MedNEXT Journal of Medical and Health Sciences

DOI: 10.34256/mdnt2121

REVIEW ARTICLE

Stress Fracture in Non-Athletes: A Systematic Review

Cátia Irene Duarte Valente [1,2,4], Elaine Cristina Silva dos Reis [3,4], Durval Ribas Filho [4,5]

[1] Clinical Hematology of the HemopaMedica Foundation, Belem, Para, Brazil.
[2] Santa Casa de Misericordia do ParaMedica Foundation of Unimed Belem, Para, Brazil.
[3] Founder of the Paraense Society of Sports Medicine, Belem, Para, Brazil.
[4] ABRAN-Associação Brasileira de Nutrologia/Brazilian Association of Nutrology, Catanduva/SP, Brazil.
*Corresponding author Email: cv0305@yahoo.com.br
DOI: https://doi.org/10.34256/mdnt2136
Received: 11-05-2021; Accepted: 01-06-2021; Published: 10-06-2021

Abstract: The present study seeks to discuss the incidence of a stress fracture in not athletes. This type of pathology occurs as a result of a repetitive number of movements in a given region, fatigue and muscle imbalance are the main responsible for these fractures, which mainly affect runners and military, groups that are more susceptible to a large amount of impact In practice, and has been increasing in non-athletes. To do so, it reviews the literature based on the first descriptions of the stress fracture, the causes of this type of occurrence, the results on the patient's body, and the modes of treatment and recovery. The objective of this study is to review the literature currently available to aggregate the most relevant information regarding this pathology.

Keywords: Stress fracture, Fatigue, Repetitive movements, Non-Athletes.

1. Introduction

In the context of bone fractures, stress fractures are prevalent in clinical practice, being classified into fatigue fractures that affect healthy bone and insufficiency fractures in which the bone is already damaged or weakened [1-3]. In this sense, stress fractures can occur even without an excessive number of functional cycles and represent the inability of a bone to handle the continued repetition of a load [4,5]. The first occurrences of stress fractures were described in 1855 by Breithaupt, who identified them in Prussian soldiers as a result of fatigue and consequent bone rupture due to repetition of movements in a certain region [6]. With the advent of radiography, stress fractures could be confirmed, even more in the scenario of seeking physical fitness in a short training time and the search for quick results, which has led more and more people to engage in activities physical activities such as running and training with continued repetition and increased loads [1].

With the increased desire to achieve a high level of physical fitness, the onset of activity occurs so intensely that they often cause injuries, among the most common sports injuries are stress fractures [7,8]. Stress fractures occur mainly in groups that perform large amounts of impact on the limbs during exercise. Fatigue and muscle imbalance are mainly responsible for these fractures, as reduced impact absorption on the bone, due to muscle weakness or failure to absorb, generates an increase in stress at focal points that can lead to fracture, and although stress fractures can affect all types of bone, they are more common in bones that support body weight, especially the lower limbs [7,9].

In this context, as an examination, conventional X-ray imaging is the standard method in case of a suspected stress fracture. Furthermore, magnetic resonance imaging (MRI) can be performed to better show a pathological fracture. Computed tomography (CT) is adequate for an accurate representation of the course of the fracture line and preoperative planning. As a nuclear medicine procedure, bone scintigraphy can be used to increase bone metabolism in the area of a fracture [1].

Therefore, this article aimed to analyze the main information obtained in studies published in recent years, focusing on the probabilities and incidences in non-athletes, presenting the general aspects of what it is, and what is the incidence of stress fractures; and the distinctions between the incidence of stress fracture cases in non-athletes, diagnosis, treatment, and prevention, based on a review of the available literature on the subject.

2. Methods

2.1. Study Design

The present study followed a concise systematic review model, following the rules of systematic review - PRISMA (Transparent reporting of systematic reviews and meta-analysis-HTTP: //www.prisma-statement.org/) [10].

2.2. Search Strategy and Information Sources

The search strategy was carried out in the PubMed, Cochrane Library and Scopus databases, as well as Google Scholar in the search for doctoral and master's theses, using scientific articles from 2004 to 2020, using the MeSH Terms (descriptors) , and use of the Booleans "and" between MeSH Terms and "or" among historical findings

2.3. Study Quality and Bias Risk

Quality was classified as high, moderate, low, or very low to the risk of bias, clarity of comparisons, precision, and consistency of the analyzes. The most evident highlight was for systematic review articles or meta-analysis of randomized clinical trials, followed by randomized controlled trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument [11]. The risk of bias was analyzed according to the Cochrane instrument [12].

