Keele UNIVERSITY

MTE 40015

POSTER ABSTRACT

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Enhancement of Osteogenic Factors in MG63 Cells by Acoustic Stimulation

Background:

Bone tissue is essential for structural integrity, movement, and mineral balance. Bone formation, through intramembranous and endochondral ossification, is regulated by osteoblasts, osteoclasts, and osteocytes. Fracture healing, often prolonged by age, diseases, and lifestyle factors, can lead to incomplete recovery.

Acoustic stimulation (AS), particularly ultrasound, is a non-invasive method that enhances bone healing by using sound waves to create mechanical forces. Research indicates that AS boosts cell proliferation, modulates signalling pathways, and increases osteogenic marker expression, highlighting its potential in bone repair.

Aim:

This study examines how 22 kHz and 40 kHz ultrasound stimulation affect MG-63 osteoblast-like cells, focusing on cell proliferation, metabolic activity, alkaline phosphatase activity, and bone-related gene expression to determine the most effective frequency for osteogenic differentiation.

Materials and Methods:

Ultrasound Platform Development: The system used a 22 kHz Visaton tweeter and six 40 kHz mini transducers, each connected to a waveform generator and amplifier, with stimulation set to 8 kHz and 4.000 Vpp.

Application to MG63 Cells: MG63 cells (337,500 cells/cm²) were cultured in nine flasks, with daily 20-minute acoustic stimulation starting 24 hours post-passage for four days. Controls had no stimulation. Cell proliferation was observed daily; metabolic activity, DNA, and protein were analysed on days 2 and 4. Data were processed using GraphPad software.

Results:

Microscopic images from Day 1 and Day 4 show changes in cell growth due to acoustic stimulation. On Day 2, metabolic activity was similar across Control, 22 kHz, and 40 kHz groups. By Day 4, the 40 kHz group had significantly reduced metabolic activity compared to Control, while the 22 kHz group did not differ from Control. Protein levels were unaffected by either 22 kHz or 40 kHz stimulation. DNA concentration was significantly higher in the 40 kHz group compared to the 22 kHz group, with no notable differences between the Control and the treatment groups.

Conclusion:

The study found that ultrasound energy transfer through T75 flasks was minimal, limiting its impact on cell growth. While high-frequency ultrasound had no significant effect, 22 kHz ultrasound showed potential for better energy delivery compared to 40 kHz. Future research will focus on using Low-Intensity Pulsed Ultrasound (LIPUS), improving ultrasound setups, and exploring alternative flask materials to enhance energy transfer and cellular effects.