Incidence of Stress Fractures in Indian Military Recruits

Deepak S, Dayanand M*, Manoj Kumar HV and Abhinav Batnagar

Bangalore Medical College and Research Institute, Karnataka, India

Abstract: *Introduction*: Stress fractures are common in Military recruits during their training period and give rise to morbidity and loss of training hours. Some cadets with stress fractures are re-instated while some are expelled out of service resulting in attrition and economic loss.

Aim: A study to find out the incidence of stress fracture in Border Security force (BSF) military recruits in India.

Method: A prospective analysis of stress fractures among 2000 BSF cadets was done in a period of 9 months of their training. Recruits with metabolic abnormality were excluded. Clinical and radiological diagnosis was made and was followed up every 4 weeks till the time of union. Result: The incidence of stress fractures among BSF trainees was found to be 15%. The incidence of stress fractures was highest during their initial weeks of physical training exercises and reached maximum at 12 weeks of the training schedule. 263 tibia, 24 fibula, 6 metatarsal, 5 femur shaft and 2 femoral neck stress fracture were seen. 3 tibia, 3 femur and 1 neck of femur fractures were operated and the rest were treated conservatively. All the fractures healed uneventfully.

Conclusion: Stress fractures are due to sudden increase in the amount and intensity of physical activity along with repeated forces due to running on a hard surface, improper training protocol, equipment. Higher incidence of stress fracture (15%) in our study suggests an appraisal and modification in training programme of military recruits.

Keywords: Military recruits, stress fracture, femoral stress fracture.

INTRODUCTION

Stress fracture is are partial or incomplete fracture resulting from repetitive loading of stress of lesser intensity that is usually required to fracture a bone in a single load. The repetitive load [1] results in an imbalance in the bone formation and resorption leading on to stress fracture. Stress fractures are common injuries, particularly in the lower extremities of athletes and military personnel [1,2]. The basic pathology is an imbalance between the repetitive loading or stress and the intrinsic ability of the bone to repair itself [4]. The presenting complaints will be a recent period of sudden increased physical exercise (or training) and, or have a higher reported incidence in activities that involve running and jumping in most of the cases [1]. Patients with stress fractures will generally present pain especially on exertion. Clinical findings are often non-specific and plain radiography may be ambiguous warranting further imaging techniques, such as bone scans or MRI to confirm the diagnosis. Increasing in age, feminine gender, white, non Hispanic race along with a poor body mechanics contribute to the intrinsic factors for stress fractures [22,23]. Abnormal Body mass index, Poor fitness level, low calcium intake, smoking, improper equipments like foot wear and improper training methods are the modifiable risk factors [23,24].

Repetitive weight-bearing activities, particularly running and marching, are the most frequently reported causes of stress fractures [25]. In general, the tibia, fibula, and metatarsals are the anatomical sites that are most frequently affected by stress fractures; however, stress fracture sites vary in relation to the precipitating activity. Early military reports of stress fractures among recruits described march fractures of the foot [27] on the other hand in post World War II, more numbers of military studies described march fractures in other bones of the lower extremities, primarily the tibia and femur [28,29]. Recent military papers have shown more number of cases occurring in the tibia [30,31]. Since there is no appropriate study done extensively about the incidence of stress fractures in military recruits in the subcontinent, we conducted a study at our institute.

METHODS

A prospective study was conducted in Bangalore Medical College and Research Institute, Bangalore, India on 2000 Border security force (BSF) cadets during their training period from March 2010 to October 2011. All symptomatic patients were investigated clinically and radiograph. C.T Scan or radio nucleotide bone scan of the involved limb was done when necessary.

