Incidence and Management of Stress Fractures Among Military Basic Trainees

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The Egyptian Orthopedic Journal; 2020 supplement (1), June, 55: 7-11

Abstract

Background
Stress fractures occur due to repetitive cumulative micro trauma on the bone over a period of time. Stress fractures represent one of the most common and potentially serious over-use injuries.
Objectives
The aim of the study was to determine the incidence of stress fractures among military basic trainees, and highlighten the methods of treatment and follow up of variable stress fractures.
Subjects and Methods
Trainees suspected to have stress fracture among 1800 military basic trainees were subjected to clinical and radiological examination through 6 months. The detected cases of stress fractures were treated either conservative or operative according to the guidelines and follow up for them till healing of their fractures.
Results
Fifty eight out of 1800 military basic trainees had stress fractures, equaled 3.2% of military basic trainees.
Conclusion
Stress fractures represent fatigue failure of bone and can be controlled by modifying the regimen of training .

Introduction

The incidence of sustained stress fractures in military recruits can be as high as 12%, as compared with a rate of 21.1% of athletes and 1% of the general population .By the mid-1900s, the condition was reported in nonmilitary populations with increasing frequency. Although almost any athlete or exerciser who engages in frequent, repetitive activity may develop a stress fracture.Repetitive weight-bearing activities such as running and marching are the most frequently reported causes of stress fracture **(Friedenburg et al., 2017).**

Stress fractures have been reported in most bones of the extremities, as well as the ribs and the spine, but the most common location is the lower extremities: Among runners, the tibia is the bone most commonly injured. Early military reports of stress fractures among recruits described march fractures of the foot **(Devas et al., 2018).**

The underlying pathophysiology is believed to relate to repetitive mechanical loading of bone secondary to physical activity that stimulates an incomplete remodeling response. According to this view, stress fractures occur when the early stage of remodeling, osteoclastic resorption of bone, outstrips the osteoblastic formation of new bone, resulting in a weakened bone that is vulnerable to injury. Bone remodeling can be stimulated in anyone being exposed to a level of physical stress or activity to which he is not adapted **(Kaeding et al., 2015).**

People with stress fractures typically appear for treatment complaining of localized pain that gradually worsens, most commonly in the lower extremity. They usually recount a history of a recent increase in physical activity or the beginning of a new activity or some other change in their routine. Palpation elicits localized tenderness over bone. Additionally, swelling and erythema may be observed **(Devas et al., 2017).**

If positive, radiographs are diagnostic. However, radiologic signs depend on the time from onset of symptoms and the type of bone affected. Radiographic findings may include early lucent zones, periosteal newbone formation, focal sclerosis, endosteal callous, or later fractures or cortical cracks **(Hulkko et al., 2016).**

While they are very specific, radiographs are not sensitive. Bone scans, on the other hand, are very sensitive but not very specific, and they should not be used alone to make the diagnosis of a stress fracture. The patient's history and the physical examination provide the foundation for making a diagnosis of stress fracture **(Burrows et al., 2018)**.

Once stress fracture diagnosed, often multi-disciplinary approach is important in order to identify metabolic risk factors, training regimens, and anatomic variables that may place an athlete at greater risks. Modification of training intensity, training surface, and footwear may decrease forces seen by bone **(Jones et al., 2009).**

Supplementation of calcium and vitamin D are low-risk and simple methods to decrease risk of occurrence. Bisphosphonates and recombinant PTH may accelerate fracture healing, though should be used after careful discussion of risk and benefits with the patient.

The aim of this study was to determine the incidence of stress fracture among military basic trainees and highlighten the methods of treatment and follow up of variable stress fractures.

Subjectss and Methods

One thousand and eight hundred military basic trainees from Police Academy in Cairo suspected to have stress fracture were subjected to clinical and radiological examination through 6 monthes. The detected cases of stress fractures were treated either conservative or operative according to the guidelines and follow up till healing of their fractures.Patients were classified according to age, site, and time of injury.Most of cases needed conservative treatment.

Assessment and follow up were by clinical examination and radiological investigations using mainly PXR because of its availability to this number of trainees. Bone scan was done until complete healing of stressfractures. Also, laboratory investigations included serum calcium, serum vitamin D and serum PTH were done to exclude endocrinalcauses.We estimated healing time and time to return to training according to the anatomical site of every stress fracture. The effect of using osteotropic drugs like calcium and vitamin D and the effect NSAIDS on healing of stress fractures were estimated.The relationship between stress fractures and special types of training lead us how to reduce the incidence of stress fractures of the following military basic trainee. Data were presented as frequencies and percentages.

Results

Fifty eight out of 1800 military basic trainees had stress fractures which equaled 3.2% of military basic trainees. Forty five out of 1800 military basic trainees had midshaft and proximal tibial stress fractures which equaled 2.5% of military basic trainees. Ten out of 1800 military basic trainees had femoral stress fractures located at femoral neck and distal femur which equaled 0.5% of military basic trainees. Two out of 1800 military basic trainees had midshaft fibular stress fractures which equaled 0.1 % of military basic trainees. One out of 1800 military basic trainees had 3rd metatarsal stress fracture which equaled 0.05% of military basictrainees.

