

Stress Fractures in Female Cadets in Bangladesh Naval Academy during Training

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Abstract

Introduction: Stress fractures occur due to repetitive cumulative micro trauma on the bone over a period of time. These are common overuse injuries in military cadets and sports personnel during training. Stress fracture in female cadets is a rising cause of concern for its high prevalence. It increases morbidity, long term absence from training and significant economic loss.

Objective: To find out the prevalence, time of occurrence and sites involved among the fresh female cadets during their basic training.

Materials and Methods: A descriptive cross-sectional study was conducted during January 2011 to April 2017 in female cadets undergoing basic training at Bangladesh Naval Academy, Chittagong. A detailed history and physical assessment was performed of those presenting with pain, swelling or limping. Radiographic imagings were done to evaluate the symptoms. All cases of stress fractures were finally diagnosed on the basis of findings and were appropriately managed and followed up every two weeks till the time of union.

Results: Eighteen cases out of 82 had clinical and radiological signs of stress fractures with an overall prevalence of 21.95%. Average age was 19 years (range 18-20). Highest prevalence was around 12 weeks of training. Common sites were tibia (40.90%), pelvis (40.90%) and fibula (9.09%). There was one metatarsal and one femoral neck fracture. All the fractures were treated conservatively and were healed in an average period of 7 weeks. All cadets returned to their full activity in an average period of ten weeks.

Conclusion: Prevalence among the female naval cadets is high and probably underrated in this setting. For prevention, modifiable causes and risks factors must be evaluated and identified. A proactive approach for early detection and immediate management is indispensable to reduce the morbidity and early return to full activity.

Key-words: Stress fractures, Female cadets, Basic training.

Introduction

Since the 1980s, women's participation in competitive sports and military training has increased globally¹. Following the trend and for nation's demand, in recent decade Bangladesh armed forces have recruited female cadets. The increased participation has led to a concomitant increase in the risk of musculoskeletal injury within this population. Musculoskeletal injuries are a serious problem for recruits participating in military training but may be especially important for the women².

Prospective studies of military populations participating in different entry level programs have consistently higher injury rates among women than among men^{3,4,5}. In particular, estimates of stress fractures rates from 5% to 12% have been reported among women undergoing various entry level military programs which are about 1.5-5 times higher than for men undergoing similar training^{5,6}. Stress fractures have recently been a matter of concern in military cadets undertaking basic training since it results in attrition as well as significant economic losses. Basically an overuse injury, these are the result of repeated application of stress lower than that requires to fracture the bone in a single loading situation⁷. The activities involved in the diverse types of military training may put personnel at different injury risks. 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 routine⁸. Briethaupt⁹, a Prussian military physician first described stress fractures in 1855 and first imaging of this fracture recorded by Stechow¹⁰ in 1897. Symptoms include pain which increases on weight bearing and swelling. Typical findings include localized tenderness, swelling and erythema.

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Preliminary diagnosis of these fractures is done by thorough history and clinical assessment. Radiological diagnosis provides a reliable confirmation of these fractures and sites involved. Stress fractures may heal completely, slowly or incompletely¹¹. Prevention, however difficult is the best approach for avoiding stress fractures. Management strategies include early identification of the symptoms, early diagnosis, a sufficient long training pause and in special cases consultation of experts in this field. Surgical treatment may be required in some cases^{8,12}. Besides the knowledge about the occurrence of these fractures, their effect on economy and loss of training hours, there are relatively very few studies that provide actual prevalence and subsequent sequale in Bangladesh that are very much required to provide a basis for recommending future management and prevention strategies. Still there is no epidemiological study on stress fractures among the female cadets in Bangladesh Navy during their training. The purpose of the present study was to find out the prevalence, time of occurrence and site of the fractures in the female cadets in Bangladesh Naval Academy.

Materials and Methods

A descriptive cross-sectional study was conducted among the naval female cadets at Bangladesh Naval Academy, Chittagong and the period was from January 2011 to April 2017. Total of 62 female cadets were trained there during this tenure. The age group was 18 to 20 years and the training period was for three years. Fresh trainees from this academy, who reported to hospital (BNS Patenga, Chittagong) with complaints of gradual onset of localized bone pain, swelling and limping, were evaluated clinically and radiologically.

Clinical evaluation included a thorough clinical history regarding activities involved and interpretation of pain and tenderness at specific region. Anyone having acute history of trauma was excluded from the study. Radiograph included anteroposterior and lateral projection of the involved anatomical region. CT scan was only performed for femoral neck fracture. All cases diagnosed as stress fractures were treated with splintage in the form of plaster of Paris (POP) slab except for fibular and pelvic fractures. All were refrained from physical activities and were kept on non weight bearing mobilization.

The POP slab was removed after 6 weeks. Patients were assessed clinically and radiologically. Mobilization and activities were increased gradually over a period of 6 weeks.

Results

During the study period, 18 out of 82 female (21.95%) cadets suffered a total 22 stress fractures diagnosed on the basis of clinico-radiological evaluation. The age range was 18 to 20 years with an average of 19 years. The fracture distribution is illustrated in Table-1.

