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Review

Current concepts of shockwave therapy in stress fractures

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HIGHLIGHTS

- Extracorporeal shockwave treatments (ESWT) stimulate bone turnover and neovascularization in delayed unions and avascular necrosis.
- ESWT is a safe and effective non-invasive outpatient procedure.
- Medium and high energy focused ESWT has shown excellent results in treating stress fractures, with faster return to competition and athletic activity.

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ABSTRACT

Stress fractures are common painful conditions in athletes, usually associated to biomechanical overloads. Low risk stress fractures usually respond well to conservative treatments, but up to one third of the athletes may not respond, and evolve into high-risk stress fractures. Surgical stabilization may be the final treatment, but it is a highly invasive procedure with known complications. Shockwave treatments (ESWT), based upon the stimulation of bone turnover, osteoblast stimulation and neovascularization by mechanotransduction, have been successfully used to treat delayed unions and avascular necrosis. Since 1999 it has also been proposed in the treatment of stress fractures with excellent results and no complications. We have used focused shockwave treatments in professional athletes and military personnel with a high rate of recovery, return to competition and pain control. We present the current concepts of shockwave treatments for stress fractures, and recommend it as the primary standard of care in low risk patients with poor response to conventional treatments.

1. Introduction

Bone is a very specialized dynamic organ that forms the primary structural element of the human body. It is the solid base of the muscle-joint-bone complex and has the unique characteristic, as an engineering material, of changing form, geometry and physical properties according to mechanical demands. This process has been referred to as mechanical homeostasis, a complex biological response to physical loads that rule not only fracture healing but also bone geometry and even the evolution of species.

Bone remodeling is an essential biological process as old as the bone itself [47]. The fossil records show that the skeletons of the earliest weight bearing vertebrates contained osteonal structures and other evidence of coordinated bone resorption and formation. This process has been essential for a healthy functional skeleton for millions of years. Probably the genes that enable bone remodeling have been continued to be selected because they confer important survival advantages.

The function of bone remodeling has been debated for centuries. The vision of the anatomists and histologist of the 19th century was that the Osteon structure is a nearly perfect mechanical and biological complex and it definitely serves a mechanical function. When the discovery that calcium serum levels must be regulated to prevent muscle tetany the story changed, and the metabolic significance of calcium brought the concept of bone remodeling as a metabolic process. Both visions are correct, meaning the importance of the process of bone remodeling nowadays. But the system is not perfect, because it fails in certain conditions. Microdamage is a biological form of fatigue, creep or other accumulative mechanical processes by which the microstructure of a loaded material is

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