All the subjects were BSF recruits and BSF has their own selection and fitness criteria before recruiting them to the service. The minimum height should be 170 cms and should be of appropriate weight. BMI

*Address correspondence to this author at the 304, elegant westwood apartments, 11th cross malleswaram, Bangalore 560003, Karnataka, India;
Tel: 9902876934; E-mail: drdayanand.m@gmail.com

E-ISSN: 2313-0954/15

should be around 25 to 26. Too lean and obese candidates will not recruited since they have their own recruitment process and selection criteria hence they were not part of our study. We did not have female recruits in our series. All BSF recruits undergoing training were included. Patients with metabolic bone disease like Osteomalacia, Hyperthyroidism, Cushing's disease etc., and major trauma were excluded. Recruits with complaints of pain in the lower limb during their training period were subjected to digital radiography; if radiographs didn't reveal stress fracture then they were subjected to CT scan or Bone Scan. Metabolic conditions which affect the bone were ruled out. CBC, ESR, electrolytes, serum phosphates, Calcium level, Thyroid profile, vitamin D essay and PTH were done and was confirmed that they were in normal limits. All the recruits underwent rigorous training of 10-12 hours in a day which included march past, running and ground exercises which is of moderate to high intensity training in terms of severity as per the training protocol followed by the BSF.

Complete displaced long bone fractures were reduced by closed reduction and internally fixed with interlocking nail. Stress fracture of neck of femur was fixed with Dynamic Hip screw. Post operative patients underwent physiotherapy and were mobilized with toe touch weight bearing with the help of crutches and gradually proceeded on to full weight bearing depending on the clinical and radiological improvement on follow-ups. Incomplete stress fractures were treated conservatively which consisted of a 6-week period of partial weight bearing, with the aid of crutches. This was followed by a minimum of 6 weeks of pre-recovery training, performing non-impact cardiovascular work. This progressed to 4 weeks of light impact training on a treadmill and then a minimum of 4 weeks of mainstream training, with progressive impact training before progressing on to marching and regular exercises.

RESULTS

All the cadets were males with age range of 18-25 years. There were no female recruits in our study. 300 (15%) BSF cadets had clinical and radiological signs of stress fracture. Average period of incidence of stress fracture was at 12 weeks of training (range 4-36 wks). 95% of the cases were diagnosed by radiograph alone and the rest 5% was subjected to bone scan and CT scan. Femoral stress fractures both in the neck and shaft were seen on the compressive side. Similarly in tibia the stress fractures were seen in the medial shaft and all the fractures were in the proximal third of tibia. Fibula stress fractures were seen in the lower third and in the neck in the 2nd metatarsal bones. 263 tibia, 24 fibula, 6 metatarsal, 5 femur shaft and 2 femoral neck stress fractures were seen, 1 femoral neck was incomplete and 1 was complete which was operated with Dynamic hip screw. 3 femoral and 3 tibial fractures were due to trivial fall in a preexisting stress fracture. They were complete and displaced. Closed reduction and internal fixation with IL nail was done and the fracture healed within 4 months. The Average healing time was 12 weeks from the time of diagnosis (range 10-16wks). All the patients were able to return to their regular training and were recruited back successfully.

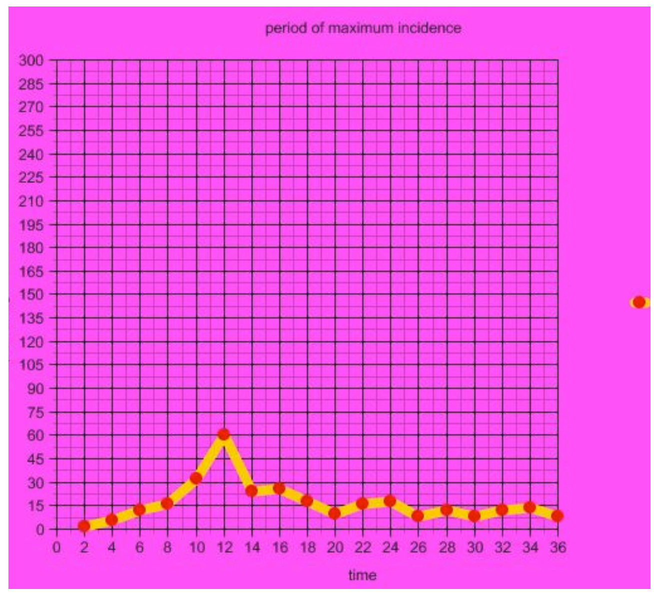

Figure 1: Period of maximum incidence.

