Functional Outcomes Following Surgical Management of Femoral Neck Stress Fractures

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abstract

The Military Health System Management Analysis and Reporting Tool was queried to identify all active duty US military service members who underwent operative fixation of femoral neck stress fractures from 2011 to 2012. A total of 13 patients with 17 femoral neck stress fractures met the inclusion criteria. Average patient age was 23.8±5.1 years, and 62% were women. At a mean 26-month follow-up, approximately one-half (46%) of the young military recruits were able to return to their preoperative activity level. Two (11%) required reoperation. Increased time to diagnosis and to subsequent fixation was associated with a greater risk of poor outcomes resulting in medical separation. [Orthopedics. 2017; 40(3):e395-e399.]

Femoral neck stress fractures are more common among military recruits than among the general population.1 This is likely attributable to the sudden increase in strenuous physical activities associated with basic training that can cause repetitive microtrauma in at-risk individuals.2 Women, individuals with low body mass index or nutritional deficiencies, and less physically fit recruits are at increased risk.3-5

Although prevention and management of femoral neck stress fractures are well described, functional outcomes after fixation have not been well characterized.6 Previous series involved mixed cohorts of conservatively and surgically managed injuries or surgical treatment of displaced fractures.7,9

This study evaluated the rate and timing of return to active duty and moderate- to high-demand lower extremity activity after operative fixation of femoral neck stress fractures. The authors hypothesized that most patients would not be able to return to duty after surgery because of persistent lower extremity disability.

MATERIALS AND METHODS

After institutional review board approval was obtained, the authors performed a query of the Military Health System through use of the Management Analysis and Reporting Tool (M2) database to identify all Tri-Service US active duty military service members who underwent operative fixation of stress fractures of the femoral neck (International Classification of Diseases, 9th edition, code 73396) between March 2011 and December 2012. The M2 is a validated health care management database that can
be used to perform clinical outcomes research after upper or lower extremity surgery.10-13

Patients were included who underwent operative fixation of a confirmed femoral neck stress fracture, had active duty military status at the time of surgery, and had follow-up of at least 6 months. Exclusion criteria were applied to patients who had nonmilitary or retired status at the time of surgery and those who were treated conservatively.

Demographic data (age, sex, rank, and branch of service) were initially extracted from the M2 database. The corresponding military electronic medical record was accessed through the Armed Forces Health Longitudinal Technology Application, and a thorough line-by-line analysis was performed to confirm the primary diagnosis, procedure, and date of surgery. The authors recorded additional patient (laterality, body mass index, metabolic or endocrine abnormalities) and surgical variables (tension- vs compression-sided injury, time to diagnosis, time to surgery, fixation construct).

The primary outcome of interest was ability to return to active duty and high-demand lower extremity activity. The authors also extracted data on complications and reoperations as secondary outcomes.

Statistical mean and standard deviation were calculated for continuous variables. Categorical data were recorded as frequencies.

RESULTS
Demographics

Of 236 patients with hip pathology, a total of 13 patients with 17 femoral neck stress fractures met the inclusion criteria (Table). Four patients had bilateral stress fractures. Average age was 23.8±5.1 years, and 62% were women. Average body mass index was 23.9±0.7. All patients underwent metabolic and endocrine evaluation, and 2 were diagnosed with thyroid disorders.

Almost all patients were junior enlisted (92%) in the US ground forces. Most patients (85%) were actively involved in basic training at the time of diagnosis.

Surgical Variables

Of the 17 fractures, 2 (11%) were complete, 3 (18%) involved the tension side, and the rest (71%) involved the compression side (>50%) at the time of diagnosis. Four patients with bilateral fractures were classified with the following patterns: bilateral tension-sided (n=1), bilateral compression-sided (n=1), mixed tension- and contralateral compression-sided (n=1), and completed fracture and contralateral compression-sided (n=1).

Average time to diagnosis was 30 days (range, 0 days to 15 months), and average time to surgery was 53 days (range, 0 days to 4 months).

Of the 2 complete injuries, 1 required open reduction with internal fixation with a sliding hip screw construct and the other required open reduction with percutaneous screw fixation. The remaining injuries were treated with percutaneous screw fixation, except 1 patient with bilateral injury who underwent open reduction and pinning with 3 cannulated screws on 1 side and fixation with percutaneous screws on the other side (Figures 1-2).

Outcomes

At average follow-up of 26.2±17.4 months, 7 (62%) of the patients returned to duty and 6 (38%) were medically separated because of persistent disability attributable to the hip. Of the patients who returned to duty, 6 (88%) returned to full high-demand activity an average of 6.2 months (range, 5.5-6.8 months) after surgery and 1 was maintained on a permanent no-run profile as a prophylactic measure despite having no persistent symptoms.

At final follow-up, 6 patients (46%) had persistent pain in the affected hip. Two patients (11%) required reoperation. Of these, 1 underwent removal of symptomatic hardware and the other had varus malunion and required valgus-producing osteotomy that was complicated by avascular necrosis, with subsequent conversion to total hip arthroplasty.

Statistical Analysis

No significant difference was found in patient demographics between patients who remained on active duty and those who were medically separated. Of the 4 patients with bilateral femoral neck stress fractures, 3 were medically separated and 1 was maintained on a permanent no-run profile. All of these patients were women, but there was no difference in body mass index or prevalence of metabolic or endocrine abnormality between this group and the overall cohort. Both mean time to diagnosis (49 vs 14 days) and time to surgery (94 vs 18 days) were longer for patients who underwent medical separation compared with the overall cohort, but the difference was not statistically significant (P=.13 and P=.36, respectively).

