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Fractures in Combatants-Training Epitome or Inherent Cause: Retrospective Analysis

Y Devadoss[1], Gurmeet Singh Sarla[2], Yelamanchi Hanock Devadoss[3*], Mahesh Muraleedharan[4]

Abstract

Stress fractures are most commonly sustained during the first few weeks of training by recruits who are not accustomed to high intensity activities involving jumping, walking, running, and marching can precipitate the development of repetitive stress. All of these activities are incorporated as part of daily military training exercises, in both the training centers.

In our hospital we have received recruits from two training establishments which are involved in maintenance of heavy equipment's and machinery, over a period of 2020 to 2022, during which 2115, 960 , total of 3075, individuals were trained in each training establishment per year, i.e. total of 6150 recruits.

We have observed total of 292 cases per year in 2020-2021 and 284 cases in 2021-2022. Out of which tibial upper third fractures were (1.98%), mid third tibia fractures (3.51%), tibial lower third fractures (2.34%), fracture both bones were (0.35%), fracture fibula were (0.84%), fracture of metatarsals (0.29%), fracture of femur (0.03%), for 02 years.

The recruits were managed with rest, analgesics, pop cast immobilization, wax bath, and period of rest from intense physical activity for periods of 06 weeks and 08 weeks depending on recovery. Most of the recruits were recovered completely and able to complete the training .out of 576 stress fractures 6 were boarded out due to recurrence of stress fracture.

Keywords: Stress fractures; Imaging diagnosis; Treatment; Follow up

Introduction

Stress fractures result from repetitive and excessive bone stress, with microfracture rates exceeding rates of bone remodeling. Without adequate rest, osteoblasts cannot adequately produce new bone to compensate for osteocyte remodeling of stressed bone. This is the simplified mechanism of fatigue resulting in Stress fractures.

Stress fractures are most commonly sustained during the first few weeks of training by recruits who are not accustomed to high intensity. Activities involving jumping, walking, running, and marching can precipitate the development of repetitive stress. All of these activities are incorporated as part of daily military training exercises, in both the training centers.

Our recruits run for an average of 42 minutes and march for 180 minutes per day. Running can triple forces across the femoral neck when compared to walking, and the cumulative stress of all training activities can be substantial.

Affiliation:

[1]Department of Orthopaedics and Trauma, Balaji Medical College and Hospital, Tirupathi, Andhra Pradesh, India

[2]Senior Advisor Surgery, Military Hospital Khadki, Pune, Maharashtra, India

[3]Department of Surgery, Military Hospital Ahmednagar, Maharashtra, India

[4]Department of Radiology, Military Hospital Ahmednagar, Maharashtra, India

***Corresponding Author:**
Yelamanchi Hanock Devadoss, Assistant Professor, Department of Surgery, Military Hospital, Ahmednagar, Maharashtra, India.

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Additional weight bearing during activities due to intentional loading and any equipment carriage also increases injury risk and is a unique factor contributing to the risk in military recruits.

In our hospital, we have received recruits from two training establishments which are involved in maintenance of heavy equipment's and machinery, over a period of 2020 to 2022, during which 2115, 960, total of 3075, individuals were trained in each training establishment per year.

Materials and Methods

This is a retrospective observational study conducted in a peripheral hospital of Armed forces in Maharashtra, during the period Oct 2020- Oct 2022.

The inclusion criteria were

a) All recruits diagnosed as stress fractures clinically and radiologically.

b) All who are performing basic training course in 02 training establishments.

The exclusion criteria included

a) Patients sustained stress fractures other than basic training course like, Physical training (PT) Course, drill course.

b) NCC female cadets.

All patients admitted were subjected to clinical, biochemical, radiological evaluation primarily by X-ray and few were subjected to NCCT. The data is entered and analysed using IBM SPSS version 24.