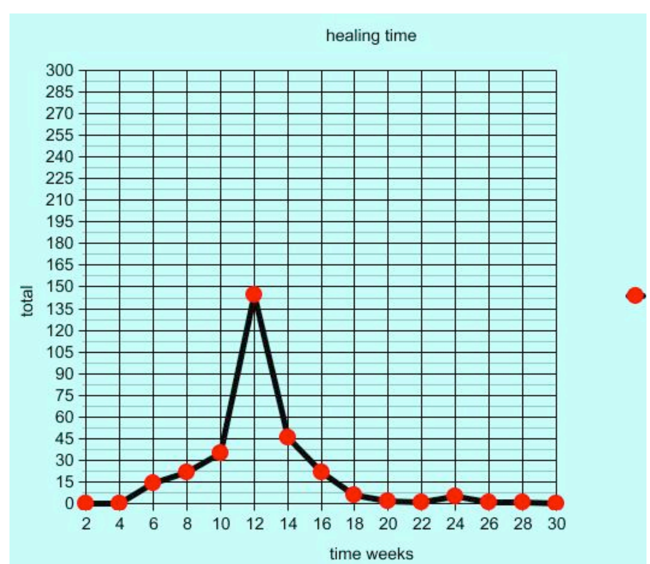

Figure 2: Average Healing Time.

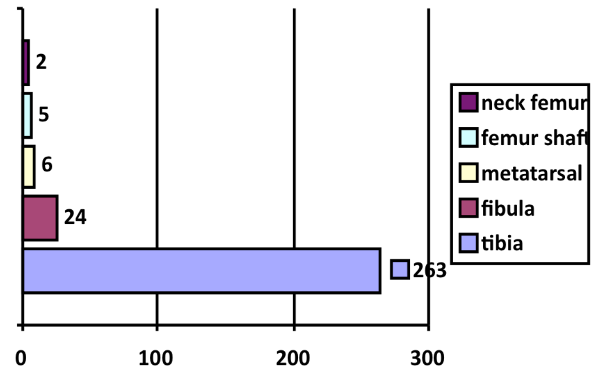

Figure 3: Incidence of stress fracture.

DISCUSSION

The 15% incidence of stress fractures observed in our study far exceeds the figures reported from any previous study [1-3]. This could be due to a larger number of cadets that has been studied. Other factors include a probable awareness and early referral policy adopted by the medical staffing at BSF. Some factors may also be attributed to the training program adopted which is not known to us and the foot wear used during the exercises that could have played some role in incidence and distribution of stress fracture. Anatomical distribution of stress fractures in our study was similar to that previously reported [4,30,31] as compared to study by Wood *et al.* where metatarsal fractures were more common [25].

Our study showed similarity in the onset of symptoms and occurrence of stress fracture in the early stages of training as reported in the American studies [12].

Stress fracture is frequent in the running population, commonly affecting the lower limb and foot. In our study, stress fractures occurred in about 15% of recruits, and the most common site is the tibia as compared to 10% incidence in the study done by Dafner *et al.* [2, 3]. Stress fractures of the femur are relatively uncommon. Brudvig *et al.*, in their study observed an incidence of femoral fractures in 2.8 - 7 % of all the sports related fractures [1], which is similar to 2% in our study. Those of the femoral stress fractures reported comprised between 2.8 and 21 percent of the femoral stress fractures in athletes [3, 4]. Femoral neck stress fractures in our study were 1 per 1000 as compared to 1.2 per 1000 in study by Talbot *et al.* [12]. Brudvig *et al.* [1] highlighted the challenges in diagnosis and treatment of such fractures.

Clement *et al.* [11] showed that radiographic study is diagnostic only in 24% of the cases. In case of suspicion an MRI or a radio nucleotide bone scan should be sought to confirm to arrive to a definitive diagnosis as this fracture poses great challenges in treatment and prognosis. MRI has many advantages like avoidance of radiation, detection any other soft tissue abnormalities in the recruits, detection of early signs of stress fractures and is more specific when compared to bone scan though it is similar in sensitivity [7]. Limitation of MRI is that it will usually be limited to small region where as a bone scan can detect the lesion in a larger area and is very cost effective when compared to MRI. Hence bone scan was used as the screening tool when the recruits came with hip and thigh pain and the x rays showed no abnormality.

