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# Stress Fractures in the Employees of the Federal District Court and Territories

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## Abstract

**Objective:** To identify and diagnose stress fractures in adults attended at the orthopedics and traumatology clinic of the Federal District Court and Territories, evaluating the patient's profile, the most common site and standard of living, whether sedentary or regular practitioner of physical activity, and the intensity of training. The patients were submitted to anamnesis, physical examination and imaging examinations, in an outpatient setting, to elucidate the diagnosis and treatment orientation.

**Results:** There was no significant difference between male (13 patients) or female (12 patients). The absolute majority of lesions occurred in bones of the lower limbs, especially the feet and tibia. There was only one case of upper limb fracture (on the radio). Most injuries to lower limbs were related to running sports. The most affected age group was 40 to 50 years old (40%).

**Conclusions:** Classically the populations most affected are the military, runners, dancers and soccer players. In the present study, there was no difference between sex, a fact that may be related to the small number of patients. There was disagreement with the literature on the most affected bones. In the literature half the cases occur in the tibia. In the present study foot lesions (48%, considering all the bones of the foot) were more frequent. Even so, the tibia was the most affected individual bone (40%). Conservative treatment with rest (removal of the activity that caused the injury, maintaining other activities) and physiotherapy, was effective in all cases.

***Keywords:*** *Stress Fracture; Fracture due to Insufficiency*

## Introduction

The German military surgeon Breithaupt, in 1855, performed the first clinical description of stress fractures among soldiers who had plantar pain and edema after long marches [1,2]. The first radiographic confirmation of a stress fracture in military recruits was recorded in 1897.2 This phenomenon was also observed in athletes, and the first clinical description was performed by Devas in 1958 [3]. His original studies were based on flat radiographs, since the examination of technetium 99 bone scintigraphy had not been developed until 1971 [2,3].

The stress fracture represents the inability of a bone to resist repetitive episodes of mechanical load, which results in fatigue, causing localized signs and symptoms [4,15,20].

Bone tissue is a structure in continuous metabolic activity, the balance of which stems from the bone cycle proposed by Wolff [4,5]. Wolff's law states that bone will reshape according to the stress to which it is subject, i.e. bone in regions of greater stress and resorption in those with less stress [22,25,29]. Biological responses depend on age, nutritional status, hormonal status and genetic predisposition

[23]. In the last decades, humans have been practicing sports activities, its skeleton to an extra overload that sometimes even surpasses the physiological and histological resistance of the bone, according to the sport performed.

Currently two theories are accepted to explain the etiology of stress fractures. One theory states that weakened musculature leads to reduced shock absorption at the lower extremities, allowing a greater redistribution of forces to the bone, which leads to increased stress on the bone [6,24,26]. Muscle fatigue observed in situations of physical overload contributes to triggering stress fractures as attenuation of loads decreases where the related musculature is compromised [7,25,27]. This theory largely explains the origin of stress fractures found in the lower limbs.

Another theory aims to explain upper limb stress fractures, where bone traction through the bone is capable of generating enough repetitive forces to trigger bone failure [6,13,18,25].

The physical activity of the athlete or the new practitioner followed by a sudden and non-gradual increase after 6 to 8 weeks generates a cyclical and repetitive physiological overload, causing microfractures [8,21,26]. This intensity does not allow sufficient time for bone remodeling, adaptation to the new condition and repair of the lesion [8,13,17].

The population most affected are the military, runners, dancers and football players. Risk factors are considered: age (less than the female sex (3.8 to 12 times greater than in the male sex), the white race, the level of activity and physical conditioning, the hormonal disturbances (hypoestrogenism), the dietary imbalances, and biomechanical characteristics (limb asymmetry, increased femoral anteversion, decreased tibial width, excessive knee valgus, and excessive foot supination or pronation) [9,14,20,28].

Stress fractures can affect all types of bones, but are more common in body weight bearing bones, especially those in the lower limbs: tibia (49%), tarsal bones (25%) and metatarsals (9%, second and third mainly) [10,11]. In the axial skeleton, they are not frequent and are located mainly in the interarticular pars, lumbar vertebrae and pelvis [12-14].

