

MR elastography (MRE) has three essential elements: mechanical activation, MR motion estimation and shear modulus reconstruction. Mechanical activation of the brain is extremely difficult. Indeed it is much more difficult than actuation of other body parts because the skull and meninges form an excellent mechanical isolation system. Vibrations and impacts are heavily damped to protect the brain. Several methods have been used previously including whole head shaking using bite bar, a band around the head or actuators behind the head. We have found significant discomfort with all the methods we tried and that discomfort diminishes the utility dramatically because, when uncomfortable, patients do not complete examinations or introduce motion artifacts. All methods produce very small vibrations that are far below regulatory limits on vibration in the brain. We present evidence that the best way to couple shear waves to the brain is through the spinal cord. In a series of feline MRE examinations the largest shear motion occurred when the cerebellar motion was largest. The cerebellar motion was large where the spinal cord connects to the brain on every study that produced the most coherent, convergent solutions. Increased motion in the cerebellum occurred in 17 of 25 (68%) studies on seven animals. We postulate that one way to produce shear waves within the brain is through the spinal cord; i.e., that mechanical waves are transmitted along the cord and into the brain much more effectively than they are transmitted through the skull and meninges.