Results

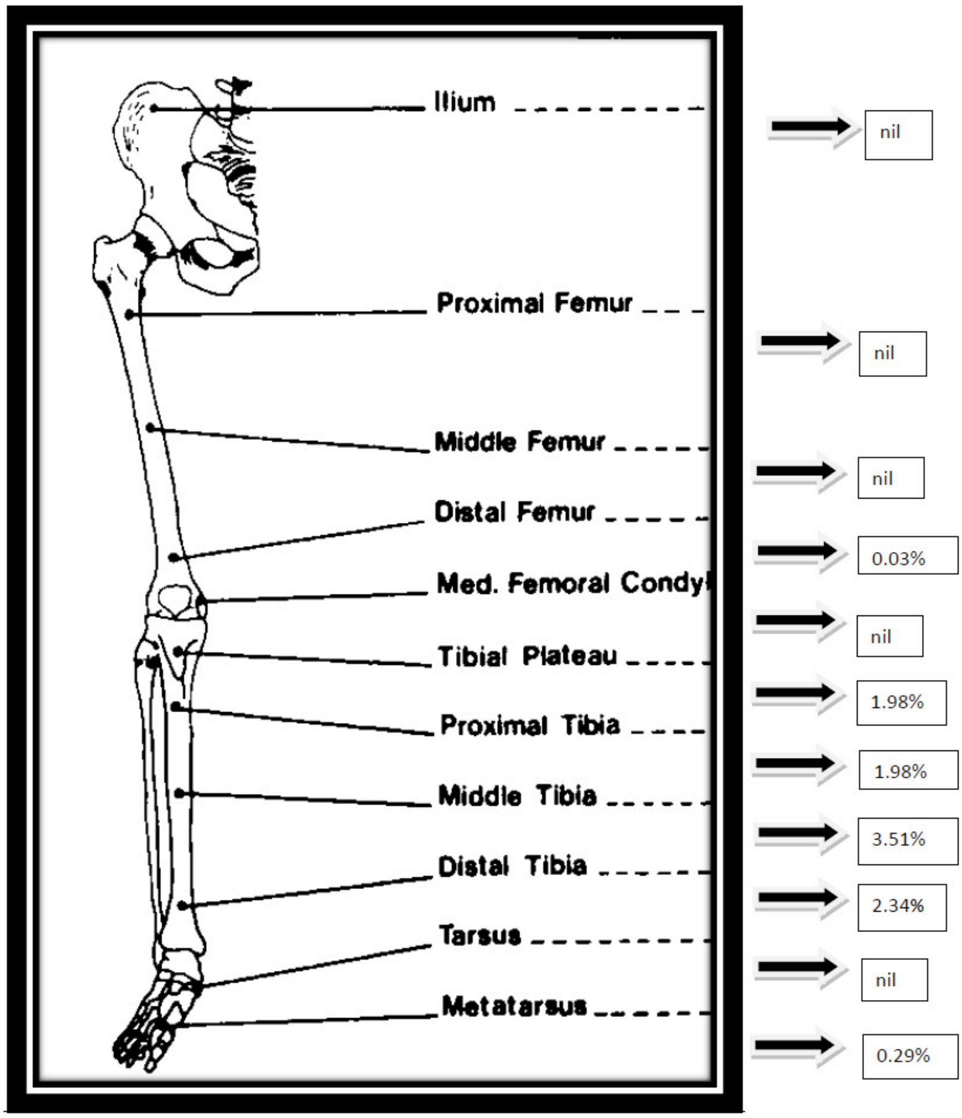

Figure 1: Percentage of fractures found individually in our study in lower extremity.

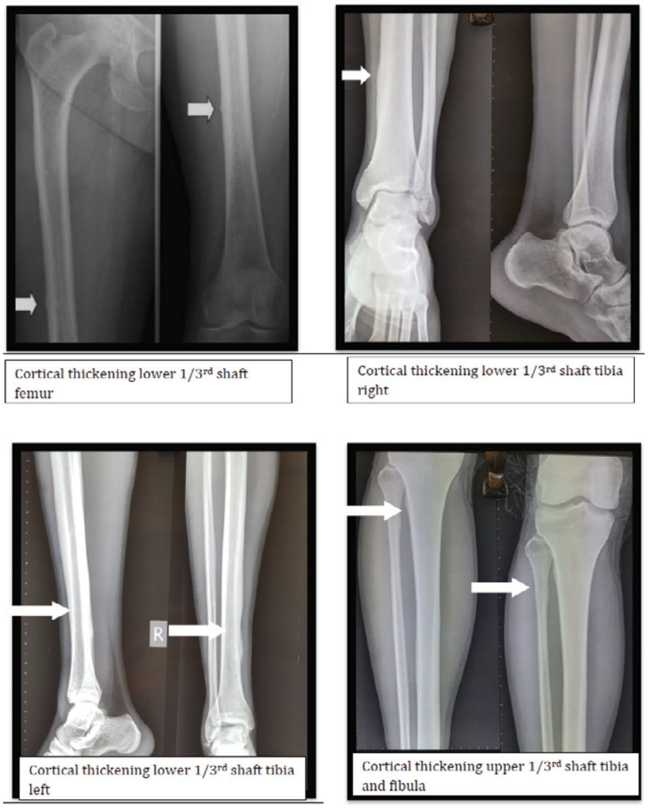

Figure 2: Marked areas indicate involved portion of bones in lower extremity.

Discussion

Military personnel represent a unique population exposed to intense physical and cognitive demands during both training and operational missions. Typically, military service commences with basic training (BT) which is characterized by intense physical training, emotional and mental stress [1].

It should be emphasized that such a challenging environment is enhanced during combat recruit training. Individuals seeking to enhance physical performance through participation in arduous physical activity, particularly athletes and combat soldiers, must adhere to rigorous regime to make them fit soldiers and for deployment in areas which demands such high standards of agility in musculo skeletal system [2].

