TECH REPORT

104:

StageFlexer I®

Quantification of strain at the membrane level

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Culturing Cells in a Mechanically Active Environment™
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INTRODUCTION

Flexcell®'s StageFlexer I® (Fig. 1) can be used in conjunction with the FX-6000™, FX-5000™, or Flex Jr. ™ tension systems to observe cell stretching activity with an inverted objective microscope. Cells are grown on a 54 mm diameter silicone elastomer membrane (Stageflexer I® Membrane, growth surface area = 23 cm²), which is clamped and sealed to a cylindrical vacuum chamber. When vacuum is applied, the membrane translates across the chamber circumference, applying strain to the cells on the membrane surface (Fig. 2). The membrane deformation results in application of uniform, equibiaxial strain to the cells (Fig. 2).

Figure 1. *Inverted StageFlexer® microscopy strain device.*

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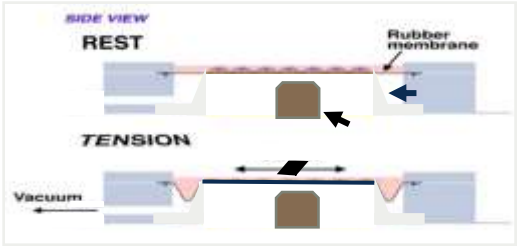

Figure 2. *Schematic of strain application in a StageFlexer I®.*

STRAIN QUANTIFICATION

The strain was experimentally determined by imprinting the StageFlexer I® membrane with a random pattern. Strain was determined by measuring the distance between pairs of dots and measuring their position change proportional to vacuum levels. All vacuum measurements were made using a digital manometer. Vacuum was applied with a Liebold vacuum pump (model GM6H). Designated distances were measured using the following method:

A Canon Compact EOS Digital Rebel XTI® camera equipped with a macro lense was leveled and fixed directly above the membrane. The resolution of the image was adjusted to ensure each pair of dots filled the maximum horizontal distance across the digital image, maximizing the number of pixels and measurement accuracy. A FX-6000™ Tension System regimen was designed to step through pressures from 0-90 kPa. At each static step, the image was captured using a Lexar™ memory card. Adobe Photoshop® CS2 image analysis software was used to measure the distances between the dots.

RESULTS AND DISCUSSION

The results showed a nearly linear relationship between vacuum level and strain. Given that two different radii of dots had uniform radial strain, the assumption was made that each radius was increasing uniformly with vacuum level. With this, the change in circumference could be measured from a single point; i.e., the same dots used for radial strain.