

# Shock wave treatment enhances osteogenesis of mesenchymal stem cells from the blood or Wharton jelly of human umbilical cord

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## Device and producing company:

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## Introduction:

Mesenchymal stem cells (MSCs) which present in bone marrow and human umbilical cord (HUC) can generate bone, muscle, cartilage and even neurons. We investigated whether mesenchymal tissue could derive from the MSCs of HUC blood or Wharton jelly, and whether shock wave (SW) treatment could enhance osteogenesis from MSCs of HUC.

## Methods:

MSCs isolated from the blood or Wharton jelly of HUC were treated with and without shock waves (SWs) at 0.16 mJ/mm<sup>2</sup> and set for in vitro culture or in vivo injection to a fracture site of severe combined immunodeficiency (SCID) mice for experiments.

## Results:

Shockwave (SW) treatment at 0.16 mJ/mm<sup>2</sup> for 200 impulses significantly enhanced CFU-Stroma ( $17.8 \pm 3.2$  v.s.  $32.7 \pm 4.9$ ,  $p < 0.01$ ) formations. The SW enhancement of CFUStroma formations were associated with TGF $\beta$  but not IL-3 or GM-CSF induction, which was suppressed by addition of superoxide dismutase suggesting redox reaction is involved in the SW-enhanced osteogenesis. Studies with MSCs from Wharton jelly of HUC also showed that MSCs from Wharton jelly could differentiate into bone nodules in in vitro culture which was enhanced by SW treatment. Further in vivo studies demonstrated that injection of the MSCs harvested from HUC with and without SW treatment into the segmental defect of severe combined immunodeficiency (SCID) mice induced obvious bone callus formation. The ones with shock wave treatment revealed a significantly larger callus formation than those without shock wave treatment. The callus formation revealed human HLA antigen and bone morphogenic protein 2 expression, indicating the bone formation originating in HUC.

## Discussion:

Results from this study suggest that physical SW treatment and its related biological responses may be useful in promoting osteogenesis of mesenchymal cells from HUC.

## Conclusion:

A combination of SW and stem cell therapy may be useful for bone and tendon reconstruction.