

# INVESTIGATION OF CENTRAL NERVOUS SYSTEM NEURONS UNDER MECHANICAL TENSION: AN *IN VITRO* TRAUMATIC BRAIN INJURY MODEL

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## **Introduction**

Central nervous system damage has become one of the important health problems in developed countries because of the increasing life expectancy. Effects of mechanical loading on development of central nervous system (CNS) cells and neurite extension have been recognized recently. [Chetta J, 2010] Effects of loading are very complicated since until a threshold, tension plays a positive role while after the threshold value, it is degenerative. The situation gets more complicated since CNS is made up of several different cell types that respond to different loads diversely. There are some mechanical trauma models in the literature, but they usually employ hard and two dimensional culture substrates, which fail to mimic the natural niche of the cells. [Hengst U, 2009] The aim of this project is to create an *in vitro* experimental model that can mimic the physiological habitat and normal loading conditions on CNS cells.

## **Methods**

### **Scaffold production:**

2% chitosan (wt/v) is dissolved in 98% glacial acetic acid. Solution is produced as a nanofibrous scaffold by electrospinning.

### **Cell culture:**

Cells are cultivated in RPMI1640 medium with, 5% fetal bovine serum (FBS), 4ng/ml basic fibroblast growth factor (bFGF), 100 U/ml penicillin and 100 mg/ml streptomycin. Cell culture is incubated at 5% CO<sub>2</sub> and 37°C.

### **Cell Culture Stretching Device:**

The device consists of a moving upper part and stable base part. Nanofibrous tissue scaffolds are, fastened to the bottom of the upper cylinder and fixed with the grooves. In this way a uniform bi-axial strain is applied on attached cells. The displacement and frequency are controlled by computer, and allexperiments are carried out in a reservoir under sterile conditions.

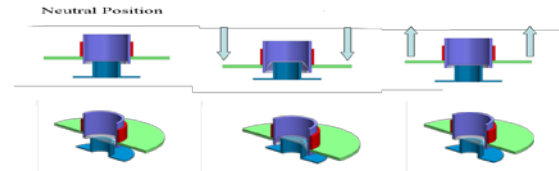


Figure 1: Tension application

## **Results**

Effects of different levels of mechanical strain on cell morphology, neurite elongation and cytoskeleton are under investigation. The strain threshold level for PC12 cells that the degenerative effects start will be determined. Also apoptosis effects of the increased strain will be studied.

## **Discussion**

Sensitivity of different CNS cell types to the mechanical strains and threshold strain values will be determined. Neuron growth and neurite elongation for the tissue engineering studies can be supported by this bi-axial straining technique. Tissue engineering techniques that can be used in the treatment of neurodegenerative diseases will be supported by this technique. By this model, a powerful system is built to simulate traumatic brain injury due to falls, traffic accidents and battlefield explosions, etc. This model will also allow experimentation with new drugs and treatments *in vitro*. By increasing the variables in a controlled manner, for example, changing the cells types, co-culturing different relevant cell types, modifying mechanical loading conditions, etc., trauma models closer to *in vivo* conditions can be generated. This work is funded by [The Scientific and Technological Research Council of Turkey \(TUBITAK\)](#).

## **References**

- Chetta J *et al*, Cytoskeleton; 67(10):650-665, 2010  
Hengst U *et al*, Nature Cell Biology Aug;11(8):1024-U1263, 2009