Table-I: Stress fractures sites (N=22) in 18 female Naval Cadets in Bangladesh Naval Academy, Chittagong

Fractures	Number	Percentage (%)
Tibia	09	40.90
Fibula	02	9.09
Femur	01	4.54
Pelvis	09	40.90
Metatarsal	01	4.54
Total	22	100

Out of total 09 fracture sites in the tibia 55% were found in the lower third, 33.33% in the upper third and 11.11% in middle third. For the pelvic fractures (total 09) most of these were at inferior ramus of pubic bone (60%). Other sites were ischio pubic ramus and ischium. Out of 02 fibular fractures, all were at the junction of middle and proximal third. There was single stress fracture at the neck of femur and 2nd metatarsal bone.

All cases presented with pain at involved sites with difficulties in walking and running. The prevalence of stress fractures was more during initial period and reached maximum around 12 weeks of training schedule. The pain was typically aggravated with physical activities and progressively worsen with continuation of activities. Pain was relieved with rest. The radiological findings were faint fracture line (lucency), sometimes heaped up callus and periosteal reactions in the form of sclerosis at the stress fracture sites. All cases of stress fractures were hospitalized and managed conservatively. The average duration of hospitalization was 20 days and all the stress fractures were healed uneventfully in an average period of 7 weeks. All cadets returned to full activity in an average period of 10 weeks.



Fig-1: Stress fracture of tibia.



Fig-3: Stress fracture of pelvis.



Fig-2: Stress fracture of 2nd metatarsal.



Fig-4: Stress fracture of fibula.

Discussion

Stress fracture is usually a hairline fracture of bone caused by rapid and repeated application of a heavy load, such as constant pounding on a surface during running, route march, parade, drill, games and weapon training¹³. It occurs when muscles become fatigued and are unable to absorb added shock. Eventually the fatigued muscles transfer the overload of stress to the bone causing tiny cracks¹³. Women cadets have been reported to sustain a disproportionately higher incidence of stress fractures than men. The relative risk of stress fractures among women in military populations undergoing identical training program as their male counterparts has been reported to be as high as 10 times¹⁴.

Various studies of stress fractures in military recruits have found an incidence ranging from less than 2% to an unusually high incidence of 31%¹⁵. In this study, the prevalence of stress fractures in female cadets of Bangladesh Naval Academy is 21.95%. It is found 31% in a prospective study in male Israeli military recruits¹⁵. Incidence ranging from 12% among female Caucasian American recruits to less than 2% for their male counter parts¹⁶. In India two studies by Agarwal PK and Dash N et al, reported high incidence of 11.4% and 7.04% in military training centers^{17,18}. It was 15% in a study done on cadets of Border Safety Force (BSF) in India¹¹. An American study showed incidence of stress fractures from 5% to 12% among women underwent entry level military training programs^{5,6}.

During 13 weeks of Marine Corps basic training, 5-7% suffered stress fractures². Another study¹⁹ in female officer cadets of US military, the rate was reported higher about 9.6%. In Indian Air force Academy, the rate of stress fractures in female cadets was 7.3% during 24 weeks basic training^{20,21}. A result from research in US and UK Armies, the rate of stress fractures in women was 12.3% and 10.9% during basic training^{22,23}. Within the anti aircraft combat units of Israeli Defense Force (IDF), 23.9% females develop stress fractures over the 10 weeks of basic training²⁴. Apparently the prevalence of this study far exceeds most of the previous studies.

The significant higher incidence of stress fractures has been attributed to training with maximum stress on running, jumping, parade on hard ground and gymnastics²⁵. It can be also due to relative long training

period in comparison to other and sudden increase in amount and intensity of physical activities along with repeated impact due to running on hard surface, improper technique and equipments^{8,26}. Moreover the cadets partly due to their initial entry level fitness, nutritional status and partly their unaccustomed training regimen suffer a lot of impact on the bone. The most common sites of stress fractures in these cases were tibia (40.90%) and pelvis (40.90%) having the same distribution followed by fibula (4.54%). It is almost similar with the study done in female Marine Corps recruits in USA¹ but the tibial frequency is higher (57.6%) then pelvis (15.2%). Another study² among the female marine recruits in Parris Island, USA, the commonest sites were tibia (24.9%), metatarsal (22.1%) and pelvis (21.6%). The maximum occurrence of stress fractures in this study at around 12 weeks of training which is similar to the study done by Shaffer RA et al². However in another study, the maximum occurrence was between 9 weeks and 27 weeks²⁵.

Conclusion

The female cadets have high rate of stress fractures during their basic training in all countries but there is variation in site of occurrence. The principal causative factor is rigorous and sustained physical activities over a relatively short period in unaccustomed cadets. The protractive approach for the prevention is to start at a lower level activity and gradually progress to the full scale. Training program should include endurance training to help the cadets withstand intense physical activities. Proper education of all concern, use of better equipments and appropriate running surface can reduce the incidence. Early detection by high index of suspicion to the complaints of pain by the cadets with proper evaluation is indispensable to reduce the morbidities. Since complete elimination of stress fractures is impractical, an objective approach to minimize the loss of training hours should be the goal of all training establishments.

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