Bone overuse injuries, also referred to as stress reactions and stress fractures, are the most common overuse injuries among combat soldiers and are observed most frequently among young army recruits who undergo strenuous exercise during basic training [3-5]. The occurrence of severe cases of stress fracture has even reached rates as high as 64% in the Finnish army [6,7] and 31% in the Israeli Defense Forces (IDF) [7,8].

Stress fractures have been found to be related to several risk factors, both intrinsic and extrinsic over most of which we have no control [9,10]. These include bone geometry, and genetic predisposition, nutrional status of individuals as most of the recruits are from low socio economic groups, and iron deficiency and micronutrient deficiency are very much prevalent in third world countries like India especially northern and southern remote parts of the country [11-13].

Studies on bone density have been contradictory [14], and biochemical markers of bone turnover are also probably not related to stress fractures [15].

Calcium deficiency has been found deterrent to bone quality in animal models [16,17] but studies on athletes and soldiers have been less conclusive. Calcium and vitamin D are probably important in women [18] and in Finnish males (who may be effected by the latitude) [19], but in general, there is not enough data on males. In our study we have not included any female recruits or cadets as their training establishments are different from the institutes where we were placed.

Smoking (present or past history) has also been found to be related to stress fractures, particularly in the US [20,21], and is possibly related to risk taking behavioral patterns. However, this finding has not been reproduced consistently in other militaries, most of the recruits of our training establishments are under strict surveillance for tobacco and other narcotic products, but their consumption has been denied by recruits before their entry.

Blood samples representing nutritional status were collected at admission and hemoglobin (Hb%), PCV Packed cell volume, Mean corpuscular volume, mean corpuscular hemoglobin and total serum calcium, albumin , concentration were examined to rule out deficiency of iron, and broadly to distinguish the poorer intake of other bone building nutrients in general. Approximately 10 cc's of venous blood samples were obtained by antecubital venipuncture into tubes (BD Vacutainer) [23-25].

Dietary supplements were not given or encouraged, though they were not prohibited and their use was not monitored. Formally, recruits were allowed to get additional snacks at the canteen, but they were given access to the canteen on a regular basis as part of recreation and for day to day maintenance items like shaving creams, razors, personal extra inner clothing, They might also have eaten extra food sent by relatives.

In one study, Significant differences ($p<0.05$) were found after 6 months in serum calcium (9.5 ± 0.2 and 9.8 ± 0.3 mg•dl-1, respectively) and iron (71.7 ± 27.2 and 130.4 ± 71.5 µg•dl-1, respectively), on induction and after 4-months of blood tests [26-28].

Stress fracture susceptibility is multifactorial. A main factor in the mechanism of long bone stress fractures is imbalance in osteoclasis and osteogenesis that are over

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activated to enable the bone remodeling necessary for the bone strengthening [29,30].

In this milieu of excessive osteogenic needs, it is reasonable to assume that dietary deficiency of calcium and/or vitamin D could contribute to stress fractures, as has previously been implicated in rickets, osteomalacia, osteopenia, osteoporosis, fractures and other cases of excessive bone resorption [29].

Although vitamin D3 (cholecalciferol) is either formed in the skin after exposure to sunlight or obtained from nutritional sources, in our geographical location the magnitude of exposure to sun rays especially during morning and evening is quite substantial for generation of vitamin D. during military training. But in countries where exposure to sun is decreased due to cold weather and intensity of sun is hampered by applying special skin applications which may limit the generation and vitamin D3 synthesis, and therefore, the importance of balanced nutritional intake, especially of vitamin D and calcium, should be emphasized, even though we did not actually find low serum levels of calcium and vitamin D [29,30]. Release of paratharmone, PTH is controlled by the level of calcium in the blood, with low blood calcium levels causing an increase in PTH. The main purpose of this hormone is calcium homeostasis. Studies have found that there is a pathological difference in PTH and calcium levels healthy young recruits [29].

In a study slight trend towards higher levels of PTH after 4-months of physical training attributed to lack of dietary calcium. However PTH levels between induction values and 4 month values were not significant [29]. It should therefore be emphasized that while engaging in strenuous physical training, proper nutrient intake may act as a long-term protector against bone resorption and stress fracture development and is recommended for maintaining healthy bones [30].

The development of stress fracture is multifactorial. Although the recruits in our centers were from poor economic background their body capability and exposure to sunlight were very much towards the normal bone development and none of them had or previously sustained any fractures. The intensity of training and shoes used and duration were similar in both the centers, but the development of stress fracture in femur and mid tibia were observed in late entry individuals whose age reaching 21 years compared to 18 years which is first age to entry. The use of Wax bath and rest , and gradual pull up in to normal routine after initial rest of 4 weeks had made most of the bone remodeling process normal and the recruits with more motivation did well than the persons with more bodily agility who are not motivated post recovery.

Conflict of interests: None

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