The effects of sustained inhomogeneous deformation on muscle cells

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Introduction

This project is embedded within the existing research line on soft tissue damage and adaptation, more specifically the project *Aetiology of Pressure sores*. Pressure sores are defined as localised areas of tissue degeneration in skin and underlying tissue resulting from prolonged mechanical load. It affects in particular disabled and debilitated patients and its occurence is likely to increase due to the higher average age of the population [1].

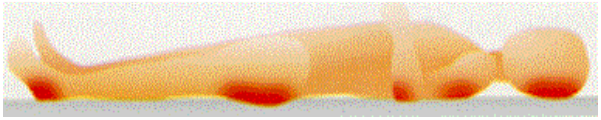

fig 1. *Areas which are most susceptible to pressure sores development*

Objective

It is aimed to investigate the relationship between the degree of cell deformation, cell defence response and cell damage. The ultimate goal is to identify an objective marker for cell damage.

Methods

Numerical

A model of a single muscle cell under compression will be developed. It should incorporate the passive mechanical properties as well as metabolic phenomena and signaling cascades which relate the cellular deformation to cellular damage

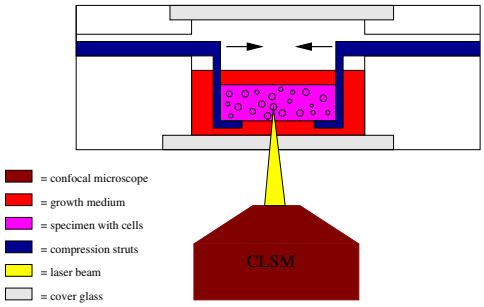

fig 2. *Compressive loading device*

Experimental

In-vitro experiments on cultured muscle cells will be performed in order to determine:

- mechanical properties → input for the numerical model
- (patho)physiological effects.

A loading device capable of compressing populations of cells embedded in a gel-like matrix is being developed (figure 1).

Results

In preliminary experiments myoblasts (muscle precursor cells) were seeded into agarose gel and subsequently compressed up to a compressive strain of 20%. No statistically significant area and volume changes were observed. The cell deformation index (ratio between X and Y diameter) appeared to reduce from a mean of 0.98 to 0.66 [2].

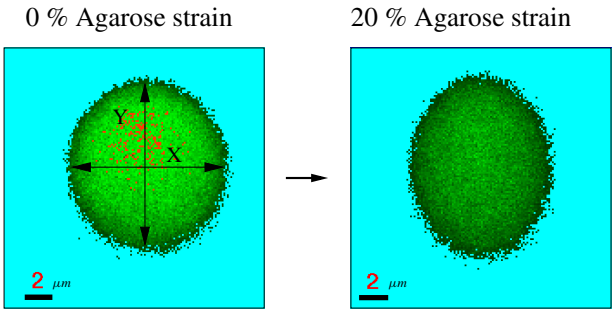

fig 3. *Deformation of myoblasts*

Discussion

Until now, only general information about the deformation of compressed muscle cells is available. Future work should reveal what specific function the load bearing elements of the cell (the cell membrane and the cytoskeleton) and certain signaling molecules (proteins and ions) have in the complex cascades of mechano-transduction.

References:

[1] BADER, D.L.: *Pressure sores: clinical practice and scientific approach* (London, MacMillan Scientific & Medical, 1992)

[2] PEETERS, E.A.G.: *Deformation of myoblasts, mounted in agarose constructs* (Eindhoven, MT 98.007, 1998)