

Why Culture Cells in a Mechanically Active Environment?

The Theory Behind Our Products

Cells are subjected to compression, tension, and shear stress in the body and undergo acute and adaptive biochemical changes in response to deformation. Investigators have used various methods of applying mechanical deformation to cells growing *in vitro* in an attempt to simulate *in vivo* conditions. Methods have included wounding cells by scraping a monolayer, applying magnetic or electric fields, or applying static or cyclic tension or compression with a screw device, hydraulic pressure, weights, or fluid flow. In many cases, dramatic morphologic or biochemical changes have been reported in response to load. There are both short and long term changes that occur when cells are loaded in culture, such as alterations in cell alignment (Figs. 1-2), signaling, the rate and amount of protein synthesis, secretion or degradation, the rate of cell division, changes in energy metabolism, and other changes in biochemistry and bioenergetics. However, few procedures have allowed for quantitation of the applied strains or provided regulation to achieve a broad, reproducible range of cyclic deformations.

For these reasons, Flexcell introduced the Flexcell Tension, Tissue Train and Compression systems. These systems have broad applications in the biomedical research field as the mechanical loads these systems produce

(i.e. tensile strain and compression) have been found to induce biochemical changes in cells derived from tissues that are normally subjected to tension, compression, or shear *in vivo*. Such tissues include cardiac, skeletal and smooth muscle, lung, endothelium from vascular vessels, skin, tendon, ligament, cartilage, and bone.

The Flexcell Tension, Tissue Train and Compression systems are patented, computerized, pressure-operated, tension or compression-providing instruments that apply defined controlled, static or variable duration cyclic tension or compression to cells growing *in vitro* in either monolayer (Tension) or 3-D (Tissue Train) culture. The Tension and Tissue Train systems use vacuum pressure to deform BioFlex, Tissue Train, UniFlex and Flex I flexible-bottomed culture plates and “exercise the cells in culture” yielding up to 30% substrate elongation. The Compression system uses positive air pressure to deform a piston-loaded BioPress plate against a stationary platen, compressing a sample with up to 14 pounds of force.

The Flexcell Tension, Tissue Train and Compression systems are fast becoming a valuable standard in research laboratories. We believe our systems add a vital, new dimension to biological research.



Figure 1. Control osteoblasts. Avian calvarial osteoblasts cultured 24 hours *in vitro* on a Flex II rigid-bottomed culture plate coated with type I collagen. NOTE the random cell distribution. (Photos courtesy of Dr. M. Buckley, J Bone Mineral Res, 4:225-236, 1988).



Figure 2. Stretched osteoblasts. Avian calvarial osteoblasts cultured on a Flex I flexible-bottomed culture plate coated with type I collagen. Using a Flexcell Tension system, cells were subjected to 24% strain at 3 cycles/minute for 24 hours. NOTE the perpendicular cell alignment to the applied strain field (arrow) at the periphery of the culture well.