

# Tibial Stress Fractures in an Active Duty Population: Long-Term Outcomes

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*Tibial stress fractures are a common overuse injury among military recruits. The purpose of this study was to determine what, if any, long-term effects that tibial stress fractures have on military personnel with respect to physical activity level, completion of military training, recurrence of symptoms, and active duty service. Twenty-six military recruits included in a previous tibial stress fracture study were contacted 10 years after initial injury and asked a series of questions related to any long-term consequences of their tibial stress fracture. Of the 13 patients available for contact, no patients reported any necessary limited duty while on active duty, and no patient reported being separated or discharged from the military as a result of stress fracture. Tibial stress fractures in military recruits are most often an isolated injury and do not affect ability to complete military training or reflect a long-term need for decreased physical activity. (Journal of Surgical Orthopaedic Advances 22(1):50–53, 2013)*

Key words: stress fracture, tibia

**S**tress fractures are an overuse injury in which the rate of stress-induced microfracture exceeds the rate of bone repair. They are common injuries among athletes and military recruits. Approximately 5% of all military recruits incur lower extremity stress fracture (1). Treatment for stress fractures is typically protected weight bearing and modification of physical activity (2). Once pain has resolved, recruits are typically returned to full activity and training, usually within approximately 60 days (1–5).

During plebe summer, a 2-month indoctrination of new midshipmen into military life at the United States Naval Academy (USNA), new recruits participate in intense physical training and activity. Similar to outcomes for new recruits military-wide, the incidence of stress fractures

during plebe summer is 3% for men and 10% for women (6). Among new recruits at the USNA, and military-wide, the most common site of stress fracture is the tibia (4, 7).

Tibial stress fractures have an immediate impact on the recruits' physical and emotional health, training, and overall military readiness. They result in a substantial loss of training opportunities, a decrease in the recruits' physical performance, and at times separate and isolate the recruit during a critical period of training and indoctrination. As a result, although classically thought of as a relatively benign, self-limited injury, stress fractures can be associated with significant fear and anxiety about near- and long-term military life on the part of the recruit.

Although the diagnosis and treatment of stress fractures is well documented, the long-term outcomes of these injuries have never been reported in the literature. Knowledge of the outcomes of these common injuries is important for the patient, treating physician, and military service. The purpose of this study was to examine the outcomes of stress fractures from a series of patients at 10 years after initial injury, as related to persistence and recurrence of symptoms, physical activity level, and active duty service.

## Methods

Institutional review board approval was obtained to contact 26 USNA recruits with 43 tibial stress fractures that were included in a prospective, randomized clinical study in 2000, performed by the senior author (JPR), titled "The incidence of stress fractures in midshipmen at the USNA during two consecutive plebe summers." The previous study attempted to determine risk factors for the

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Received for publication September 22, 2012; revision received October 28, 2012; accepted for publication November 19, 2012.

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1548-825X/13/2201-0050\$22.00/0

DOI: 10.3113/JSOA.2013.0050

development of stress fractures and prospective outcomes of various treatments (2, 6).

For the current study, patients were contacted via telephone to determine the outcome of their initial stress fracture at 10 years from time of injury. Sources for contact information included the United States Naval Academy Alumni Association, electronic medical record (demographic information only), and military-wide e-mail databases. Patients were asked a series of questions specific to their stress fracture, including injury recurrence, resultant long-term activity modification, re-diagnosis of stress fracture in same or new location, time on active duty, any resultant limited duty while on active duty, and need to be retired, separated or discharged from military as a result of initial stress fracture. The Tegner activity level was determined for each patient, and each patient completed an SF-12 questionnaire. The SF-12 is scored based on a mean of 50 on both the mental and physical component summary, with a standard deviation of 10, in the general U.S. population in 1998 (8). Because of the relatively small sample size and single study cohort, only descriptive statistics were utilized.

## Results

Of the 26 patients included in the original cohort, 13 patients originally diagnosed with 18 stress fractures were available for follow-up and completed the three questionnaires. Thirteen patients were unavailable for follow-up. Based on the previous study, it can be said that these 13 patients were no different than those available for follow-up with respect to patient demographics or time to return to duty after initial injury (2). Additionally, 10 of these 13 patients graduated from the USNA. Thus, 23 of the original 26 patients with tibial stress fractures were able to complete their military training at our institution and enter active duty military service.

Of the 13 patients available for contact, five were males and eight were females (Table 1). The mean Tegner activity level score was 6 (range, 4–7). The mean physical function score on the SF-12 was 54.7 (range, 41.1–57.7), and the mean mental score was 53.4 (range, 32.3–61.7). One patient reported a recurrence of the initial tibial stress fracture, with a re-diagnosis while still at our institution. Three patients reported a diagnosis of a stress fracture in a new location: one of the contralateral tibia and two of the metatarsals. Only two patients reported necessary activity modification, specifically running limitations, although both reported remaining on active duty. No patients reported any necessary limited duty while on active duty, and no patient reported being separated or discharged from the military as a result of stress fracture. The mean active duty service time for patients available for contact was 6.4 years.

