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Research Article

LOWER LIMB STRESS FRACTURES AND RADIOLOGICAL EVALUATION IN SOUTHINDIANS AND THEIR MANAGEMENT AND OUTCOME

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ABSTRACT

Stress fractures are fatigue injuries of bone usually caused by changes in training regimen in the population of military recruits and both professional and recreational athletes. Raised levels of sporting activity in today's population and refined imaging technologies have caused a rise in reported incidence of stress fractures in the past decades, now making up more than 10% of cases in a typical sports medicine practice. Plain Radiograph, CT scan and MRI of 50 patients imaged with history of of localized pain related to change in their physical activity or followed by an effort/activity to which they were not accustomed were retrospectively reviewed for stress fractures. Lesions with both bone injuries and pathological findings on the adjacent soft tissues were taken into consideration and evaluated further. The study was conducted at Sri Lakshmi Narayana Institute of Medical Sciences, Pondichery and age of the population ranged from 16 to 70 years. Of the 60 patients studied, 30 were men and 30 were women. We found 5 mild stress reaction, 10 insufficiency fractures and 45 stress fractures. The use of CT and MRI is of a great importance for early diagnosis and thus was essential to exclude other causes of bone lesions that may create confusion in the differential diagnosis of a patient with pain and non-specific abnormalities on plain radiography. In the absence of a clear co-relation between repeated stress and pain in an active individual the clinical diagnosis of a stress related bone injury may be troublesome and a possible delay may cause worsening of this condition and further impairment to a professional athlete.

Keywords: - Magnetic Resonance Imaging, Radiographs, Stress Fractures, Lower extremity.

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INTRODUCTION

Stress fractures belong to the wide spectrum of overuse injuries. Due to their strenuous training activities, military recruits and competitive athletes are primarily affected and have been subject of most articles written about stress fractures. However, the increase in participation of recreational athletes in major sports events (i.e. marathon running), often pushing their limits, have led to an increase of stress fractures in this population as well. Increased incidence has subsequently increased understanding of stress fracture mechanism and behavior, resulting in recognition of low and high risk sub categories.

Stress fractures represent one of the more serious injuries in sport [1]. Following such injuries, return times to sport are often prolonged, and failure to return to sport, chance of re-injury and persisting morbidity are all distinct possibilities [2-8].

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As a group, stress fractures comprise just over 10% of all sport-related injuries, with this figure as high as 30% within certain sports, such as running [1,9-12]. The incidence of these injuries is around 1% within recreational athletes, and around 20% within elite level athletes [1,9-12]. Around 90% of these injuries are located within the lower limb [12,13]. Given the financial implications of sport within modern society, both with the substantial revenues associated with professional sport, as well as the economic implications associated with injuries to amateur athletes, the effect of such injuries is considerable[1].

High risk fractures often require specialised imaging to better define and quantify the injury, particularly when first line imaging is equivocal; these injuries also may require surgical management, depending on the location of the injury and the response to initial conservative management [14]. As a consequence of this, return to sport is often more challenging with high-risk injuries, and this proves particularly demanding with the high-level professional athlete [4,7,14-15]. For individual fracture types, the severity of the injury can be graded from the extent of the radiological changes, using either generic (Fredericson et al [16] or Arendt et al [17]) or site-specific (Saxena et al [18] or Torg et al [19]) classifications [1,20]; such classifications can further guide management planning as well as provide prognostic information regarding return times to sport [1,20].

Stress fractures are a result of accelerated physiologic change from excessive loading applied to a normal bone. [21] Chronic repetitive stress injury of bone involve a myriad of bone lesions extending from mild stress reactions with pain, soft tissue and periosteal oedema to complete and displaced stress or insufficiency fractures [22]. Stress fractures are common in professional or recreational athletes, military personnel and also seen in any individual who starts a new activity or carries out normal activity in excess. The most frequent patients with stress related bone injuries are Runners and athletes. Stress fractures of the calcaneus, metatarsals ,tibia, distal end of the fibula and sesamoid bones. [23] Insufficiency fractures usually occur in eldery patients with abnormal mineral content or with diminished elasticity of bone and are frequent in osteoporosis. These fractures are becoming increasingly important by the progressive aging of the population with a higher prevalence of osteoporosis. The most frequent locations for insufficiency fractures are the pelvic girdle, femur, tibia, and foot bones. Hence, in this study we intend to use multi-modality imaging and sensitivity of modalities to diagnose the stress fractures at earliest. Our study aim is to Assess the sensitivity of Plain radiograph, Computed tomography and MRI in early and correct diagnosis of Stress Fractures.

