OSTEOBLAST MECHANICAL STIMULATION BY CONVERSE PIEZOELECTRIC EFFECT

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Objectives

The aim of this work was to experimentally validate the use of piezoelectric materials as a mean of directly straining bone cells by converse piezoelectric effect.

Materials and Methods

The polymeric piezoelectric films used (PVDF) had an active area of 12x13 mm, with silver ink electrodes. Film coating and sterilization processes are described.

The amount of the displacement and its distribution along the piezoelectric surface was studied by Electronic Speckle Pattern Interferometry (ESPI).

MCT3T3-E1 cells were cultured under standard conditions and on the surface of films, in static and dynamic conditions. In dynamic conditions the substrates were deformed by applying a 5 V current, at 1Hz and 3Hz for 15 minutes. Cell viability and proliferation were addressed by the resarzurin method; nitric oxide was measured in medium after stimulation and normalized to protein content, 24 and 48 hours after seeding.

Immunofluorescence studies were conducted on the cytoskeleton.

Results and Conclusions

Cells under dynamic stimulation showed significantly higher levels of nitric oxide and changes on cytoskeleton organization, although no significant differences were found between dynamic and static groups' viability. The ESPI studies show the maximum displacement on the substrate was 0,6 μm.

The present study shows MC3T3 osteoblast cells are able to sense and respond to minimal displacements of the substrate in a reproducible manner.

The inverse piezoelectric effect can be used to mechanically stimulate bone cells, allowing the control of stimuli range by the potential differential applied and ensuring a wide choice of frequencies due to swift answer.