**TABLE 1 Demographic and outcome data**

No. of patients who graduated from USNA	23
No. of patients available for contact at 10 years	13 (5 males, 8 females)
Mean Tegner Activity Level Score	6
Mean SF-12 Physical Function Score	54.7
Mean SF-12 Mean Mental Score	53.4
No. of patients reporting recurrence of original tibial stress fracture	1
No. of patients reporting additional stress fracture in new location	3
No. of patients reporting long-term activity modification	2
No. of patients reporting need for limited duty	0
No. of patients reporting need for separation of discharge from military	0
Mean active duty service time	6.4 (years)

Note: Numbers based on original cohort of 26 patients, with associated outcomes directly relating to, or as a result of, initial tibial stress fracture.

## Discussion

Tibial stress fractures are common in military recruits and in the civilian population, most commonly among runners (9). Within the literature there is a consensus that treatment of these injuries with rest, activity modification, and a short period of protected weight bearing, if needed, usually allows relatively quick return to activity (2–4, 6, 9). There are numerous studies in the literature focusing on the prevention of tibial stress fractures (1, 4, 5, 7). Surprisingly, despite the relatively high incidence of injury, to our knowledge there are no studies focused on the long-term outcomes of tibial stress fractures. Our study is the first to evaluate the long-term impact that these injuries have on the patients' activity level, overall health, and active duty service.

The cohort of 26 patients for the current study was included in two previous studies performed by the senior author (JPR) while they were plebes at the USNA (2, 6). The first study matched them against a matched group of uninjured controls to identify possible risk factors for the development of stress fractures (6). The study concluded that significant, acute weight loss in the subjects versus the controls was the main predictor of stress fracture development, when combined with the rigorous physical activity required of new recruits. The 26 patients who developed stress fracture were also included in a prospective, randomized, double-blind clinical study assessing the effect of pulsed ultrasound on tibial stress fracture healing time (2). The patients were randomized to pulsed ultrasound or placebo treatment. The results of placebo versus pulsed ultrasound were no different with respect to healing time and return to duty.

Despite making a relatively large physical and emotional impact at initial diagnosis, tibial stress fractures do not seem to result in any long-term limitations. All of the included patients, regardless of gender, continue relatively active lifestyles, with an average Tegner activity level of 6 and a mean SF-12 score of 54.7. Only two patients reported any necessary activity limitations, both related to running, although both remain on active duty and are able to pass physical fitness tests. The biggest long-term consequence after an initial tibial stress fracture seems to be the development of additional stress fractures. Only one patient had recurrence of a tibial stress fracture on the same side as the initial injury, and it occurred while still at the USNA. Three patients (23%) developed stress fractures at different locations: one in the contralateral tibia and two in metatarsals.

Trainees can be counseled that after treatment, they have a good chance of graduation from training, with 20/23 (87%) of the initial patients graduating from the USNA. It is not known if ongoing problems related to the initial tibial stress fracture had a role in three patients not graduating from the USNA. Additionally, trainees will not be limited in active duty service after tibial stress fracture, with included patients serving an average of 6.4 years on active duty at time of follow-up.

One of the major strengths of this study is the duration of follow-up: all patients 10 years from initial injury. The major limitation of this study is the small sample size and study population attrition. This is likely secondary to multiple factors. First, the long time from initial enrollment almost ensures that some patients will have separated from the military, having fulfilled their required active duty obligation (5 years for class of 2004). It is possible that some of those patients unavailable for follow-up are currently deployed, participating in current overseas conflicts, or living abroad, making contacting them difficult. However, we cannot state for certain that these patients did not medically or otherwise separate from the military as a result of recurring stress fractures limiting physical activity and preventing active duty service. We can say that the rigors of physical activity at the USNA are equal or greater than the rigors of active duty service.

For the years 2000 to 2005, 20% of each class left the academy before graduating (10). Thus, the failure of three previous study participants to graduate is expected; based on the average rates, we would expect that five of the 26 patients would not have graduated. Additionally, because 20 of the 23 original patients graduated from the USNA, despite the extensive physical requirements, we feel confident that not all of the patients unavailable for follow-up separated or discharged from the military as a result of ongoing problems from, or recurrence of, tibial stress fractures.

An additional weakness of this study is that all included subjects graduated from the USNA and were commissioned as officers. Compared with enlisted personnel, officers could potentially have more ability to control their own environment (e.g., the choice to run during physical training). It could be argued that the results of our study do not apply to all military recruits, just officer recruits. However, only two of the subjects available for contact reported running limitations, and both were able to pass annual physical fitness testing. Additionally, alternate events to running, including swimming, biking, and walking, are equally available to officers and enlisted personnel for completion of required physical fitness testing.

As previously mentioned, military recruits are not the only population prone to tibial stress fractures. Athletes who participate in high-impact sports, such as track and field, basketball, soccer, dance, and long-distance running, are also at increased risk of developing stress fractures (4, 11–13). As in military recruits, the tibia is the most common location for the development of stress fractures in athletes (4, 11). Although the patients included in our cohort are all in the military, they also represent a relatively even mixture of both male and female recreational and competitive athletes. As such, the results of our study would also seem to apply to other young, healthy athletes.

Although tibial stress fractures can be challenging to prevent and can acutely decrease the patient's physical functional level, trainees and physicians can be confident that once resolved, the recruit will not have recurring pain or limitation and will be able to enter, and stay, on active duty without further limitation.

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