3. Results and Discussion

As a corollary to the literary search system, a total of 85 studies were compared that were submitted to the eligibility analysis and, after that, 25 studies of high to medium quality were selected, considering in the first instance the level of scientific evidence of studies in type of study as meta-analysis, randomized, prospective and observational. The biases risk not compromising the scientific basis of the studies.

3.1 Stress Fracture

Stress fractures are a type of injury characteristic of high-performance athletes and military personnel due to the level of exercises submitted to these groups. Currently, it affects practitioners of a wide variety of sports activities when there is an overload in the practice of these activities and this extra load exceeds the resistance of the bone causing the stress fracture; which can also happen due to muscular exhaustion when the muscles fatigued by excessive effort and lack of absorption of accumulative impacts, transfer the stress overload to the bone [4,7,13,14].

As an example, a prospective cohort study made evidence-based changes to the Israel Defense Forces diagnosis of the medial tibial stress fracture. Thus, a total of 429 elite infantry recruits were screened for signs and symptoms of medial tibial stress fracture during 14 weeks of basic training. Recruits with suspected medial tibial stress fracture were initially treated with 10-14 days of rest. Bone scintigraphy was performed only when the recruits did not respond to the rest regime or demanded an immediate diagnosis. A total of 31 of 49 recruits with suspected medial tibial stress fracture underwent bone scintigraphy, including 8/26 recruits whose symptoms did not disappear after being clinically treated as stress fractures. There was a significantly higher incidence of medial tibial stress fractures when a positive hop test was present, in addition to tibial pain and tenderness. Medial tibial stress fracture occurred when the tibial sensitivity band was ≤10 cm in length [15].

Also, there are numerous stress fractures in the foot and ankle, including metatarsal, tibia, calcaneus, navicular, fibula, talus, medial malleolus, sesamoid, cuneiform, and cuboid. Knowledge of these fractures is important, as the diagnosis is often overlooked and appropriate treatment is postponed. Delayed identification may be associated with prolonged pain and disability, requiring surgical intervention [16].

In this context, according to Astur et al, regarding injuries caused by stress fractures: "This injury occurs as a result of a high number of cyclical overloads of intensity lower than the maximum bone strength on non-pathological bone tissue. This fracture can be the final stage of fatigue or insufficiency of the affected bone. They occur after the formation and accumulation of microfractures in normal bone trabeculae. In contrast, a fracture resulting from bone failure occurs in a mechanically compromised bone, usually with a low bone mineral density. In both situations, the imbalance between the formed and remodeled bone and the resorbed bone will result in a bone discontinuity in the affected site" [17].

Increasingly common in sports medicine clinics, stress fractures, according to Oliveira et al, can be divided etiologically into two groups: "1) Due to fatigue, which is a consequence of an abnormal stress applied to a bone with structure and normal elasticity (often seen in military personnel and long-distance runners); 2) Due to insufficiency of a normal muscle force applied to the bone that has deficient structure and elasticity (it occurs more often in elderly patients and is usually associated with postmenopausal osteoporosis or other types of osteoporosis caused by rheumatoid arthritis, diabetes mellitus or use of corticosteroids)" [18].

In general, all bones are subject to a stress fracture if subjected to acyclic and repetitive physiological overload. This overload can make the bone tissue not have time to adapt to the appearance of microfractures, which can lead to a chronic injury without adequate recovery time, and without proper treatment, they evolve to complete bone fracture [17,19]. Stress fractures can originate from intrinsic factors, which are those inherent to the body that supposedly predisposes to injuries, or extrinsic, those directly or indirectly linked to the preparation or practice of the race [13,20].

According to Wen in Pileggii et al: "The intrinsic factors are: 1) biomechanical and anatomical abnormalities (feet, ankle, calcaneus, tibia, knees, asymmetries in the length of the lower limbs); 2) flexibility; 3) history of injuries; 4) anthropometric characteristics (weight, height, BMI); 5) bone density and body composition; 6) cardiovascular conditioning. The extrinsic factors, on the other hand, are those that involve: 1) training planning and execution errors (intensity, frequency, duration, rest, periodization, warm-up, and stretching); 2) type of training surface (sand, asphalt, grass, concrete); 3) type of route (sloping, tortuous, flat, irregular); 4) type of footwear; 5) food (total energy consumption, macro and micronutrients, alcohol or drugs); 6) concomitant practice with other sports. " [20].