Fifty three stress fractures have been treated by conservative treatment, 13 by bed rest and 40 by above knee casts which equaled 91.4% of total stress fractures. Only 5 stress fractures have been treated by surgical intervention which equaled 8.6% of total stress fractures. Fixation was done by 2 distal femoral locked plates and 2 proximal tibial locked plates, and one case with femoral neck cannulated screws.

Fifty six stress fracture cases have been reported at the first thirty days of basic training which equaled 96.6%. Only 2 cases at the 2nd thirty days whichequaled 3.4%, and no cases have been reported at the3rdthirty days.

The age of 49 stress fracture cases was 19 years old which equaled 84.5% of all cases, while only 9 cases were 20 years old which equaled 15.5% (Table 1).

Follow up of these cases have been done clinically and radiologically to asses healing which completed after 3 months. The only complication of cases either treated conservatively or surgically was knee stiffness and muscle wasting which became better by physiotherapy.

Plain X ray took the upper hand in diagnosis and follow up of all cases with a little use of CT in 4 cases and MRI in2 cases only without using bonescan. Serum calcium,serum vitamin D, and PTH were done to all cases with negative results in all cases.

Table 1: Age, site, time and treatment of stress fractures

Parameters	Data	NO	%
Age (years)	19 years	49	84.5%
	20 years	9	15.5%
Site of stress fractures	Tibia	45	77.6%
	Femur	10	17.2%
	Fibula	2	3.4%
	Metatarsal	1	1.7%
Time of stress fractures	First 30 days	56	96.6%
	Second 30 days	2	3.4%
	Third 30 days	0	0.0%
Treatment of stress fractures	Conservative	53	91.4%
	Surgical	5	8.6%

Femoral stress fractures took 3 months for complete healing, while tibial, fibular and metatarsal stress fractures took 2 months for complete healing.

Time to return to training was 4 months in femoral stress fractures, 3 months in tibial stress fractures, and 2 months in fibular and metatarsal stress fractures.

All stress fracture cases used osteotropic drugs like calcium and vitamin D with good effect on healing time. Only surgically treated cases used NSAIDS as post operative treatment .

By following different types of military basic training , we found special type of training involved in most of stress fracture recorded cases which was force stepping on a very hard ground. After stopping this training, stress fracture recorded cases decreased to 20% of the previous recorded number.

Discussion

Stress fracture constitutes a spectrum of injury that includes bone strain, stress reaction, and stress fracture. The etiology is repetitive loading in the setting of inadequate bone remodeling **(Wall et al., 2016).**

The spectrum of injury reflects to some degree the quantity of strain, although exact thresholds are not known and likely mediated by numerous individual host factors in addition to the inciting activity **(Bernstein et al., 2009).**

In general, repetitive injury is more likely to occur in the lower extremity, which sees greater loads than the upper extremity in ambulatory athletes, and with activities that are high volume and offer repetitiveloading.

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While they are very specific, radiographs are not sensitive. Bone scans, on the other hand, are very sensitive but not very specific, and they should not be used alone to make the diagnosis of a stress fracture. The patient’s history and the physical examination provide the foundation for making a diagnosis of stress fracture **(Burrows et al., 2018).**

Fifty three stress fractures have been treated by a conservative treatment either rest or casting with medication, equals 91% of total stress fractures, and only 5 stress fractures have been treated by surgical intervention, which equaled 9% of total stress fractures. Follow up of these cases have been done clinically and radiologically till complete healing with remodeling of the training regimen to reduce the number of stressfractures.

During a 4-year study period, there were 4200 recruits in Royal Marine training sustaining 220 stress fractures at a prevalence of 5%. Similar studies estimated the annual incidence of stress fractures among groups of athletes and military recruits to be between 5 and30% **(Cosman et al., 2013).**

One possible explanation can be derived from a directly comparable study undertaken by Ross and Allsopp (2013). This study looked at stress fracture rates in recruits undergoing basic training at the Commando Training Centre both before and after the installation of the Revised Common Recruit Syllabus (RCRS), commissioned to optimise the training programme with respect to reducing injury rates. Results demonstrated a statistically significant reduction in stress fracture rates with the more physiologically progressive RCRS syllabus (3.8%) versus the original training programme (7%) **(Floyd et al., 2009).**

Another possible reason for a low incidence of stress fractures is that most fractures were diagnosed by radiograph. It has been recognised that radiographs do not usually contain positive signs associated with stress fractures until two weeks after the onset of symptoms **(McBryde et al., 2017).**

In this study, recruits were diagnosed as having a stress fracture after symptomatic presentation with positive radiograph findings. If symptomatic with a negative initial radiograph, a further radiograph was taken at two weeks **(Belkin et al., 2017).**

Those who were symptomatic with two negative radiographs proceeded to Magnetic Resonance Imaging (MRI) to confirm thediagnosis. The pattern of distribution of stress fractures in this study correlates well with previous studies. Tibial stress fractures sustain the greatest number of injuries in athletic and military populations **(Scully et al., 2017).**

Previous research suggests that the third metatarsal is the most common site as a result of increased ligament support of the middle metatarsals resulting in a relative resistance to movement which increases stress forces placed upon this bone **(Ogden et al., 2014).**

Conclusion

Stress fractures occours due to repetitive mechanical loading of bone secondary to physical activity that stimulates an incomplete remodeling response.

Modification of training intensity, training surface, and footwear may decrease forces seen by bone. Supplementation of calcium and vitamin D gave a low-risk, and simple methods to decrease risk of occurrence.

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