

Ultrasound Mechanical Index as a Parameter Affecting of the Ability of Proliferation of Cells

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Abstract : Mechanical index (MI) is used for quantifying acoustic cavitation and the relationship between acoustic pressure and the frequency. In this study, modeling of the MI was applied to provide treatment protocol and to understand the effective physical processes on reproducibility of stem cells. The acoustic pressure and MI equations are modeled and solved to estimate optimal MI for 28, 40, 150 kHz and 1 MHz frequencies. Radial and axial acoustic pressure distribution was extracted. To validate the results of the modeling, the acoustic pressure in the water and near field depth was measured by a piston hydrophone. Results of modeling and experiments show that the model is consistent well to experimental results with 0.91 and 0.90 correlation of coefficient ($p < 0.05$) for 1 MHz and 40 kHz. Low intensity ultrasound with 0.40 MI is more effective on the proliferation rate of the spermatogonial stem cells during the seven days of culture, in contrast, high MI has a harmful effect on the spermatogonial stem cells. This model provides proper treatment planning *in vitro* and *in vivo* by estimating the cavitation phenomenon.

Keywords : ultrasound, mechanical index, modeling, stem cell

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