The bones with the most intense overload, poorly performed, or with no recovery, the interval is the most vulnerable to this type of injury, which are the bones of the lower limbs, especially the bones of the foot, tibia, fibula, and femur [7,20]. According to Brazil: "Stress fractures are partial or complete fractures, in a normal or abnormal bone, that result from repeated load cycles, with forces less than those applied to a bone in a single acute situation with sufficient load to fracture. it. Two types of stress fractures can be recognized: a fatigue fracture, resulting from the application of abnormal stress or torque to a bone with normal elastic resistance; and an insufficiency fracture, occurring when normal stress is applied to a bone with a deficiency in elastic resistance "[14].

In a stress fracture classification system, four specific points should be noted, as listed in Table 1.

Table 1. Stress fracture classification system [1].

✓	Be reproducible to have clinical value;
✓	Be generalizable so that it can be applied in all places, preferably without the need for imaging exams;
✓	It should be easily applied clinically, and should not be restrictive in situations where it can be used and easily remembered;
✓	Be clinically relevant, with prognostic value in the treatment decision.

❖ According to the model proposed by Kaeding and Miller in Ferreira, the classification system is divided into five degrees:

✓	Grade 1 Indicates an asymptomatic stress reaction;
✓	Grade 2 Indicates pain with evidence of imaging stress reaction but no fracture line;
✓	Grade 3 There is already a fracture line;
✓	Grade 4 There is a fracture misalignment of more than 2 millimeters;
✓	Grade 5 There is fracture disunion.

Stress fractures are clinically classified according to the risk of complications such as misalignment, disunion, or fracture propagation, this classification is mainly based on the fracture site, and they are classified as high and low-risk fractures [4,19] For Ferreira: " Low-risk fractures are unlikely to have complications, so a more conservative treatment can be done, unlike high-risk fractures that need aggressive treatment, sometimes with surgery. The places of high-risk fractures are femoral neck, on the side that suffers from tension; kneecap; tibial anterior cortex; medial malleolus; talus, navicular; 5th metatarsal; and the sesamoids of the hallux "[4].

The classification and distinction of low and high-risk stress fractures are extremely important, as it directly affects the diagnosis, prognosis, and treatment that are differentiated [4,5].

3.2. Incidence and Causes

The incidence and proportion of stress fractures were the targets of several studies in different populations of athletes, in which differences in the type of activity, frequency, and intensity of the activity were shown to be preponderant factors in the results. These differences lead to difficulty in comparing results, as the cases have their specificities that must be carefully observed and lead to different incidence proportions [9,17,21].

Studies indicate a higher occurrence of stress fractures, even in non-athletes, in activities associated with athletics, especially running [17]. According to Hino et al, "the incidence of stress fractures is 20.4% in men and 21.7% in women in a population of athletic practitioners" [22].

One of the most important factors in the occurrence of stress fractures is muscle fatigue, because when the muscles get tired, they stop absorbing energy, bringing an increasing amount of shock to the bones, subjecting the bone involved in the activity to an excessive load without rest, which can start a fracture of the internal part of the bone, which can evolve into a complete fracture [7,17,22]. For Ferreira: "The cause of stress fractures is multifactorial and athletes vary in their susceptibility to a stress injury" [23]. And according to Bennell and Crossley in Ferreira: "The incidence of stress fractures in the general population is less than 1%. Most of the literature on the epidemiology of stress fractures refers to female athletes or military populations" [23].

Some factors are predominant for a higher incidence of stress fractures in women than in men. According to Simões: "Studies have shown results that indicate that women have more stress fractures than men. Many orthopedists attribute this to a condition known as "the female athlete's triad": eating disorder (bulimia or anorexia), amenorrhea (absent menstrual cycle) and osteoporosis. When a woman's bone mass decreases, the chances of a stress fracture increase" [7].

According to Ferreira: "Although several studies present details regarding the location of the fractures, their significance has a limited value when trying to study the occurrence of fractures in different sports. The heterogeneity of populations and study methods makes it impossible to conclude. In addition to training intensity and volume, other potentially confounding variables must be considered. For example, the different proportion of men/women who practice a certain sport" [23].

In general, no study projects in large dimensions, with all possible variables, gender differences in risk, and incidence of stress fractures.

