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Update article

Stress fractures: definition, diagnosis and treatment☆

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ABSTRACT

Stress fractures were first described in Prussian soldiers by Breithaupt in 1855. They occur as the result of repeatedly making the same movement in a specific region, which can lead to fatigue and imbalance between osteoblast and osteoclast activity, thus favoring bone breakage. In addition, when a particular region of the body is used in the wrong way, a stress fracture can occur even without the occurrence of an excessive number of functional cycles. The objective of this study was to review the most relevant literature of recent years in order to add key information regarding this pathological condition, as an updating article on this topic.

Fraturas por estresse: definição, diagnóstico e tratamento

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RESUMO

A fratura por estresse foi descrita inicialmente em soldados prussianos por Breithaupt em 1855 e ocorre como o resultado de um número repetitivo de movimentos em determinada região que pode levar a fadiga e desbalanço da atuação dos osteoblastos e osteoclastos e favorecer a ruptura óssea. Além disso, quando usamos uma determinada região do corpo de maneira errônea, a fratura por estresse pode ocorrer mesmo sem que ocorra um número excessivo de ciclos funcionais. O objetivo deste estudo é revisar a literatura mais relevante dos últimos anos para agregar as principais informações a respeito dessa patologia em um artigo de atualização do tema.

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Introduction

Stress fractures were first described in Prussian soldiers by Breithaupt in 1855.[1–3] They were named "march fractures" and their characteristics were confirmed 40 years later with the advent of radiography.[1,2] In 1958, Devas made the first report on stress fractures in athletes.[1–3]

This injury occurs as a result of high numbers of occurrences of cyclical overloading of intensity lower than the maximum bone strength, on non-pathological bone tissue.[4–6]

These fractures may be the final stage of fatigue or insufficiency of the bone affected.[6] Fatigue fractures occur after formation and accumulation of microfractures in normal bone trabeculae. On the other hand, fractures resulting from bone insufficiency occur in bone that is mechanically compromised and generally presents low bone mineral density.[6] In both situations, imbalance between the bone that is formed and remodeled and the bone that it reabsorbed will result in discontinuity of the bone at the site affected.[7,8] The aim here was to present an updating article on this topic and condense the main information obtained through the most important studies published over the last few years.

Epidemiology

Population

Runners, soldiers and dancers are the main victims of stress fractures.[6,9,10]

Anatomical region

All the bones of the human body are subject to fracturing caused by stress. This stress is closely related to the daily practice that athletes undertake. The predominance of stress fractures in the lower limbs, over fractures in the upper limbs, reflects the cyclical overloading that is typically exerted on bones that bear the body weight, in comparison with bones that do not have this function.[3] Stress fractures are mostly commonly diagnosed in the tibia, followed by the metatarsals (especially the second and third metatarsals) and by the fibula.[3,11] Stress fractures in the axial skeleton are infrequent and are mainly located in the ribs, pars interarticularis, lumbar vertebrae and pelvis.[11–13]

Types of sport

Runners present greatest incidence of stress fractures in long bones such as the tibia, femur and fibula, and also present fractures in the bones of the feet and sacrum.[11,12] Types of sport in which the upper limbs are used, such as Olympic gymnastics,[14] tennis, baseball and basketball may result in fractures due to stress. The bone most affected is the ulna, especially in its proximal portion, while the distal extremity of the humerus is also affected.[6,11,13] Stress fractures occur mainly in the ribs in golfers and rowers[11,13] Jumpers, bowlers and dancers present greatest risk of injury to the lumbar spine and pelvis.[11]

Sex

Among athletes, the difference in the incidence of stress fractures between men and women is minimal. It is believed that the intensity and type of controlled training for each athlete and the physical preparation that already exists diminish the impact of the training program.[9,15] In the military population, the incidence of stress fractures among females is greater than among men.[16,17]

Physiopathology

Six to eight weeks after a sudden and non-gradual increase in the intensity of an athlete's or new patient's physical activity, this cyclical and repetitive physiological overloading may lead to the appearance of microfractures and may not allow the bone tissue to have sufficient time to undergo remodeling and adapt to the new condition, and thus to repair the microlesion.[4–6,10,18,19] The load applied is considered to be insufficient to cause an acute fracture, but the combination of overloading, repetitive movements and inadequate recovery time make this a chronic injury.[11] Elastic deformation occurs initially, and this progresses to plastic deformity until it finally results in microfracturing. If this is not treated, it will evolve to complete fracturing of the bone affected.[10] The bone repair process in stress fractures differs from the process in cases of common acute fractures and only takes place through bone remodeling, *i.e.* reabsorption of the injured cells and replacement with new bone tissue take place.[19]

Markey also proposed that the muscle mass acts toward dispersing and sharing impact loads on the bone tissue.[20] Therefore, when fatigue, weakness or muscle unpreparedness occur, this protective action is lost and the risk of bone tissue lesions increases.[16,20]

Risk factors

The factors associated with increased risk of development of stress fractures can be divided into extrinsic and intrinsic factors. This makes stress fractures multifactorial and difficult to control.[8,9,20–23]Extrinsic factors relate to sports movements, nutritional habits, equipment used and the type of ground.[8,9,14,20–23]

Abrupt increases in the intensity and volume of training are often enough for lesions to develop.[6,9–11] Equipment such as footwear that has low impact absorption, is worn out (more than six months of use) or is a bad fit for the athlete's foot may cause injuries.[8,23] The quality of the training track may also be a risk factor, when it is uneven, irregular or very rigid.[17,24] Lastly, if the athlete's fitness level is insufficient for the sports movement or functional technique, this may lead to injury, sometimes without the number of repetitions having been very high.[8,25]

The intrinsic factors relate to possible anatomical variations, muscle conditions, hormonal states, gender, ethnicity or age.[8,9,20–22]

Many studies have mistakenly considered that only female gender is a risk factor for stress factors to appear.[11,16,26] In