Average healing time was 12 weeks from time for diagnosis (range 10-16wks), Clement *et al.* [11] in their review noted a mean time to return to the pre injury exercise level was 10.4 weeks. Hershman *et al.* [10] noted an average time to return to play was 11.5 weeks.

Follow-up radiographs are helpful at 6 to 12 weeks to document bony changes that might occur during the healing process. Return to marching and regular exercises is guided, however, by the absence of clinical symptoms. Follow-up MRI/CT or bone scan is not necessary provided the athlete follows the expected course of improvement.

CONCLUSION

Stress fractures during training of fresh recruits in military and security forces are 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. The clinician must maintain a very high index of suspicion of a stress fracture to improve the prognosis. If the injury is detected before progression to a displaced fracture, conservative treatment is generally successful. Training errors and other risk factors should be evaluated to help prevent recurrence. The training programme of such trainees needs to be re-assessed and proper policies should be implemented to have a structured training programme in liaison with the clinicians, trainers and the policy makers. We recommend progressive endurance training, high altitude training, running on sand and water where stress is less and also soft footwear. Orthotics, such as shock-absorbing shoe inserts was shown to be effective in reducing the occurrence of lower extremity stress injury in military recruits [26].

DISCLAIMER

Not received and grants/financial help.

CONFLICTS OF INTEREST

None.

REFERENCES

[1] Brudvig TJS, Gudger TD, Obermeyer L. Stress fractures in 295 trainees: a one-year study of incidence as relared to age. Sex and race. Mi/it Med 1983: 148: 666-7.

[2] Daffner RH, Martinez 5, Gehweiler JA. Stress fractures in runners. JAMA l982; 247: 1039-41.

[3] Devas MB. Stress fractures of the tibia in athletes or "shin soreness". J Bone Joint Surg[br] l958; 40-b: 227-39.

[4] Giladi M, Ahronson Z, Stein M, Danon YL, Mllgrom C. Unusual distribution and onset of stress fractures in soldiers. C/in Orthop l985; 192: 142-6.

[5] Greaney RB, Gerber FH, Laughlin RL, *et al.* Distribution and naturalhistory of stress fractures in us marine recruits. Radio/ogt' 1983; 146: 339-46.

[6] Lieberman CM, Hemingway DL. Scintigraphy of shin splints. C/in nue/med l980; 5(l): 31.

[7] Luchini MA, Sarokhan AJ, Micheli Ll. Acute displaced femoral-shaft fractures in long-distance runners: two case reports. J Bone Joint Surg[am] 1983; 65-A: 689-91.

[8] Prather JL, Nusynowitz ML, Snowdy HA, hughes AD, Mccartney WH, Bagg RJ. Scintigraphic findings in stress fractures. J Bone Joint Surg[am] 1977; 59 A: 869-74.

[9] Protzman RR, Griffis CG. Stress fractures in men and women undergoing military training. J Bone Joint Surg[am] 1977; 59-A: 825.

[10] Hershman EB, Lombardo J, Bergfeld JA. Femoral shaft fractures in athletes. Clin Sports Med 1990; 9: 111-9.

[11] Clement DB, Ammann W, Taunton JE, *et al.* Exercise-induced stress injuries to the femur. Int J Sports Med 1993; 14: 347-52. http://dx.doi.org/10.1055/s-2007-1021191

[12] JC Talbot, *et al.* Femoral Neck Stress Fractures In Military Personnel - A Case Series. JR Army Med Corps 154(1): 47-50. http://dx.doi.org/10.1136/jramc-154-01-13

[13] Lee CH, Huang GS, Chao KH, *et al.* Surgical treatment of displaced stress fractures of the femoral neck in military recruits: a report of 42 cases. Arch Orthop Trauma Surg 2003; 123: 527-33. http://dx.doi.org/10.1007/s00402-003-0579-8

[14] Lassus J, Tulikoura I, Konttinen YT, Salo J, Santavirta S. Bone stress injuries of the lower extremity: a review. Acta Orthop Scand 2002; 73: 359-68. http://dx.doi.org/10.1080/000164702320155392

[15] Sanderlin BW, Raspa RF. Common stress fractures. Am Fam Physician 2003; 68: 1527-32.