3.3. Treatment of Stress Fractures

According to Ferreira's study: "Early diagnosis of stress fractures is imperative to stop the progression of the injury that can result in a complete bone fracture. The clinical diagnosis of stress fractures can be difficult, as other musculoskeletal injuries can have a similar presentation, so the imaging evaluation is extremely important to quickly and correctly obtain a diagnosis" [4].

The diagnosis of a stress fracture is based on physical examination and confirmation through imaging tests such as plain radiography, bone scintigraphy, computed tomography, and magnetic resonance imaging [19,24].

3.4. Physical Exam

For Simões, "stress fractures usually have a narrow list of symptoms: a generalized area of pain in the affected limb, weakness and pain when stepping (load) and rare edema and ecchymosis (purple)" [7]. The physical examination of the stress fracture is not very specific, as the patient presents symptoms such as increased sensitivity at the injury site, pain, and edema after an abrupt and/or repetitive increase in physical activity, which tends to decrease with rest allowing the activity again physics. However, with the continuation of the movements that cause the injury, it tends to progress with increased pain and limitation of its practice [4,14,17].

Another important factor to be considered in the physical examination is the existence of previous fractures, as well as weight, height, body mass index and its changes in the last 12 months, menstrual history and puberty, in addition to nutritional assessment, are significant information to identify possible signs of intrinsic risk during physical examination [17,19].

According to Silva: "Some laboratory tests can be useful in investigating stress fractures: serum levels of calcium, phosphorus, creatinine and 25(OH)D3. Nutritional markers should be requested in the presence of clinical pictures of weight loss and anorexia and investigation of hormonal levels (FSH and estradiol) when there is a history of dysmenorrhea" [19]. Some diseases must be considered in a differential diagnosis, mainly periostitis, Ribbing's disease (diaphyseal multiple sclerosis), osteonecrosis, insufficiency fractures, osteomyelitis, bone tumors, and bone trauma [7,17].

3.5. Diagnostic Imaging

Imaging exams are essential for the diagnosis, treatment, and monitoring of stress fractures. Observation of the symptoms presented is essential for the performance of imaging tests that will corroborate the diagnosis of the stress fracture since in the initial stages 80% of stress fractures are not evident on radiographs and confirmation may be necessary diagnosis with magnetic resonance imaging or bone scintigraphy, which detects about 95% of cases in the initial phase of the fracture [4,18].

3.6 Radiography

Radiographs, despite being very specific, have low sensitivity, causing difficulty in diagnosing stress fractures by conventional radiographs, mainly because these exams are sometimes performed after a long period after the onset of clinical symptoms, resulting in very subtle and without showing blunt signs [14,17]. Although radiography is commonly the initial examination, in situations where clinical signs of stress fractures are large, they may not show the injury or are inconclusive, other more advanced imaging exams should be continued to the final diagnosis [5,24].

3.7 Computed Tomography

As Computed Tomography can show bone anatomy in multiple planes, analyzing long bones in an axial slice can increase the sensitivity to detect subtle changes [20,24]. For Ferreira: "Computerized Tomography should be considered in cases where a stress fracture is suspected, especially if located in the axial skeleton, in which magnetic resonance is not an option due to relative or absolute contraindications" [17].

In some types of stress fractures, Computed Tomography is particularly useful for the evaluation, due to particularities that can often be hidden in an X-ray exam. It can distinguish other pathologies from a stress fracture, in addition to being able to demonstrate bone alterations, but it is limited in the assessment of the activity of the lesion and cannot distinguish a chronic lesion from a more active one [17,19,24].

3.8 Ultrasound

Ultrasonography can be used to diagnose more superficial stress fractures as the superficial margins of the cortical bone can be assessed, such as in the feet or distal tibia [17,19,24,25]. According to Ferreira: "Ultrasound can show the focal deformation in the bone cortex as well as the surrounding hypoechoic bone callus. It can also detect signs suggestive of a stress fracture such as hematoma and hypervascularity. Besides, Doppler can be applied which can be used to obtain an assessment of bone turnover. Despite having been increasing in popularity in recent years, more studies are needed to determine the usefulness in diagnosing stress fractures" [4].

