The Use of Acoustic Radiation Force with Cell-Loaded Hydrogels for Bone Repair

Autografts and allografts are each used clinically as bone grafts but also have considerable limitations, necessitating the search for alternatives. One such alternative, cell therapy, involves the injection of highly concentrated bone-healing cells into a bony defect, often encapsulated within a mechanically pliable 3-dimensional hydrogel, to enrich the injury site. A hydrogel permits minimally invasive implantation, multiple material choices that can be tailored to the encapsulated cells, and depending on the stiffness of the hydrogel itself a controlled mechanical environment. One drawback of using cell therapy for bony defects is the lack of mechanical integrity of the implanted cells and the subsequent need to protect the cells from the recognized benefit of mechanical loading. To circumvent this drawback we have developed a methodology that uses transdermal acoustic radiation force to mechanically load encapsulated cells after implantation through the controlled delivery of acoustic radiation force. Characterizing the force, the impact of the force on cells, and the overall efficacy of this technique has mandated the development of new and adaptation of existing analysis techniques. Here we will discuss some of the approaches taken to evaluate the acoustic radiation force intensity, the impact it has on hydrogels, and the effect it has on encapsulated cells both *in vitro* and *in vivo*.