DISCUSSION

Nearly half of the patients (n=6, 46%) who underwent operative fixation of femoral neck stress fractures returned to full active military service with no restrictions an average of 6 months postoperatively. Although no differences were found in patient-based characteristics between those who remained active and those who were separated, time to diagnosis and time to ultimate surgery were greater in the separated cohort.

Most literature evaluating return to function after fixation of femoral neck stress fractures involves military populations.8-9 Talbot et al8 evaluated the outcomes of femoral neck stress fractures in British military recruits during a 4-year period. Of the 20 fractures, almost all (85%) were nondisplaced and were managed conservatively. Only 3 (15%) required operative fixation. Despite a 40% rate of medical discharge, this was a mixed population of conservatively and surgically treated injuries, and functional outcomes were not characterized.
Lee et al reported the largest retrospective review of operatively treated displaced femoral neck stress fractures in a population of Chinese military recruits. They found that 30 of the 42 patients (71%) had good outcomes, with no persistent pain, and returned to preinjury walking ability at an average follow-up of 5.6 years. Two were limited by mild pain and limitations of daily activity, and 10 (24%) had avascular necrosis with significant pain and disability that required operative intervention. These included 2 core decompressions, 6 bipolar hemiarthroplasty procedures, and 2 total hip arthroplasty procedures. Delayed fixation and postoperative varus malalignment were risk factors for avascular necrosis and subsequent poor outcomes. The authors did not elucidate the level of function on return to activity. In the current series, ability to return to full preoperative level of activity was independent of persistent symptoms, and one-third of both the retained and separated cohorts reported mild to moderate pain.

Johansson et al reported 1 of the few studies of return to sport after operative management of femoral neck stress fractures in athletes. Of the 23 patients, 16 were recreational athletes and 7 were elite athletes. As in the current study, ability to return to the preoperative level of activity was largely independent of subjective rating of pain. At final follow-up of 6.5 years, of the 16 patients who underwent internal fixation, 9 (56%) maintained the preoperative activity level and the rest did not. One-third (33%) of these patients had persistent pain with exercise, and no patient was pain-free. Additionally, none of the elite athletes returned to the preinjury level of function and half (50%) had persistent pain with exercise. Given the similar intense daily physical demands, military recruits are often compared with elite athletes. Therefore, the authors believe that the current findings may be easily extrapolated to an athletic population.

Patient-based risk factors for femoral neck stress fractures have been elucidated. Kupferer et al reviewed 47 cases of femoral neck stress fracture in Air Force basic trainees and found that body mass index did not correlate with risk, but female sex and level of fitness on arrival were significant risk factors. A systematic review of 21 series of lower extremity stress fractures in military and athletic populations found that women were at significantly increased risk, given differences in bone

<table>
<thead>
<tr>
<th>Patient No./ Sex/Age, y</th>
<th>Body Mass Index, kg/m²</th>
<th>Laterality</th>
<th>Fracture Location</th>
<th>Fixation Construct</th>
<th>Return to Duty</th>
<th>Complications/ Reoperation</th>
<th>Follow-up, mo</th>
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<tr>
<td>1/F/18</td>
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Abbreviations: F, female; M, male.
anatomy, aerobic capacity, muscle mass, and diet. However, sex was less important than overall physical condition. Delay in treatment also has been identified as a risk factor for poor outcomes. Although the study design precluded determination of risk factors for femoral neck stress fractures, delay in diagnosis and surgical management correlated with decreased ability to return to the preoperative level of activity. Given an increasing understanding of potential risk factors for femoral neck stress fractures and the prevalence of these fractures among military recruits and athletes with high-demand lower extremity physical activity, a high index of suspicion may lead to earlier diagnosis and management before completion and displacement.

Recent studies called for greater awareness of stress fractures among military recruits and athletic populations. A Physical Readiness Training program was established in 2010 to provide a standardized method for physical fitness training to reduce preventable injuries by including greater variation in exercise, progressive training, and reduced running distances. After implementation of this program, a significant decrease occurred in the diagnosis of lower extremity stress fractures, including femoral neck stress fractures. In addition, a large Cochrane database systematic review of 16 trials of military recruits in training suggested the use of shock-absorbing shoe inserts to mitigate lower extremity stress fractures. The current findings suggest that improved awareness and earlier diagnosis and surgical management of femoral neck stress fractures may aid in the return to a more reliable level of function.

Limitations
The current study was limited by its retrospective nature and small size. The authors could not control for variables that were not recorded in the M2 database. Because they did not have access to radiographs, they could not control for additional risk factors or assess reduction. Despite these limitations, the current young, active cohort is ideal to study this rare injury and obtain prognostic information on the ability of young military recruits and high-demand athletes to return to preinjury levels of activity postoperatively.

Conclusion
Military recruits and high-demand athletes are at increased risk for femoral neck stress fractures. Approximately one-half (46%) of the young military population in the current study returned to preoperative levels of activity an average of 6 months postoperatively. Further, increased time to diagnosis with subsequent fixation was associated with a greater risk of poor outcomes that resulted in medical separation. A better understanding of functional outcomes and negative prognostic factors allows surgeons to counsel both military recruits and athletes on the likelihood of returning to full activity postoperatively.

References
1. Lee D, Armed Forces Health Surveillance Center. Stress fractures, active component,


