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## Prevalence of stress fracture in military cadets

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### Abstract

**Introduction:** Stress fractures have continued to plague competitive athletes and military recruits, especially at the beginning of military service. The underlying pathophysiology of stress fractures occurs when the rate of repetitive microtrauma exceeds that of osseous remodeling. The prevention of lower extremity stress fractures remains a long-standing problem in the military, and it represents a significant socioeconomic burden. Treatment strategies include early identification of the symptoms, early diagnosis, a sufficiently long training pause. The present study aimed at determining the incidence and type of Stress Fractures in Border Security Force cadets (BSF) recruited in Indore through clinical and radiological diagnosis.

**Material and Methods:** In a prospective study of Stress Fractures, a group of 1000 BSF cadets training in Indore was selected and those presenting with symptoms were evaluated clinically and radiologically. The SF was graded in to 4 groups based on the suggested clinicoradiological classification by Agarwal.

**Results:** One hundred and seventy four (174) out of 1000 consecutive recruits had symptoms of SFs. Out of 150 diagnosed with SF 60 (40%) were Grade I, 54 (36%) was Grade II, 29 (19.33%) were Grade III and 7 (4.67%) were Grade IV. The significant higher incidence of SFs has been attributed to training with maximum stress on running, jumping, parade on hard ground, and gymnastics. The maximum occurrence of Stress fracture in our study was found at 10 weeks of training.

**Conclusion:** There is a high incidence of SF in military cadets which tends to remain unreported otherwise. Proper education of trainees, trainers and instructors, modification in training procedures, use of better equipments can reduce occurrence of these fractures. Early reporting to hospital and treatment is also necessary as it can help in early return to full activity.

**Keywords:** stress fracture, military cadets, clinicoradiological

### Introduction

In the modern era, stress fractures have continued to plague competitive athletes and military recruits, especially at the beginning of military service [1-3]. Yet despite increased awareness and improved diagnosis [4], stress fractures remain an important source of disability in the contemporary military. The underlying pathophysiology of stress fractures occurs when the rate of repetitive micro trauma exceeds that of osseous remodeling [5]. This often develops during basic training, field exercises, and combat deployments, largely as a result of marked increases in exposure and/or intensity of endurance, impact physical activity. The most frequently reported cause of these fractures is repetitive weight-bearing activities such as running and marching, a recent increase in physical activity, beginning of a new activity or some other change in their routine can also result in increase of these fractures [6]. The prevention of lower extremity stress fractures remains a long-standing problem in the military, and it represents a significant socioeconomic burden due to the significant cost of treatment and time lost to injury. Prevention, however difficult is the best approach for avoiding SFs. Treatment strategies includes early identification of the symptoms, early diagnosis, a sufficiently long training pause. The present study aimed at determining the incidence and type of Stress Fractures in Border Security Force cadets (BSF) recruited in Indore through clinical and radiological diagnosis.

## Material and Methods

In a prospective study of Stress Fractures, a group of 1000 BSF cadets training in Indore was selected and those presenting with symptoms were evaluated clinically and radiologically. During their training, the recruits were reviewed by the doctor appointed at the BSF camp. All the cadets were advised to report symptoms of possible Stress Fracture, and all symptomatic recruits were referred to our hospital (Sri Aurobindo medical college & PGI, Indore) for further management. Appropriate radiographs were taken. The time of fracture was considered to coincide with the earliest manifestation of pain in the affected limb. The cadets had free access to the medical staff as well as mandatory examinations every two weeks during training. All patients were treated conservatively; with initial period of immobilization with POP, rest, ice packs and analgesics, followed by muscle conditioning, mobilization and gradual re-induction into training programme. Period of management was decided according to the site and grade of SFs and radiological signs of union.

The SF was graded in to 4 groups based on the suggested clinicroadiological classification by Agarwal [7].

**Grade I:** Mild pain, periosteal reaction, tenderness, walks without pain.

**Grade II:** Severe pain, hair line crack of cortex, tenderness, and walk without support.

**Grade III:** Severe pain, partial thickness involvement of cortex, tenderness, walks with support.

**Grade IV:** Severe pain, tenderness, cannot walk/walks with difficulty even with support, full thickness of cortex involved.

## Results

One hundred and seventy four (174) out of 1000 consecutive recruits had symptoms of SFs. On evaluation by radiography 150 recruits (15%) were diagnosed as having SFs. out of 150 diagnosed with SF 60 (40%) were Grade I, 54 (36%) was Grade II, 29 (19.33%) were Grade III and 7 (4.67%) were Grade IV [Fig-1].

