

Treatment of Heterotopic Ossifications Using Shock Waves: An In Vitro Study

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Device and producing company:

OssaTron & EvoTron, SanuWave Inc

Introduction:

Heterotopic ossification (HO) is a common clinical problem often associated with aging, trauma, immobilization, renal failure and rheumatological diseases. HO within the cardiovascular system can severely impair cardiac function as well as reduce arterial compliance, accelerating atherosclerosis. HO in joints often causes pain, swelling and contractures leading to severe disability. Current HO treatment is to wait until it matures, then surgically remove the HO. Common surgical complications are blood loss, infection and HO recurrence. We study shock wave treatment mechanisms for HO with an in vitro model.

Methods:

Mineralized macroporous nanofibrous fibrin scaffolds were fabricated using sphere-templating and leaching methods. The scaffolds were incubated in calcium phosphate solution containing $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, NaHCO_3 , NaCl and K_2HPO_4 at 37°C . The fibrin scaffolds with precipitation of calcium phosphate crystals were treated with electrohydraulic shock waves (OssaTron, EvoTron). The calcium in scaffolds was solubilized in HCl and measured using cresolphthalein complexone at absorbance 575 nm.

Results:

Scaffold calcium contents decreased from 45.4 ± 3.6 (untreated) to 20.9 ± 18.1 (OssaTron, 0.71 mJ/mm^2 , 1 Hz, x200) and $27.53 \pm 23.47 \text{ ug Ca/mg dry weight}$ (EvoTron, 0.46 mJ/mm^2 , 1 Hz, x200). Scanning electron microscopy of the scaffolds after the shock wave treatment shows separation of calcifications from the fibrin matrix.

Discussion:

High variations observed in treatment efficacy could be due to scaffold or shock wave variability (cavitation & shear stress control, scaffold movement, stability of electrohydraulic shock waves, etc).

Conclusion: Shock waves can effectively separate calcifications from soft tissue. Future research on HO treatment in an in vivo model is worthwhile.