

APPLICATIONS AND PUBLICATIONS OF CELL STRETCHING SYSTEMS

GREEN LEAF SCIENTIFIC



1) Cell mechanics in bone tissue:

Strex technology creates cyclic tensile strain conditions at a magnitude that occurs in physiologically loaded bone tissue. Researchers applied Strex technology on mechano-sensitive chondrocytes to further characterize mechanisms in the rearrangement of the cytoskeleton in response to the loading and unloading of mechanical strain. Using the Strex STB-140 model, physiologically loaded bone tissue was studied at a magnitude seen under an environment of cyclic tensile strain. Researchers were able to characterize mechano-sensitive chondrocytes to further characterize mechanisms in the rearrangement of the cytoskeleton in response to the loading and unloading of mechanical strain. Their findings identified the role of a protein, Fat1, in the formation and rearrangement of actin fibers induced by mechanical unloading.

Ref: Hatakeyama, J., Nomura, M., Wakimoto, Y., Inoue, S., Li, C., Takamura, D., ... & Moriyama, H.

Effects of cyclic tensile strain and microgravity on the distribution of actin fiber and Fat1 cadherin in murine articular chondrocytes.

(2021). *Journal of Biomechanics*, 110774.

Bone Tissue & Cytoskeleton

2) Gene expression studies:

Ghrelin is an appetite stimulating hormone that is associated with obesity. The group hypothesized that stretching stimuli, such as the process of peristalsis in the stomach, are related to ghrelin secretion which affects body weight. Using the Strex STB-100-10 system, they examined whether gastric stretching affects the secretion of Ghrelin, considered to promote obesity. While one side of the study used immunostaining in tissue samples from patients who had undergone gastrectomies, the role of receptor TRPV4 in gastric glands and ghrelin secretion in vitro was studied in vitro using Strex's cell stretching system. TRPV4 regulates ghrelin secretion in response to stretch in the stomach, which may affect body weight. MGN3-1 cells lines were used, a ghrelin-producing cell line derived from mice. Used TRPV4 agonists and antagonists and changes in intracellular Ca²⁺ concentrations were confirmed. Results showed that ghrelin secretion significantly increased in response to a 120% stretch in MGN3-1 cell lines.

Ref: Hayakawa S, Tanaka T, Ogawa R, et al. Potential Role of TRPV4 in Stretch-Induced Ghrelin Secretion and Obesity. *Int J Endocrinol*. 2022;2022:7241275. Published 2022 Nov 8. doi:10.1155/2022/7241275

Obesity & Gene Expression

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3) Mechanotransduction studies:

Researchers at the RIKEN Centre for Biosystems Dynamics Research in Japan studied potential reasons for organ malformation in the cellular development of chick embryos. Genetically modified (SHH-inhibited) chick embryos models of cyclopia (fusion of eyes) were used to study tissue/cell dynamics during development. Stress loading tests using the Strex STB-100 model revealed that mechanical responses were the cause of these malformation of cell dynamics. Their results indicate that cell disorientation caused by a loss of mechanosensation could be a pathogenic mechanism for malformations such as cyclopia, and possibly other malformations.

Ref: Ohtsuka, D., Kida, N., Lee, S. W., Kawahira, N., & Morishita, Y. Cell disorientation by loss of SHH-dependent mechanosensation causes cyclopia. (2022). *Science Advances*, 8(28), eabn2330.

Cyclops & Mechanotransduction

4) Stem cell stretching:

In response to injured tissue, the body's bone marrow produces bone-marrow-derived mesenchymal cells (BMSCs) which migrate to the injury sites through the peripheral circulation. This process is regulated by multiple mechanical and chemical factors, many of which have not been thoroughly elucidated. The group at the department of Bioengineering in Chongqing University, China, used the Strex STB-140 cell stretching system to study the role of mechanical stretching in inhibiting BMSC invasion to injury sites. Their results suggest that mechanical stretching inhibits BMSC invasion by downregulating MT1-MMP expression, a membrane protein involved in signal processing at both the RNA and protein level.

Ref: Xiaorong Fu, Alexander Halim, Boren Tian, Qing Luo, Guanbin Song. MT1-MMP downregulation via the PI3K/Akt signaling pathway is required for the mechanical stretching-inhibited invasion of bone-marrow-derived mesenchymal stem cells (2019).

10.1002/jcp.28105

Tissue injury, Stem cells

5) Cell mechanics in cardiomyocytes

Mechanical stimuli to cells is known to increase levels of intracellular calcium, which in turn regulates a variety of cell functions. The role of different calcium channels in cardiac function is still not completely understood. It has been speculated that voltage-gated L-type calcium channels play a significant role in the mechanosensitive calcium response in rat cardiomyocytes (H9c2 models). Using the Strex uniaxial stretching system, the group at the department of Cardiovascular Physiology at Okayama University, Japan, showed that there was an increase in calcium levels in H9c2 cells in response to uniaxial stretching. Results suggest that L-type calcium channel activation are involved in the stretch activated calcium response in H9c2 cardiomyocytes.

Ken Takahashi, Shogo Hayashi, Mari Miyajima, Marei Omori, Jing Wang, Keiko Kaihara, Masatoshi Morimatsu, Chen Wang, Jian Chen, Gentaro Iribe, Keiji Naruse, Masahiro Sokabe., L-type calcium channel modulates mechanosensitivity of the cardiomyocyte cell line H9c2, *Cell Calcium*. (2019) <https://doi.org/10.1016/j.ceca.2019.02.008>.

Cardiac & Ion channels