[16] Cowan DN, Jones BH, Shaffer RA. Musculoskeletal injuries in the military training environment. In: Kelley PW, Ed. Military preventive medicine: mobilization and deployment. Washington DC: United States. Dept. of the Army. Office of the Surgeon General. 2003: 199-200.

[17] Fredericson M, Jennings F, Beaulieu C, *et al.* Stress fractures in athletes. Top Magn Reson Imaging. 2006; 17(5): 309-25. http://dx.doi.org/10.1097/RMR.0b013e3180421c8c

[18] Jones BH. Prevention of lower extremity stress fractures in athletes and soldiers: a systematic review. Epidemiol Rev 2002; 24: 228-247. http://dx.doi.org/10.1093/epirev/mxf011

[19] Finestone A, Milgrom C. How stress fracture incidence was lowered in the Israeli Army: A 25-yr struggle. Med Sci Sports Exerc. 2008 Nov; 40(11 Suppl): S623-9. http://dx.doi.org/10.1249/MSS.0b013e3181892dc2

[20] Bullock SH, Jones BH, Gilchrist J, Marshall SW. Prevention of physical training-related injuries. Am J Prev Med. 2010; 38(1S): S156-S181. http://dx.doi.org/10.1016/j.amepre.2009.10.023

[21] Kupferer KR, Bush DM, Cornell JE, Lawrence VA, Alexander JL, Ramos RG, Curtis D. Femoral neck stress fracture in Air Force basic trainees. Mil Med. 2014; 179(1): 56-61. http://dx.doi.org/10.7205/MILMED-D-13-00154

[22] Cosman F, Ruffing J, Zion M, Uhorchak J, Ralston S, Tendy S, McGuigan FE, Lindsay R, Nieves J. Determinants of stress fracture risk in United States Military Academy cadets. Bone. 2013; 55(2): 359-66. http://dx.doi.org/10.1016/j.bone.2013.04.011

[23] Lappe JM, Stegman MR, Recker RR. The impact of lifestyle factors on stress fractures in female Army recruits. Osteoporos Int. 2001; 12(1): 35-42. http://dx.doi.org/10.1007/s001980170155

[24] Jones BH, Harris JM, Vinh TN, *et al.* Exercise-induced stress fractures and stress reactions of bone: epidemiology, etiology and classification. Exerc Sports Sci Rev 1989; 17: 379-422.

[25] Alexander M. Wood, Richard Hales, Andre Keenan, Alexandra Moss, Michael Chapman, Trish Davey and Andrew Nelstrop. Incidence and Time to Return to Training for Stress Fractures during Military Basic Training. Journal of Sports Medicine, Volume 2014, Article ID 282980, 5 pages.

[26] Rome K, Handoll HH, Ashford R. Interventions for preventing and treating stress fractures and stress reactions of bone of the lower limbs in young adults. Cochrane Database Syst Rev. 2005; (2): CD000450.

[27] Bernstein A, Childers MA, Fox KW, *et al.* March fractures of the foot: care and management of 692 patients. Am J Surg 1946; 71: 355-62. http://dx.doi.org/10.1016/0002-9610(46)90275-9

[28] Krause GR, Thompson JR Jr. March fracture of the tibia. Radiology 1943; 41: 580-5. http://dx.doi.org/10.1148/41.6.580

[29] Leveton AL. March (fatigue) fracture of the long bones of the lower extremity and pelvis. Am J Surg 1946; 71: 222-32. http://dx.doi.org/10.1016/0002-9610(46)90302-9

[30] Giladi M, Ahronson Z, Stein M, *et al.* Unusual distribution and onset of stress fractures in soldiers. Clin Orthop 1985; 192: 142-6.

[31] Hallel T, Amit S, Segal D. Fatigue fractures of tibia and femoral shaft in soldiers. Clin Orthop 1976; 118: 35-43.

Received on 26-08-2014 Accepted on 30-09-2014 Published on 27-05-2015

DOI: http://dx.doi.org/10.12974/2313-0954.2015.02.01.2