[Fig-2] shows the number of fractures at each site. Highest number of injuries was found in the tibia (89.22%), followed by the fibula (4.8%), and metatarsals (4%). There were five femur shaft stress fractures (1.66%) and two neck of femur (0.66%) fracture [Fig-2] which were also treated conservatively with adequate splintage.

Out of all the tibia fractures, 55.33% fractures were at the proximal 1/3rd, 40.66% were at the middle 1/3rd junction and 5.01% were at the lower 1/3rd junction. All fibula fractures were at the proximal 1/3rd junction. Third metatarsal was most commonly involved (71.66%) followed by 2nd metatarsal (29.33 %). All femoral shaft fractures were at the proximal 1/3rd junction [Fig-3].

The incidence of SFs was more during their initial training period and reached maximum at 10 weeks of the training schedule. All fractures healed uneventfully in an average period of 4 weeks. All cadets returned to full activity in an average period of 8 weeks.

## Discussion

The incidence and distribution of these SFs varies around the world. Data about the actual incidence from Indian military and precisely at what point in training do they occur is

limited. The present study was performed to understand the answers to these questions, and military service of Indore border service forces cadets provided a suitable group to study.

Intrinsic risk factors for the development of stress fractures have been studied extensively. Studies focusing on military populations have identified female gender, initial entry to service, increasing chronological age, white race, enlisted rank, Army or Marines branch of service, increased bone turnover, anatomic malalignment, and decreased tissue or bone vascularity as risk factors [8,9].

The incidence of SFs among military recruits has been reported to be around 5% amongst the US military recruits [10]. However, in India two studies by Agrawal PK and Dash N *et al.*, reported high incidence of 11.4% and 7.04% in two different military training centres [11, 12], where as our study shows the incidence of 15% SFs which is higher than any other studied group.

The significant higher incidence of SFs has been attributed to training with maximum stress on running, jumping, parade on hard ground, and gymnastics. It can be also due to sudden increase in amount and intensity of physical activity along with repeated impact due to running on hard surface, improper technique and equipment.

Commonest site involved in our cases was tibia (87.66%) followed by fibula and metatarsal. The distribution of sites of SF in this study is similar to the study by Singh SC, *et al.*, [13] and Steve B. Behrens *et al.* [14] However, in contrast Alexander M Wood *et al.*, reported metatarsals as the most common site for stress fracture [15].

The maximum occurrence of SF in our study was found at 10 weeks of training. However, in another study, the maximum occurrence of SF was found between the basic phase of training i.e. between nine weeks and 27 weeks [16].

In our study, SFs were confirmed on the basis of radiography. An additional CT scan was performed in cases where radiographs were inconclusive. Wood AM *et al.* reported return to full activity at 12.2 weeks for metatarsal fractures and 21.1 weeks for tibial stress fractures [17] which is contrary to our study where all cadets returned to their full activity in an average period of 8 weeks.

## Prevention

Adjusted training schedules and individualized risk stratification can successfully reduce stress fracture risk. Intensity of training should gradually be increased over a number of weeks, with high-strain sport-specific activities beginning approximately six weeks after graduated training [18]. Activity-specific athletic shoes should be in good condition and replaced every 200 to 300 miles [18].

Calcium and vitamin D supplementation have been widely promoted for prevention of fragility fractures, especially when a nutritional deficiency exists [19]. Further studies have shown that serum vitamin D levels greater than 40 ng/mL are associated with a lower risk of stress fractures and are recommended for stress fracture prophylaxis [20, 21].

## Conclusion

The study provides evidence that there is a high incidence of SF in military cadets which tends to remain unreported otherwise. Sometimes the cadets do not complain of symptoms and continue the strenuous exercise for fear of losing their Post/Rank, despite having symptoms. The doctor must therefore maintain a high index of suspicion of a Stress Fracture. The tombstone in avoiding SF is prevention. Proper

Education of trainees, trainers and instructors, modification in training procedures, use of better equipments can reduce occurrence of these fractures. Early reporting to hospital and treatment is also necessary as it can help in early return to full activity.