3.9 Bone Scintigraphy

Bone scintigraphy can diagnose stress injuries, with bone remodeling, and early stress fractures, when a designated bone marker is injected intravenously and, after it reaches the bone remodeling sites, the patient undergoes imaging evaluation [24]. In the case of stress fractures, an area with greater activity of the marker is related to areas of bone remodeling, trabecular microfractures, and periosteum reaction or bone callus formation [17,19,24,25]. For Silva: "Technetium bone scintigraphy is highly sensitive to detect stress fractures, but it lacks specificity. Bone scintigraphy is very sensitive in evaluating suspicious lesions in the spine and pelvis, identifying multiple fractures and also distinguishing a split bone from a stress fracture" [19].

3.10 Nuclear Magnetic Resonance

Nuclear Magnetic Resonance has become the exam of choice for diagnosing or confirming stress fractures [19,24]. According to Astur et al: "Nuclear Magnetic Resonance is the most sensitive and specific imaging test for diagnosing stress fractures. It is recommended by the American College of Radiology as the exam of choice in the absence of radiographic changes. This exam allows for the identification and classification of lesions according to their severity and prognosis, as it has equal or superior sensitivity to scintigraphy, but it is considered a more specific exam because it is sensitive to early changes in the spinal cord and stress reactions [17].

3.11 Differential Diagnosis

Table 2 shows the most common causes in a differential diagnosis, based on the symptoms presented by the patient during the clinical examination, without defining conclusive imaging tests.

Table 2. Common causes in a differential diagnosis of a stress fracture.

Causes not related to bone	one-related causes
❖ Tendonitis	Tumors
❖ Muscle strains	Infections
❖ Tendon degeneration	
❖ Inflammatory myopathies	
❖ Hematoma	
❖ Compartment syndrome	

3.12 Treatment and Prevention

From the diagnosis, or even from a strong clinical suspicion, of a stress fracture, the faster the intervention, the faster the pain reduction and recovery, in addition to preventing aggravation of bone damage. For low-risk fractures, the recommended treatment is conservative, in high-risk cases, it is necessary to follow up with an orthopedic or sports medicine specialist [5,17]. For Silva: "One of the most important steps in treating a stress fracture is identifying the risk factors and correcting those where this is possible. In addition to helping with a faster recovery, it will decrease the risk of a new stress fracture "[19].

Table 3. New therapeutic modalities for the treatment of stress fractures [4].

THERAPY	CHARACTERISTICS
Oxygen supplementation therapy (hyperbaric oxygen therapy)	In vitro studies have shown that the administration of 100% oxygen can stimulate osteoblasts and consequently bone formation. However, there is still no consensus in the literature about its benefits in the treatment of stress fractures.
Bisphosphonates	They suppress bone resorption and inactivate osteoclasts through their binding to calcium phosphate crystals. Its high cost and its many side effects can be decisive factors in choosing and trying this therapeutic modality. Its prophylactic use is not yet scientifically based.
Growth factors and preparations rich in growth factors	Applied directly to diseased tissues to accelerate and promote their repair, with encouraging preliminary results in muscles, tendons, and ligaments. There are few studies on the treatment of stress fractures. Some of them report that when used at the time of surgical treatment of high-risk fractures, they can speed up and improve their recovery.
Magnetic Field Application	It can be applied by direct current to the fracture site using the surgical placement of electrodes, the use of an electrical capacitating field device, or by a pulsed electromagnetic field. There is still no concrete evidence of its use in stress fractures.
Recombinant parathyroid hormone	Parathormone acts to regulate serum calcium levels through gastrointestinal absorption, calcium, and phosphorus reabsorption in the kidney, in addition to releasing calcium from skeletal tissue. Despite promoting primarily a stimulation of osteoclasts with its regular administration, when this is done in an intermittent and controlled manner, anabolic osteoblastic stimulation is achieved and results in bone formation with increased strength and density, followed by its remodeling. Studies show that this hormone stimulates both bone repair through the endochondral and membranous mechanisms.
Low-intensity pulsatile ultrasound	High-frequency sound waves above the human audible threshold interact with bone tissue and adjacent soft tissue and generate micro stress and tension capable of stimulating consolidation. However, its exact mechanism of action is still unknown. Some studies have demonstrated its effectiveness in treating stress

	fractures, others do not fully support its use for treating these fractures.
Bone Morphogenic Protein	Proteins with bioactive factors responsible for inducing bone matrix activity with osteoinductive function. Its primary activity is in the differentiation of mesenchymal cells into cells that form bone and cartilage tissue through direct and osteochondral ossification, with an important role in the repair of bone lesions. Animal studies have shown an acceleration of wound healing in traumatic fractures, but little can be concluded about its use in stress fractures.

