

Bioengineering Colloquium

**Friday
October 9,
2009**

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Osteocytes, Mechanotransduction, and Osteoporosis

**Presentation
4:00-5:00 pm
2112 Learned**

**Open to the
public**

Osteoporosis is defined as increased bone fragility leading to a predisposition to fracture and is strongly associated with a decrease in bone mineral density. Primary osteoporosis is associated with post-menopausal status and with aging, while secondary osteoporosis is associated with glucocorticoid treatment. Osteoporosis is due to increased osteoclast activity and decreased osteoblast activity resulting in net bone loss. Recently, several studies have shown that the osteocyte, the cell embedded in the mineralized bone matrix, can regulate both osteoclast and osteoblast activity, therefore the osteocyte may be directly responsible for bone loss. In addition to being hormonally regulated by estrogen, parathyroid hormone and other factors, this cell has been shown to be responsive to mechanical loading and to unloading. Mechanical loading in the form of exercise increases bone mass in the growing and the younger adult skeleton, but not necessarily in the older skeleton, which suggests a loss of responsiveness or mechanoperception in osteocytes. Our studies and those of others have shown that the osteocyte responds to fluid flow shear stress (thought to mimic the flow of bone fluid through the osteocyte lacuno-canalicular network) *in vitro* with changes in small signaling molecules such as calcium, nitric oxide, ATP, and prostaglandin and with changes in signaling within the prostaglandin and the Wnt/beta-catenin pathways. Many of these *in vitro* observations have been validated *in vivo*. Mechanosensation may occur through shear stress of the osteocyte dendritic processes, the cell body, cilia, or a combination. We have also shown that the osteocyte peri-lacunar space and matrix most likely plays an important role in the function of the osteocyte. The perilacunar matrix is hypomineralized compared to the intercellular matrix, can be modified in response to glucocorticoid treatment, loading, and to aging. Osteocytes can remove and replace their perilacunar and pericanalicular matrix in conditions in response to hormonal changes such as occurs in lactation. Modification of the osteocyte perilacunar and pericanalicular space and matrix would affect shear stress and potentially compromise the mechanosensation and transduction functions of this cell leading to bone loss.