Olympic gymnastics, tennis, baseball and basketball are among the physical activities that can cause stress fracture, with the bone most affected by ulna (proximal portion) and the humerus (distal portion) [16,29]. The race has a higher incidence front the other modalities, especially in the long bones such as the tibia, femur and fibula, in addition to the bones of the foot and sacrum [10,15]. Fractures in the lumbar spine and pelvis are more observed in jumpers and dancers [5,10,17]. Os rowing and golfers are more prone to fractured ribs [17,22,26].

Fracture due to bone failure occurs in a mechanically compromised bone, usually presenting a low bone mineral density [8]. Occurs due to intrinsic and extrinsic factors. In general, extrinsic factors are related to the type and pace of training, the use of inadequate footwear and sports equipment, precarious physical conditioning, training location, ambient temperature and insufficient recovery time of the previous injuries [18-20].

The intrinsic factors include: age, sex, race, bone density and structure, hormonal, menstrual, metabolic and nutritional balance, sleep pattern and collagen diseases [18-20].

Other factors are foot rigidity, plantar arch changes, and limitations in ankle dorsiflexion due to shortening of the triceps sural [6,8,21,24]. Runners with eversion, exaggerated pronation and pronounced plantar arch have a 40% to develop a stress fracture [21,24,28].

## Goals

Identify, diagnose and guide the treatment of stress fractures in the servers of the Federal District Court and Territories served in the orthopedic office of the court itself.

## Specific Objectives

Identify the patient's profile, most affected fractured bone and life habits, whether sedentary or practicing intense or irregular physical activity.

## Methodology

The patients were submitted to anamnesis, physical examination and complementary imaging to elucidate the diagnosis and treatment orientation. The care was performed by an orthopedist of the Federal District Court and Territories and member of the Brazilian Society of Orthopedics and Traumatology (SBOT) accompanied by a resident of the specialty of orthopedics and traumatology. The main complementary examination was simple radiography, requiring computed tomography and/or magnetic resonance imaging when necessary.

### Criteria for inclusion and exclusion

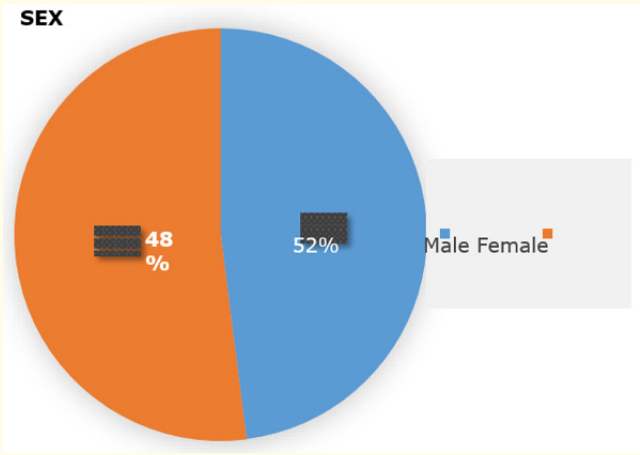
The inclusion criteria are employees and dependents aged between 13 and 60 years of both sexes with clinical diagnosis and image of stress fracture and who completed the Free and Informed Consent Form according to the Research Ethics Committee of the institution number CAAE: 58071316.0.0000.5553.

Exclusion factors were patients with Osteometabolic diseases, chronic diseases who underwent any previous bone surgical procedure and those who refused to complete the Informed Consent Term. Based on these factors, a patient with lupus/corticoid and fracture due to insufficiency of the pubic branch, an elderly woman with osteoporosis and fracture of the 5$^{th}$ metatarsus, a woman with bilateral fracture of the tibia after high risk pregnancy, were excluded.

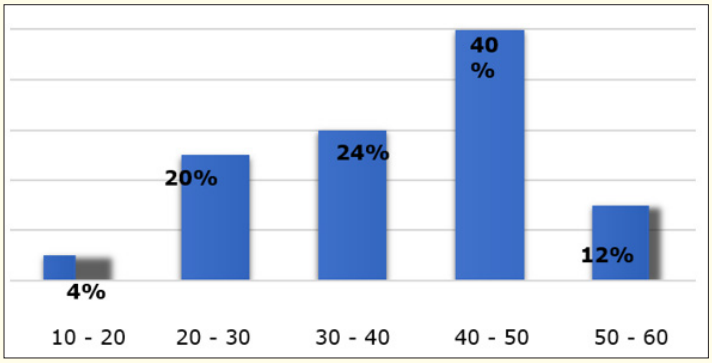
It should be noted that all patients who did not fit the inclusion factors were treated according to their right to consultation at the orthopedics and traumatology outpatient clinic of the Federal District Court and Territories.