The treatment of conservative stress fractures, for low-risk stress fractures, is done with relative rest, away from any impact activity, during the period indicated by the doctor for the fracture to heal. The rest time depends on the medical evaluation and the evolution of the treatment patient, other factors are used as support for the treatment, such as the use of appropriate shoes, the substitution of the activity practiced for another one with less impact, but all must be accompanied by the doctor which will assess at each stage the stage of recovery until the injured bone can be considered fit [5,14,17].

According to Astur et al: "Analgesics are used for pain relief. Anti-inflammatory drugs, if used, should be prescribed with caution and for a short period. Animal studies have shown that there may be a negative interference in the bone healing process. However, more recent literature reviews report that there is no conclusive evidence of this negative action. In general, the time to fracture healing lasts between four and 12 weeks when fractures are of low risk. The patient must be re-examined every two to three weeks to monitor changes in symptoms and pain during the rest and rehabilitation period. To maintain flexibility, strength, and cardiovascular fitness during the rest period, the patient must engage in a physiotherapy program of controlled exercises "[17].

In high-risk fractures, in which surgery may be necessary for adequate re-adaptation, the procedure may involve fixation of the fracture site with an increase in the rehabilitation time [4,9]. According to Silva: "The high-risk stress fracture can be treated as an acute fracture. For example, when the diagnosis is delayed, non-operative treatment has worse results due to the high rate of complication. In simple stress fractures, we reduce the pace of training, and after a few weeks, the athlete gradually increases the mileage of the run and progressively returns to specific sports activities, with clinical pain monitoring by the sports doctor or orthopedist" [19].

Currently, new therapeutic modalities are being studied for the treatment of stress fractures that can obtain a faster consolidation with a reduction in recovery time, they are divided into biological or physical therapies. Table 3 describes the new treatment therapies and their main features [4].

The time to return to sport depends on the various factors involved in the injury, such as the sports activity being practiced, the severity of the injury, as well as the possibility of correcting the patient's risk factors, which are criteria for returning to sport [14]. According to Silva, "Low-risk stress fractures and non-surgical treatment usually allow the patient to return to activity four to 17 weeks after the injury" [19].

For Astur et al: "The possible criteria used to allow the athlete to return to their practice are: the total absence of pain in the affected area, especially during the performance of the sports gesture, absence of symptoms during the performance of provocative pain tests in the area of the injury, absence of abnormalities in the imaging exams and, above all, the understanding of the patient, coaches, and sports technical team of the risk factors and conditions that led to that injury so that they can be corrected and prevent recurrence and the appearance of new one's injuries. The gradual return to definitive sports activity should be started after 10-14 days with a total absence of pain and with a 10% increase in training intensity per week. The formation of bone callus and obliteration of the fracture line on plain radiographs and especially on tomography are determining factors for the proper healing process of the stress fracture" [17]. According to Table 4, some measures can be taken to prevent the appearance of new stress fracture injuries.

Table 4. Measures that can be taken to prevent the appearance of new stress fracture injuries [4].

✓	**Gradually increase your workout intensity by up to 10% weekly. This allows the bones to adapt to the added stress thus being able to withstand greater amounts of stress in the future;**
✓	**Do stretching, as they also help to build more muscle strength in your feet;**

✓ **Increase the intake of calcium and vitamin D, depending on the individual;**
✓ **Monitor nutrition, because nutrition plays a vital role in bone development. Certain individuals are at increased risk for osteoporosis;**
✓ **Use adequate equipment, such as new, soft shoes with shock absorbers, suitable for your sport;**
✓ **If there is pain or swelling, stop the activity immediately and rest for a few days. If pain persists, see an orthopedist.**

