination of left hip in AP and frog leg views.

Figure 6. MRI T1W and T2W sagittal view images, and T1W and T2W axial view images of both hips shows FNSF of the left femoral neck (arrows).

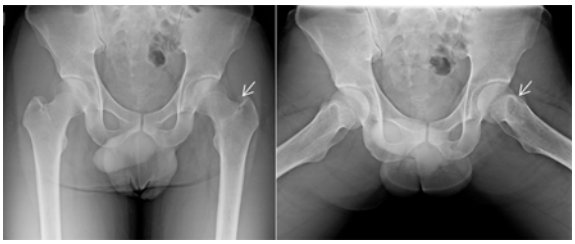

Figure 7. Radiographic examination of both hips in the AP and frog leg views at the 3-month follow-up shows union at the fracture site (arrows).

displaced FNSFs among athletes who received delayed treatment developed osteonecrosis of the femoral head by a mean follow-up duration of 14 weeks. Significant complications in displaced FNSFs include osteonecrosis of femoral head (24 to 42%), non-union (16 to 44%), delayed union (8 to 50%), malunion (5 to 33%), fixation failure (14%), revision (21 to 50%), and late OA (68%)[2,6,10]. This patient was demanding for a high level of function, so we described the advantages and disadvantages of fixation compared to arthroplasty of the hip. The patient ultimately decided upon total hip arthroplasty. Total hip arthroplasty has greater longevity than fixation, but a higher failure rate in displaced FNSFs. During the rehabilitation period, the patient could initially bear full-weight with the use of a walker. At the 2-week follow-up, he was completely pain-free with full ROM on clinical examination. He was able to walk with full load without pain, he started normal physical activity, and there was no hip pain at 1 month after surgery. At 6 weeks after surgery, this patient could manage a gentle running program, and he remains pain-free in ROM and weight-bearing exercises.

The second case is a young active runner who developed deep pain at the left groin at the 4th kilometer of a 10.5-kilometer run. Initial investigation by plain radiograph was unable to identify the fracture line on his left hip. Since FNSF was suspected in this case, MRI was ordered. MRI of his left hip revealed an incomplete compression fracture of the femoral neck (Fullerton and Snowdy Type II). The management options for this type of FNSF are conservative treatment and surgical treatment. A decision was made to treat this patient conservatively with 2 weeks of bedrest, followed by rehabilitation that included non-weight-bearing to toe-touch weight-bearing with crutches for 6 weeks, followed by partial weight-bearing with crutches for 6 weeks[4,11]. Weight-bearing ambulation was then permitted as tolerated[4,11]. Both radiological and clinical evidence of fracture union should be evaluated. At the 3-month follow-up, radiographic examination revealed union of the FNSF at his left hip. At approximately 12 weeks, normal activity can be performed, especially strengthening and range-of-motion exercises of the hip[4,11].

Ambulation by partial weight-bearing with crutches should be used until the patient becomes pain-free within 6 to 8 weeks, but it can take up to 14 weeks in some cases[4,12]. Ambulation should progress from non-weight-bearing to toe-touch weight bearing to partial weight-bearing according to the patient's level of pain and discomfort[4,12,13]. Frequent radiographs during follow-up are necessary to assess the fracture and the quality of fixation, and follow-up should continue for a minimum of 2 years to assess for delayed postoperative osteonecrosis of the femoral head[4,11]. If fracture displacement occurs, immediate non-weight-bearing should be ordered, and surgical fixation should be performed.

A return to full running can normally be achieved within 3 to 6 months after surgery, but the duration can sometimes be as long as 1 year[4,11]. The patient must be able to fully perform all normal activities of daily living in a fully pain-free state before a transition to full sports-related activity can be achieved[3,4]. In 2016, Neubauer, et al published a systematic review of runners with FNSFs, and 28 of the 48 included runners were able to return to running[4].

Conclusion

Although FNSF is a rare injury, it should be considered in marathon runners and long-distance runners who present with exercise-related groin pain. Delayed diagnosis can adversely affect quality of life. Plain radiograph, which is the first-line investigation for FNSF, may yield a negative finding. MRI is the a gold standard or second-line investigation for this condition. In cases with delayed diagnosis, displaced FNSF, and that cannot be treated conservatively, total hip arthroplasty should be considered the treatment of choice in physically active patients. Early detection and management of FNSF shows excellent results in terms of return-to-sport rates.

What is already known on this topic?

Although FNSF is a rare injury, it should be considered in long-distance runners who present with exercise-related groin or thigh pain. Early detection and management of FNSF showed promising results in terms of return-to-sport rates and time to return to normal activities.

What this study adds?

Marathon runners and long-distance runners that present with hip pain should be investigated for the presence of femoral neck stress fracture.

Acknowledgements

The authors gratefully acknowledge the two patients profiled in this report for granting us permission to disclose details relating to their case, and the staff of the Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University for their support of this study.

Potential conflicts of interest

The authors declare no conflicts of interest.

References

1. Adkins SB 3rd, Figler RA. Hip pain in athletes. Am Fam Physician 2000;61:2109-18.
2. Fullerton LR Jr, Snowdy HA. Femoral neck stress fractures. Am J Sports Med 1988;16:365-77.
3. Behrens SB, Deren ME, Matson A, Fadale PD, Monchik KO. Stress fractures of the pelvis and legs in athletes: a review. Sports Health 2013;5:165-74.
4. Neubauer T, Brand J, Lidder S, Krawany M. Stress fractures of the femoral neck in runners: a review. Res Sports Med 2016;24:185-99.
5. Arendt EA, Griffiths HJ. The use of MR imaging in the assessment and clinical management of stress reactions of bone in high-performance athletes. Clin Sports Med 1997;16:291-306.
6. Egol KA, Koval KJ, Kummer F, Frankel VH. Stress fractures of the femoral neck. Clin Orthop Relat Res 1998;348:72-8.
7. Bencardino JT, Palmer WE. Imaging of hip disorders in athletes. Radiol Clin North Am 2002;40:267-87.
8. Aro H, Dahlstrom S. Conservative management of distraction-type stress fractures of the femoral neck. J Bone Joint Surg Br 1986;68:65-7.
9. Belcher A. Ueber den Einfluss des Parademarches auf dieEntstehung der Fussgeschwulst. Med Klin 1905;1:305-6.
10. Goldin M, Anderson CN, Fredericson M, Safran MR, Stevens KJ. Femoral Neck Stress Fractures and Imaging Features of Femoroacetabular Impingement. PM R 2015;7:584-92.
11. Ejnisman L, Wajnsztejn A, Queiroz RD, Ejnisman B. Unusual presentation of a femoral stress fracture. BMJ Case Rep 2013;2013. pii: bcr2012007828.
12. Avrahami D, Pajaczkowski JA. Femoral neck stress fracture in a female athlete: a case report. J Chiropr Med 2012;11:273-9.
13. Asal D. Uberlastungsschaden am Knochensystem bei Soldaten. Arch fur Klinische Chirurgie 1936;186:511-22.