MATERIAL AND METHODS

The study was conducted at Sri Lakshmi Narayana Institute of Medical Sciences, Pondichery and age of the population ranged from 16 to 70 years. Of the 60 patients studied, 30 were men and 30 were women. We found 5 mild stress reaction, 10 insufficiency fractures and 45 stress fractures.

Inclusion Criteria:

Patients were clinically evaluated for history of localized pain related to change in their physical activity or followed by an effort/activity to which they were not accustomed.Lesions with both bone injuries and pathological findings on the adjacent soft tissues were taken into consideration and evaluated further.

Exclusion Criteria:

Diagnosed case of fracture on clinical examination and plain radiograph.

Observation:

Location is an important factor in the diagnosis of stress fractures. Different sports activities lead to location specific injuries. This information was useful to draw inference and classify the fractures in the high or low risk categories. Treatment is specific to type of fractures where high-risk fractures required prompt treatment.

Plain Radiography: -

Initial Radiography in most of the cases is negative.The first imaging test on the majority of the studied cases was plain radiography. Its initial sensitivity is lower than 10 percent but it increases reaching 30 to 70 percent after three weeks. Common described features of stress fractures on plain radiography are as follows:-

Subtle lucency. Faint sclerosis showing obvious signs appearing over the weeks. Sclerosis with periosteal thickening and callus formation. Subtle loss of cortical density has been described as the grey cortex sign of earlystage stress injury. Sign known as the dreaded black line occurs in the anterior cortical bone of the tibia and suggests the presence of a fracture with poor prognosis and a high probability of evolution to a complete fracture because of its location in a region of bone tension and poor vascularization [4-5]

Radiographic osseous changes that correspond with exam findings of pain are significantly more likely to have features on MRI that would confirm diagnosis of BSI. Therefore, the clinical presentation of the patient remains a mainstay of assessment despite the radiographic findings.

Bone lesions and infection are less common sources of leg pain in pediatric patients that can be visualized using plain radiographs. Primary bone tumors

are the sixth most common neoplasm in pediatric patients, although most in this age population are benign. Consequently, clinicians should not overlook the importance of imaging in the pediatric population who present with shin pain.

Computed Tomography:

The findings are similar to plain radiography, including sclerosis, new bone formation, periosteal reaction, and fracture lines in long bones. CT may be useful in differentiating stress fractures from a bone tumor or osteomyelitis if the plain radiographs are negative and bone scans are positive. CT Computed tomography was very useful in studying the bone in detail and to diagnoseifficult cases mainly for fractures of the pelvic girdle or the foot and for demonstrating linear stress fractures following the long axis of the tibia. Chronic and quiescent lesions were observed to be more evident on CT scan. Following were the findings that was observed on CT scan: - Sclerosis, New Bone Formation, Periosteal, eaction Fracture lines in long bones. It was also essential in differentiating stress fractures from bone tumour or osteomyelitis if the plain radiographs are negative and bone scans are positive. Hence, superior to other modalities in such cases.

Magnetic Resonance Imaging:

MRI is the most sensitive modality for detecting stress fracture, and may also be useful for differentiating ligamentous/cartilaginous injury from a bony injury. Typical MRI appearance of stress fracture includes: periosteal or adjacent soft tissue edema,band-like bone marrow edema, T1 hypointense fracture line evident in high-grade injury. The use of an MRI grading system for bone stress injuries helps predict recovery time (important, especially for athletes).

MRI is recognised as the most sensitive and specific imaging technique for the diagnosis of stress related bone injuries and most preferred examination in the absence of radiographic alterations.MRI is essential and makes it possible to differentiate medullary damage from cortical, endosteal and periosteal damage and thus allows gradation of the lesions regarding their severity and prognosis. A multimodality approach to these conditions allows the radiologist to

correctly diagnose most of these complex cases. Sometimes however final diagnosis is made after biopsy. It is finally important to take note that the signal changes. Intramedulary endosteal edema is one of the first signs of bone remodelling. It is important to take note that the signal changes in stress fractures may persist during 5 to 6 months after the onset of the symptoms on the follow-up.

