Department of Biomedical Engineering
MCMICKEN COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

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The Department of Biomedical Engineering is pleased to offer the following research project for the summer of 2006. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

DEVELOPMENT OF A COLLAGEN FIBER BASED IN VETRO MODEL OF INTRACRANIAL ANEURYSMS

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Project Description
This project will be conducted in the Endovascular Device Mechanics Research Laboratory (EDMRL) located in the Dept of Biomedical Engineering. The goal of this project is the develop an in vitro model of intracranial aneurysms, which are dilated lesions in the cerebral vascular tree that form due to complex interactions between the hemodynamic loading and the biological activity in the vessel wall. The resulting lesion is a collagenous sac that is devoid of the internal elastic lamina and smooth muscle components that are typically found in the cranial vessels. A result of this event is the progressive growth of the aneurysm that eventually results in rupture and haemmorhagic stroke. The growth of these aneurysms is presumed to be due to collagenase activity initiated by adverse biomechanical conditions imposed on the endothelium lining aneurysm sac. However, the specific combinations of mechanical factors and associated biologic interactions are still a subject of intense research.

The purpose of this research project is to investigate the possibility of creating a collagenous aneurysm sac in vitro, that is similar in biomechanical characteristics to aneurysms seen in patients. The current proposal is to create a silicone balloon analog model of patient specific aneurysm geometries that can be placed in a bioreactor well. We will then fill the well with a Type I collagen gel that will be mixed with fibroblasts. Similar to other studies that have been done in cell mediated contraction of collagen gels, we propose that the cells will contract the gel around the silicone balloons. After equilibrium contraction is achieved, the silicone balloons can be removed, leaving behind a vessel with a fusiform aneurysm that can then be connected to our existing pulsatile flow loop. The resulting experimental system would then be used to impose various hemodynamic conditions on the aneurysm and study the effects of these conditions on the aneurysm wall tension, stress and strain fields, cellular suynthetic actitivity, apoptic events, and protease activities responsible for collagen breakdown in the aneurysm sac.

Results of this investigation, if successful will represent the first step towards the construction of an in vitro cell/organ culture based model of aneurysms. This data will form the basis for future research and grant applications being planned for submission to the NIH, and NSF.