## Results

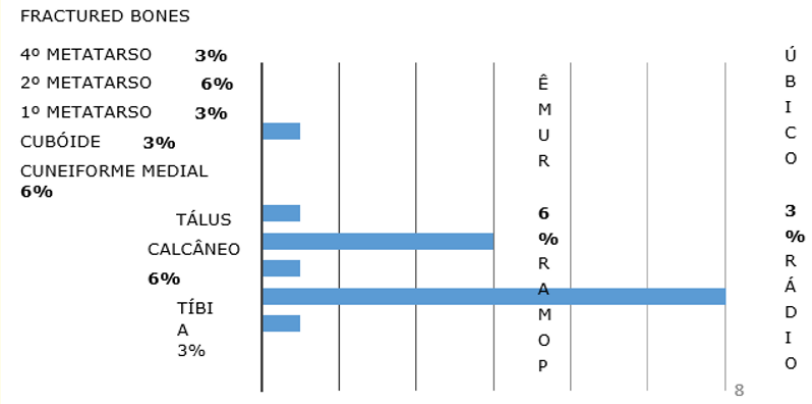
Twenty-five patients were evaluated, 12 men and 13 women. There was exclusion of a lupus patient with a fracture of the pubic branch, an elderly woman with osteoporosis and fracture of the 5$^{th}$ metatarsal, and finally a high-risk pregnant woman who suffered a stress fracture of the tibia during the puerperium when return to previous activity.



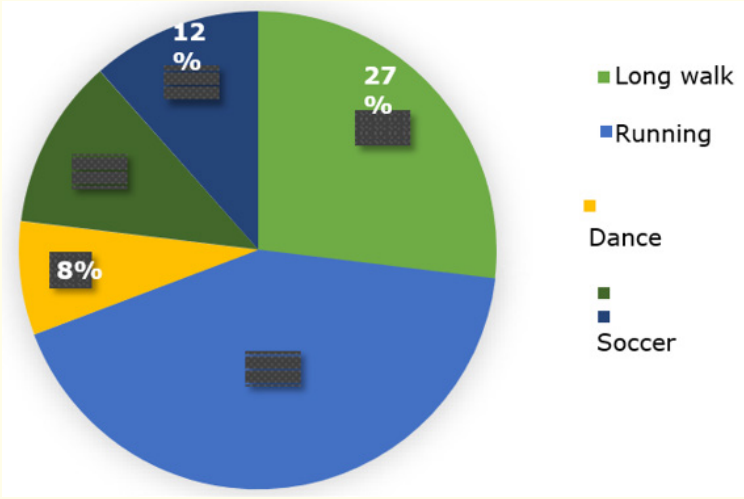

***Graph 1:*** *Percentage of patients with fracture in relation to Sex.*




***Graph 2:*** *Percentage of patients with fracture in relation to age.*




***Graph 3:*** *Bones most affected by stress fracture.*




***Graph 4:*** *Relationship of stress fracture with physical activity.*

## Discussion

Stress fractures are clinical entities that are related mainly to activities involving overload, such as runners, athletes and dancers [9,12,18,25].

The physiology of the stress fracture is represented by an accelerated bone remodeling in response to a repetitive stress [1,4,6]. As a result of this stress, the bone responds and forms a new periosteal bone as an extra reinforcement [15,22,24]. However, if the osteoclastic activity continues to exceed the mean of the osteoblasts for new bone formation, eventually a cortical fracture may occur [15,22,24].

The factors influencing this type of fracture are divided into intrinsic (sex, age, ethnicity and muscle strength) and extrinsic (training regimen, type of footwear, training surface and type of sport), biomechanical factors (bone mineral density and geometry (leg morphology, leg length discrepancy and leg alignment), hormonal factors (delayed menarche, menstrual disorders and contraceptives) and nutritional factors (calcium and vitamin D deficiency, eating disorders, and the triad of female athlete) [7,12,13,16,18,21]. The athlete's triad is an important syndrome consisting of eating disorders, amenorrhea, and osteoporosis [11]. The components of the triad are interrelated in etiology, pathogenesis, and consequences.