3.13 Final Considerations

Stress fractures are a type of injury that can occur to anyone who engages in continuous physical activity, from the elite athlete to the non-athlete. Its incidence is higher in the population that practices activities that require repetitive, continuous movements and with increased load, in which the body is pushed to its limits. They occur mainly in runners, dancers, and military personnel, with a slightly lower prevalence in women and more common in the lower limbs and axial skeleton. There are several factors, intrinsic and extrinsic, that contribute to the increased risk of this type of injury, and when they occur, it is important to understand these factors and analyze the conditions to which bones respond to the stress to which they are subject, as the fracture of stress is an evolutionary process that, if not contained and treated, tends to evolve into more serious injuries. Most stress fractures are diagnosed through physical examination of the patient and clinical history, with the aid of imaging tests, which are defined by the physician, when necessary, according to the symptoms presented, and which can be done together, or more than one type until an accurate diagnosis is reached. Among the imaging tests used, bone scintigraphy and nuclear magnetic resonance have more positive points in identifying stress fractures, as they are more specific and more sensitive. The quick identification of the lesion, based on the correct diagnosis, is essential for the success of the treatment and allows the patient to return to activities with a shorter recovery time. The treatment chosen depends on the severity of the injury, simple injuries are treated with conservative treatment, with withdrawal from activity and immobilization, which may include the use of medication; while more serious injuries may even require surgery for the patient's complete recovery in a much longer time. Among the available treatments, some need studies to confirm their effectiveness. Understanding the intrinsic and extrinsic risk factors, related to the individual and the training, is important in the diagnosis, treatment, and prevention of stress fractures, aiming at an early rehabilitation, concomitant with the gradual return to the practice of sports activity. Stress fractures have different characteristics from overload injuries, with a clear association between the intensity and number of repetitions of the activity and the volume of the load used. Other factors also contribute to the increased risk of stress fractures, such as the surface on which training sessions are carried out, inadequate shoes and equipment, changes in training programs, and the lack of monitoring by a professional in the area in carrying out the activity, increase the probability of occurrence of this type of injury. This study does not exhaust the proposed theme, since, given the wide range of incidence possibilities, there is a need for large-volume studies to establish risks by sex, age, and sports practice that would allow for better future prevention, especially in non-athletes, since specific groups of athletes such as runners, gymnasts and even dancers are the subject of specific case studies for the activities they develop.

References

[1] K. M. Thierfelder, J.S. Gerhardt, S. Langner, T. Mittlmeier, M.A. Weber, [Special aspects of stress fractures], Radiologe, 60 (2020) 506-513. [DOI] [PubMed]

[2] E. Thein, J. Mahlouly, [Stress fractures], Revue Médicale Suisse, 15 (2019) 2293-2297. [PubMed]

[3] R.A. Marshall, J.C. Mandell, M.J. Weaver, M. Ferrone, A. Sodickson, B. Khurana, Imaging Features and Management of Stress, Atypical, and Pathologic Fractures, Radiographics, 38 (2018) 2173-2192. [DOI] [PubMed]

[4] Ferreira, João Duarte, Fraturas de Stress – Uma revisão bibliográfica. Dissertação. Instituto de Ciências Médicas Abel Salazar, Universidade do Porto, (2014). Disponível em: http://hdl.handle.net/10216/76917. Acesso em 03/10/2016.

[5] Leonardi, Adriano, Fraturas de estresse, Artigo, (2016). Disponível em: http://adrianoleonardi.com.br/fraturas-de-estresse. Acesso em 03/10/2016.

[6] J. Breithaupt, Zur pathologie des menschlichen fubes, Med Zeitg, (1855) In Fraturas de Stress – Uma revisão bibliográfica. Dissertação. Instituto de Ciências Médicas Abel Salazar. Universidade do Porto. 2014. Disponível em: http://hdl.handle.net/10216/76917. Acesso em 03/10/2016.

[7] Simões, Ana Paula, Fraturas por Stresse, (2016). Disponível em:

http://www.milton.com.br/esporte/saiba_mais/ort_3.htm. Acesso em 03/10/2016

[8] Hespanhol Junior, Leonardo O. P. Costa, Aline C. A. Carvalho, Alexandre D. Lopes, Perfil das características do treinamento e associação com lesões musculoesqueléticas prévias em corredores recreacionais: um estudo transversal. Revista Brasileira de Fisioterapia, São Carlos, (2011).

[9] Pinto, Roberto Zambelli de Almeida, LOPES, Fernando Araújo Silva, DIAS, Bruno Fares, Fratura por estresse do tornozelo bilateral em corredores: relato de dois casos, Belo Horizonte – MG. RBM Dez 10 V 67 Especial Ortopedia, Revista Brasileira de Ortopedia, (2010).

