What causes pressure sores?

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Introduction

A key question in pressure sore research is: "Why do cells die from sustained tissue compression?". It is commonly believed that tissue compression impairs oxygen supply to the cells. We hypothetise that sustained cell deformation induces cell death. This hyhothesis is tested by monitoring location and number of dead cells in compressed engineered muscle tissue constructs.

Methods

Engineered muscle tissue

Engineered muscle tissue constructs were developed by suspending premature muscle cells in a collagen scaffold (Fig. 1). The muscle cells fuse into a branched network of multinucleated, contractile myofibres by application of appropriate biochemical and mechanical stimuli [1].

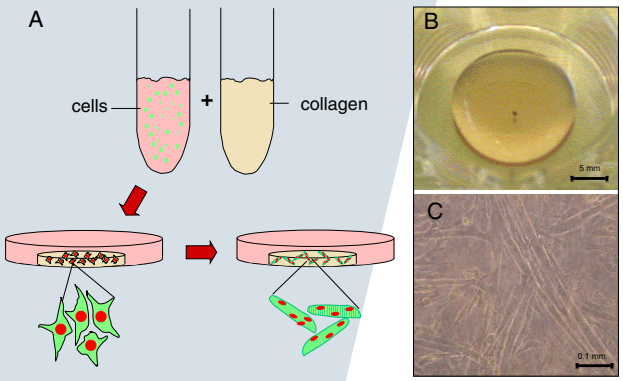

Figure 1 *A: Tissue engineering of muscle. B: Engineered muscle tissue construct. C: Branched network of contractile, multi-nucleated muscle fibres.*

Compression device

A compression device enabled simultaneous indentation of six constructs (Fig. 2). Constructs were compressed for 8 hours at 0 (control) and 50 percent strain.

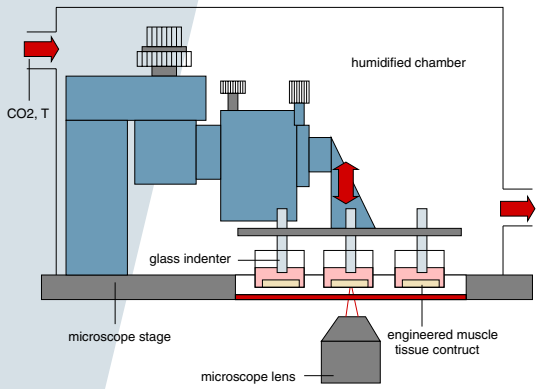

Figure 2 Schematic drawing of compression device.

Viability assay

A real-time, non-destructive viability assay [2] is used to monitor cell death. This assay is based on fluorescent staining of cells (Fig. 3A) and provides quantitative data on location and number of dead cells below the indented area (Fig. 3B).

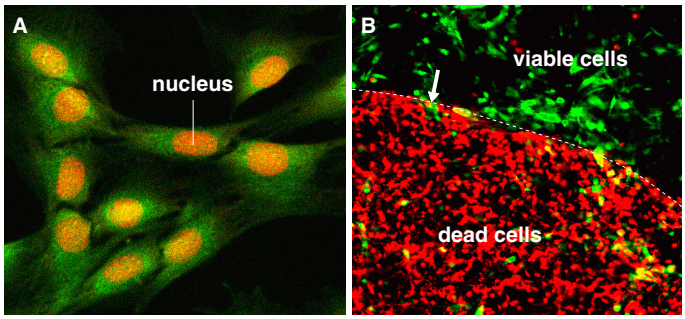

Figure 3 *A: Fluorescent staining of dying muscle cells. Red nuclei identify dead cells. B: Scan of the indenter edge showing a clear demarcation line between living and dead cells.*

Results

Cell damage dramatically increased between 2-4 h of compression (Fig. 4, left). However, for each point in time, damage was uniformly distributed across the area below the indenter (Fig. 4, right).

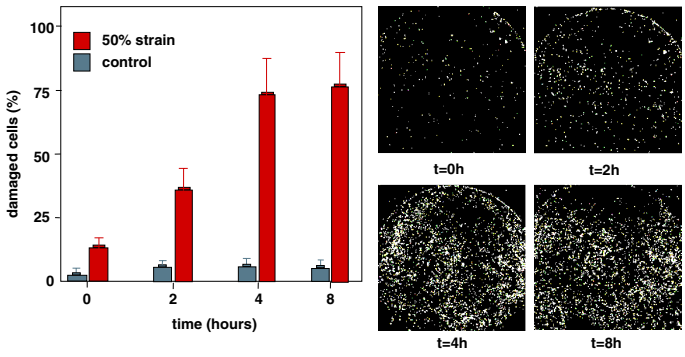

Figure 4 *Left: Cell damage as a function of time. Right: Location of damage below indenter for different moments in time. White dots identify dead cells.*

Conclusion

If impaired oxygen supply was the trigger for cell death, a gradient in cell damage across the indented area is expected. Since this is not the case, we conclude that cells died from cell deformation. Nevertheless, impaired oxygen supply may have increased cell vulnerability.

References:

[1] R.G.M. Breuls et al.: *MaTe Poster 2000*

[2] R.G.M. Breuls et al.: *Monitoring local cell viability, Tissue Engineering, in press; MaTe Poster 2001*