Your occurrence is not exclusive to elite athletes, it may occur in physically active youth and women participating in a wide range of physical activity types [16,18]. The triad may result in decreased physical performance, increased clinical and psychological morbidity, and increased mortality [18,20].

The literature demonstrates that women have more stress fractures compared to men [15,16]. It is also known that stress fractures are more common in young people subjected to intense physical activities, such as military, dancers, runners and athletes in general. This type of fracture can occur in any bone but predominates in the bones of the lower extremities [3,7,8,12]. The most affected bones are: tibia (34%), distal fibula (24%), diaphysis of the 2$^{nd}$ and 3$^{rd}$ metatarsals (18%), femoral neck and diaphysis (14%), pelvis (6%) and other bones (4%) [4,7,9,10,15,17,18,23].

This type of fracture can be classified as low and high risk. Low-risk fractures are those that present a favorable natural history, located in the areas of bone compression, which present good response to changes in activity, with a low rate of complications [18,19,28,29]. They affect the following bones: ribs, humerus, radius, diaphysis of the ulna, femoral neck (lower cortical), femoral diaphysis, tibia (medial cortical) and 1$^{st}$ to 4$^{th}$ metatarsals [18,19,28,29].

High-risk stress fractures present unfavorable natural history, a high rate of complications (recurrence, pseudoarthrosis and complete fracture) and the need for surgical treatment [18,19,26,27]. It affects the following bones: olecranon, femoral neck (upper cortical), patella, tibial diaphysis (anterior cortical), tibial malleolus, navicular, medial sesamoid and 5$^{th}$ metatarsus [18,19,26,27].

During the investigation of the pathology a detailed history is needed, as well as complementary imaging tests such as radiography, nuclear magnetic resonance and scintigraphy. In simple radiography, stress fracture appears as a radiolucent line due to local sclerosis due to the formation of internal callus, periosteal reaction or as external callus (Figures 1 and 2) [13,18,20]. In the initial phases approximately 80% of the stress fractures are not evident, and between one and three weeks 50% become evident [21,24,29].

Magnetic resonance imaging has a greater sensitivity and specificity compared to radiography and scintigraphy. A fracture line perpendicular to the cortical bone characterized by hyposignal in all sequences with underlying bone edema can be observed (Figures 3 and 4) [6,8,11]. The observed adjacent bone edema decreases with time and may be absent after four weeks of onset of symptoms [6,8,11]. Scintigraphy was not requested from the patients because magnetic resonance imaging was more useful and had greater specificity.

In the initial stages of treatment, the use of specific physiotherapeutic measures to reduce the pain: cryotherapy, electrotherapy, ultrasound to accelerate the production of bone, and anti-inflammatory drugs to reduce the synthesis of prostaglandins, are responsible

for activating the free nerve endings that bring sensory information to the brain and increase the perception of pain [8,22]. Functional strengthening and stretching exercises should be included as soon as the pain has been reduced and thus limb exercises are used lower, initially in closed kinetic chain and then in open kinetic chain [22,24,25].

Stress fractures considered to be at high risk should be treated surgically, as the chances of success with conservative treatment are low [23,26,27].

## Conclusion

Stress fracture is a relatively common pathology in athletes who are physically ill or exercising in excess, whose main symptom is pain. Classically the populations most affected are the military, runners, dancers and football players. The site of the lesion will depend on the activity performed by the patient. In this study we can verify the activity most related to this type of fracture is the run (42%), followed by long walk (27%), bodybuilding (12%), soccer (11%) and dance (8%). Imaging methods are essential in the diagnosis of this entity.

In the present study there was no significant difference between the sexes, a fact that may be related to the small number of patients. There was disagreement with the literature on the most affected bones. In the literature half the cases occur in the tibia. In the present study foot lesions (48%, considering all the bones of the foot) were more frequent. Even so, the tibia was the most affected individual bone (40%). Conservative treatment with rest (removal of the activity that caused the injury while maintaining other activities) and physiotherapy was effective in all cases.

## Interest Conflicts

There are no conflicts of interest.

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