[10] D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, The PRISMA Group Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement, PLoS Medicine, 6 (2009) e1000097. [DOI]

[11] H. Balshem, M. Helfand, H.J. Schünemann, A.D. Oxman, R. Kunz, J. Brozek, G.E. Vist, Y. Falck-Ytter, J. Meerpohl, S.Norris, G.H. Guyatt, Grade guidelines: 3 ratng the quality of evidence. Journal of Clinical Epidemiology, Maryland Heights, 64(2011) 401-406. [DOI] | [PubMed]

[12] J. Higgins, S. Green, Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0 [2011]. The Cochrane Collaboration; 2011.

[13] N.M. Silva Luna, A.C. Alonso, M. Serra, N.F.B. Andare, E.Y. Nakano, D.S. Bocalini, J. Maria d'Andrea Greve, Análise isocinética e cinética de corredores e triatletas com e sem histórico de fratura por stresse, Revista Brasileira de Medicina do Esporte, 21(2015). [DOI]

[14] Brasil, Luciano Moraes, Fratura por stress em atletas: revisão de literature, Revista Médica, 35 (2001).

[15] C. Milgrom, E. Zloczower, C. Fleischmann, E. Spitzer, R. Landau, T. Bader, A.S. Finestone, Medial tibial stress fracture diagnosis and treatment guidelines, Journal of Science and Medicine in Sport, 24 (2021) 526-530. [DOI] [PubMed]

[16] M. J. Welck, T. Hayes, P. Pastides, W. Khan, B. Rudge, Stress fractures of the foot and ankle. Injury, 48 (2017) 1722-1726. [DOI] [PubMed]

[17] D.C. Astur, F. Zanatta, G. G. Arliani, E. R. Moraes, A. de Castro Pochini, B. Ejnisman, Fraturas por estresse: definição, diagnóstico e tratamento, Revista Brasileira de Ortopedia, (2016). [DOI]

[18] U. S. de Oliveira, P.J. Labronici, A. J. Neto, A. Y. Nishimi, R. E. Santos Pires, L.H.P. Silva, Fratura de estresse bilateral do colo do fêmur em não atleta – relato de caso Bilateral stress fracture of femoral neck in non-athlete – case report, Revista Brasileira de Ortopedia, 51 (2016) 735-738. [DOI]

[19] Silva, Marcos Britto, Fraturas de Estresse: diagnóstico e prevenção, (2016) Disponível em: http://www.marcosbritto.com/2011/01/fraturas-de-estresse-diagnostico-e.html. Acesso em 03/10/2016.

[20] P. Pileggii, B. Gualano, M. Souza, V. de Falco Caparbo, R. M. R. Pereira, A. L. de Sá Pinto, F. R. Lima, Incidência e fatores de risco de lesões osteomioarticulares em corredores: um estudo de coorte prospective, Revista Brasileira de Educação, 24 (2010). [DOI]

[21] R. P. Ribeiro, P. Amado, P. Carvalho, P. Freitas, Fraturas de stress. Fratura do escafoide társico em atleta professional, Rev Port Ortop Traum, 19 (2011) 193-197.

[22] A.A.F.Hino, R.S. Reis, C. R. Rodriguez-Añez, R. C. Fermino, Prevalência de Lesões em Corredores de Rua e Fatores Associados, Revista Brasileira de Medicina do Esporte, 15 (2009). [DOI]

[23] A. C. Ferreira, J. M. C. Dias, R. de Melo Fernandes, G. S. Sabino, M. T. S. dos Anjos, D. C. Felício, Prevalença e fatores associados a lesões em corredores amadores de ua do município de Belo Horizonte, MG, Revista Brasileira de Medicina do Esporte, 18 (2012). [DOI]

[24] Kempfer, Gérson Luís. Figueiredo, Andrea Bruno. Macedo, Sandro Tadeu. Rocha, Antonio Fernando Gonçalves da, Fratura de Stress e a medicina nuclear, Relato de caso, Revista Brasileira de Medicina do esporte. 10 (2004). [DOI]

[25] Gonçalves, Danilo et al. Prevalência de lesões em corredores de rua e fatores associados: revisão sistemática, Artigo de revisão, Revista do Departamento de Educação Física e Saúde e do Mestrado em Promoção da Saúde da Universidade de Santa Cruz do Sul / Unisc, 17 (2016). [DOI]

Acknowledgement

Nil

Funding

Not applicable

Data sharing statement

No additional data are available

Informed consent

Informed written consent obtained from the participant

Conflict of interest

The authors declare no conflict of interest.

About The License