RESULTS AND DISCUSSION:

The study age of the population ranged from 16 to 70 years of the 60 patients studied, 30 were men and 30 were women. We found 5 mild stress reaction, 10 insufficiency fractures and 45 stress fractures

Radiologist is needed to obtain a high index of suspicion for this easily overlooked entity. Radiographs are not reliable for detection of stress fractures and radiologist should not falsely be comforted by them, which could result in delayed diagnosis and possibly permanent consequences for the patient. Although radiographs are mandatory to rule out differentials, they should be followed through when negative, preferably by magnetic resonance imaging (MRI), as this technique has proven to be superior to bone scintigraphy. CT can be beneficial in a limited number of patients, but should not be used routinely [24-26].

Fractures at low-risk sites are managed conservatively with analgesia, ice, reduced weight-bearing and modification of activities until pain resolves. At high-risk sites or in patients where long-term rehabilitation is detrimental to their livelihood (i.e. athletes or laborers), orthopedic consultation is required. Risk factors such as diet, vitamin D, and calcium should be addressed to prevent recurrence. Other factors, such as a gradual return to training and biomechanical evaluation of gait, may be required. Bone density evaluation can be considered in patients with recurrent stress fractures, a family history of osteoporosis, or stress fractures unexplained by exercise activity.

Areas found to be of particular value in the management of these injuries, were the site-specific classifications, which were effective in guiding treatment and prognosis of these injuries [1,16-19,]. As such, we recommend the development of further evidence-based classifications for lower limb sport-related stress fractures. Areas requiring further clarification in the management of these injuries include the role for surgical management of certain high-risk injuries, the optimal surgical modality in such cases, and the optimal rehabilitation methods for each fractures type, particularly the role for various adjuncts such as air casts [1-6,14,15]. Further work is required in these areas to better define the optimal treatment methods of these injuries.

The use of CT and MRI is of a great importance for early diagnosis and thus was essential to exclude other causes of bone lesions that may create confusion in the differential diagnosis of a patient with pain and non-specific abnormalities on plain radiography. In the absence of a clear co-relation between repeated stress and pain in an active individual the clinical diagnosis of a stress-related bone injury may be troublesome and a possible delay may cause worsening of this condition and further impairment to a professional athlete. Imaging

plays an important role in the specific diagnosis of stress related bone injuries and helps in classifying them into high and low risk fractures. Also in some patients there are indeterminate findings that may suggest stress related bone injury but subsequent imaging techniques or biopsy provide a final diagnosis of inflammation or tumour. In cases where stress fractures are secondary to any systemic lesion, diagnosing the condition promptly had helped in further treatment and better
prognosis of a patient.

When managing such injuries, clinicians should remember to provide a holistic approach, performing a detailed assessment of each patient to establish pre-disposing risk factors, such as abnormal gait biomechanics or nutritional deficiencies, which should be addressed appropriately, to avoid recurrence of the condition. Similarly, when managing the female athlete, clinicians should always consider the female athlete triad as an underlying cause of the condition, assessing and managing this accordingly [1,14,15,23]. Lastly, it should be noted that all athletes and clinicians should adhere to the established treatment principles that have been developed for these conditions [1,14,15,23]. Such treatment protocols have been developed from well-organised research within military and sporting populations, both of which provide robust patient cohorts. Thus any attempt to over-accelerate rehabilitation in the athlete, is likely to results in inadequate treatment and recurrence of the condition[1,14,15,23]. With appropriate compliance to the recommended treatment, athletes should be reassured that outcomes from these injuries are largely positive, with high return rates to previous level sport and favourable return times [1,14,15,23]. Given the importance of providing well-informed, individually directed care for such injuries in the high-level athlete, it remains important that specialised sport physicians and sports surgeons provide care for these individuals, in order to optimise their management and outcome [1,14,15,23].

CONCLUSION

Stress fractures occur following excessive use and are commonly seen in athletes, in whom the lower limbs are frequently involved. Delayed diagnosis and management of these injuries can result in significant long-term damage and athlete morbidity. A high index of suspicion may facilitate diagnosis, but clinical presentation may be non-specific. In this regard, imaging in the form of plain radiograph, CT, MRI and bone scintigraphy may be of value.

Proper communication between treating physician, physical therapist and radiologist is needed to obtain a high index of suspicion for this easily overlooked entity. Radiographs are not reliable for detection of stress fractures and radiologist should not falsely be comforted by them, which could result in delayed diagnosis and possibly permanent consequences for the patient. Although radiographs are mandatory to rule out differentials, they should be followed through when negative, preferably by magnetic resonance imaging (MRI), as this technique has proven to be superior to bone scintigraphy. CT can be beneficial in a limited number of patients, but should not be used routinely.

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