

# **Wound Healing - Influence of focused and radial shock wave treatment on the behaviour of human mesenchymal stem cells**

## **Author:**

Yvonne Delhasse, H. G. Neuland (2), W. Bloch (1)

## **Institutions:**

- 1) Department of Molecular and Cellular Sport Medicine, German Sport University Cologne, Am Sportpark Müngersdorf 6, 50933 Köln, Germany
- 2) ZES, Centre for ESWT, Kronberg im Taunus, Germany

## **Device and producing company:**

Swiss DolorClast (EMS), Piezason 100 (Richard Wolf)

## **Introduction:**

Recent studies demonstrate the successful use of shock wave therapies for improvement of wound healing disorders. Mesenchymal stem cells seem to be involved in tissue regeneration such as occur in wound healing. Therefore the question arises as to whether shock waves can influence mechanisms involved in stem cell dependent regeneration. MSC dependent regeneration can be improved by inducement migration, proliferation and apoptosis. Migration is of particular importance with regard to MSC's reaching the target location. Due to the fact that two different kinds of shock waves (focused and radial) improve mesenchymal stem cell dependent regenerative processes such as wound healing, it seems appropriate to investigate the influence of both kinds of shock waves on MSC's.

## **Methods:**

We established a new experimental cell culture setup for shock wave treatment under more absorbing conditions to better simulate in vivo circumstances. We tested the effects of different intensities of energy, frequency and total number of shocks on MSC's to investigate changes in cytoskeleton ((F-Actin) by phalloidin staining) and migration (by Boyden chamber assay) for both kinds of shock waves.

## **Results:**

We developed methods for in vitro treatments of MSC's with both kinds of shock waves that guarantee cell vitality and allow investigation of both kinds of shock wave treatments. We can show significant results in influence of migration and reorganisation of cytoskeleton (F-Actin) dose dependency with both kinds of shock wave treatments. Different shock wave systems show a different range of efficiency in our investigations. Treatments with densities of energy of 0.077 mJ/mm<sup>2</sup> with a focused shock wave system show significant increase in the migration and reorganisation of F-Actin fibers without actin accumulation. We detected converse results at treatments with higher energy levels of 0.122 mJ/mm<sup>2</sup> in migration and reorganisation of cytoskeleton. Small spots of actin accumulation were visible at higher doses of 0.122 mJ/mm<sup>2</sup>. Treatments with 0.122 mJ/mm<sup>2</sup> had a lower rate of migration in Boyden Chamber Assay but a higher rate of reorganisation of cytoskeleton compared to control. Radial shock wave treatment shows a significant increase in migration by densities of energy of 0.50 bar but no significant increase effects of the reorganisation of cytoskeleton.

## **Discussion:**

The present results indicate that MSC's can be influenced depending on the dose of shock wave treatments. We can verify explicit influences on migration of MSC's with both kind of shock waves, but with different ranges of efficacy. The results also provide evidence for a distinct dose-dependent influence of shock waves for cytoskeletal organisation with signs of cytoskeletal disruption at higher doses leading to an inverse migratory effect.

## **Conclusion:**

We can show the importance of correct dosing for treatment especially for focused shock waves.