**Abstract**: Maintaining the physiologic integrity of paralyzed limbs may be critical for those with spinal cord injury (SCI) to be viable candidates for a future cure. We do not know the long-term effects of neuro-musculoskeletal deterioration on the overall health of individuals with SCI. Importantly, we do not understand the “windows of opportunity” for this deterioration and the extent to which we can influence neural, muscle and bone tissues after SCI. This presentation will describe some of the temporal changes that occur in bone, muscle, and neural circuitry after SCI and present the effects of an early long-term neuromuscular electrical stimulation training program designed to preserve the physiological properties of the plantar flexor muscles (peak torque, fatigue index, torque-time integral and contractile speed) and tibia trabecular bone mineral density (BMD). The results demonstrate that the training protocol yielded significant trained versus untrained limb differences for torque (+24%), torque-time integral (+27%), fatigue index (+50%), torque rise time (+45%), between-twitch fusion (+15%), and post fatigue potentiation (-60%). These between-limb differences were even greater when measured at the end of a repetitive stimulation protocol (125 contractions). Peripheral quantitative computed tomography revealed 31% higher distal tibia trabecular BMD in trained limbs than in untrained limbs. Similar interventions in those with chronic paralysis yielded non-significant effects on bone, but muscle remained highly mutable. The intervention, which was highly feasible and dose specific, preserved many of the musculoskeletal properties of individuals with SCI. New studies, designed to influence the entire paralyzed lower extremities after SCI, are underway in our lab.