**Picture legends**

[Fig-1]: Percentage distribution of stress fractures according to clinic-radiological classification by Agarwal

[Fig-2]: Percentage distribution of stress fractures according to site involved

[Fig-3]: Percentage of site wise distribution of stress fractures

[Fig-4]: Showing no signs of fracture at time of presentation but shows callous formation after 4 weeks

[Fig-5]: showing healed fracture with callous formation in proximal shaft tibia

[Fig-6]: image shows stress fracture at basicervical femoral neck with consequent healing over the period of time

[Fig-7]: Xray of cadet with symptoms of stress fracture but no radiological finding on xray and CT scan of the same patient showing signs of stress fracture

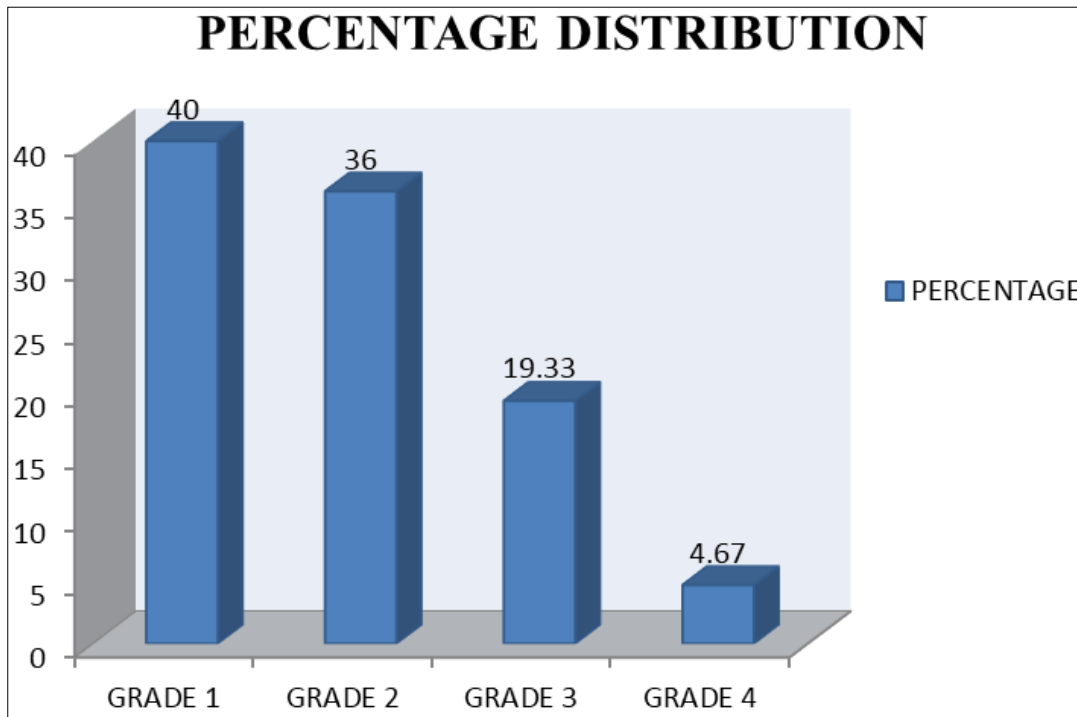


Fig 1

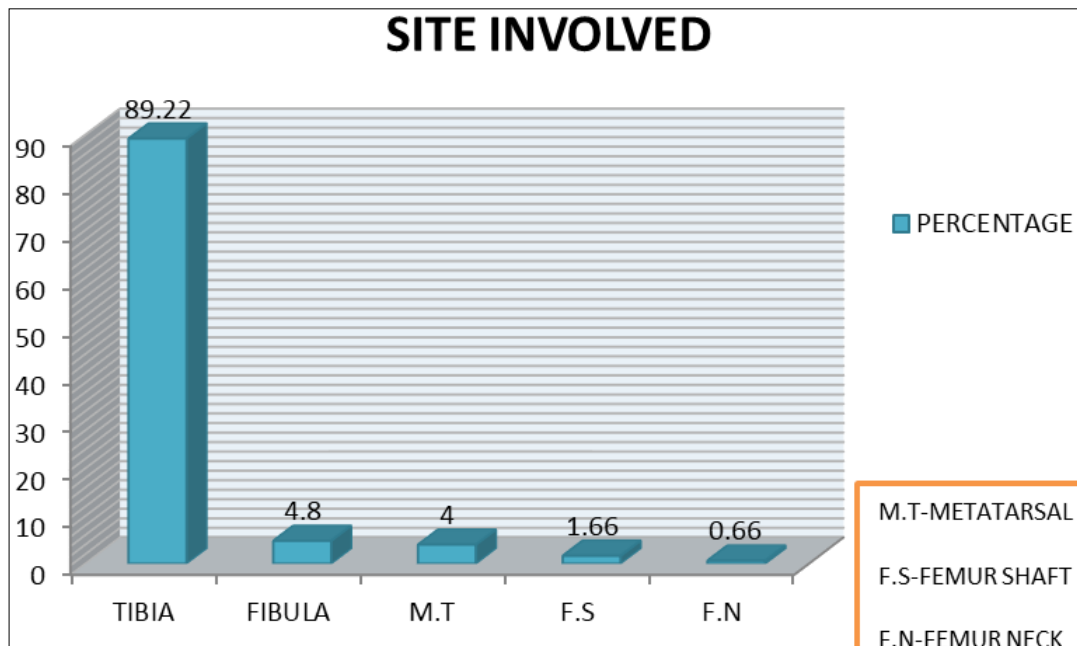


Fig 2

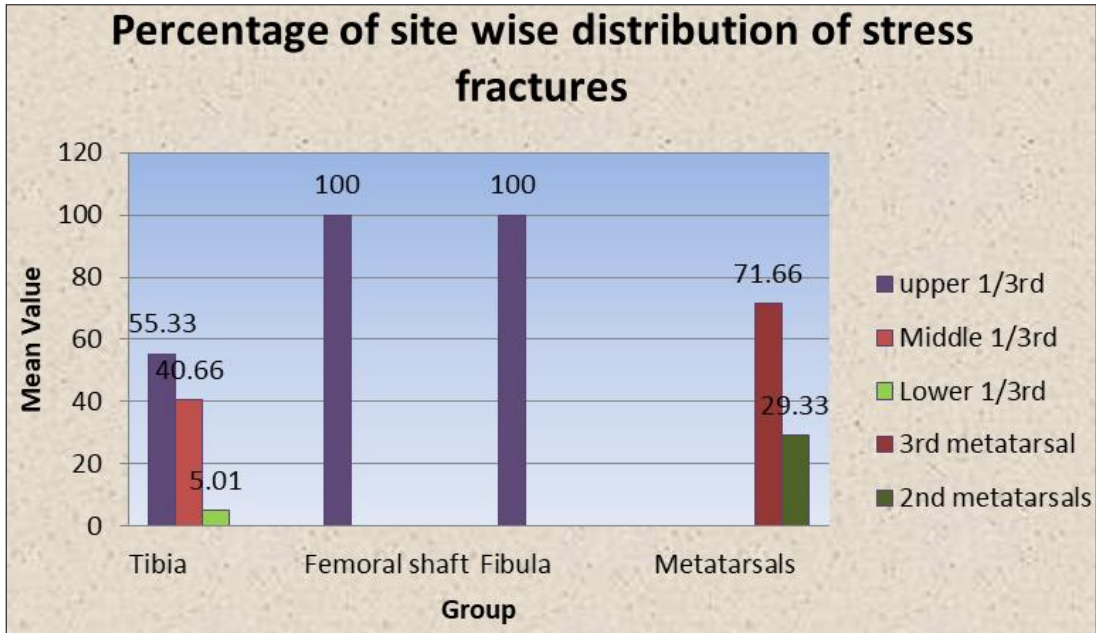


Fig 3



Fig 4



Fig 5

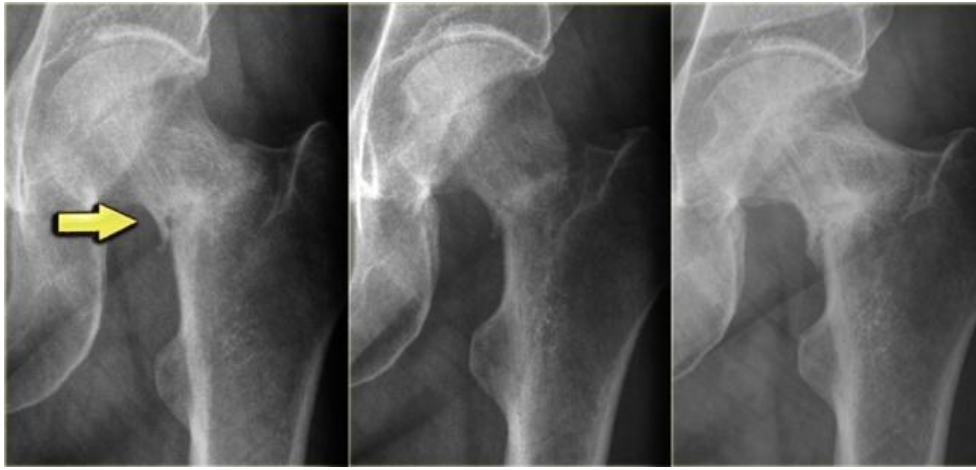


Fig 6



Fig 7

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