

Idea Statement 1

An unmet need in osteoarthritis (OA) research is the availability of an imaging technique capable of diagnosing OA in its earliest stages and accurately monitoring OA disease progression. This problem stems from the limited signal-to-noise ratio of MR performed at standard clinical field strength (1.5-3 Tesla), which restricts the ability to perform high spatial resolution imaging, and the ability to assess cartilage biochemistry via non-proton MR techniques. We propose to solve this problem by utilizing ultra high field strength (7 Tesla), high resolution proton and sodium MRI to quantitatively assess cartilage and trabecular bone in healthy subjects and subjects with OA. In doing this we will explore two fundamental questions that are closely related: 1) Will 7 Tesla MR be able to detect early minute decreases in cartilage volume, cartilage proteoglycan content, and trabecular number and thickness that have heretofore been difficult to detect at standard clinical field strength? and 2) Will the biochemical and microstructural changes of cartilage and bone identified at 7 Tesla predict OA disease progression? This is important because it will improve our understanding of the pathologic events in cartilage and subchondral bone that leads to the development of osteoarthritis.

Idea Statement 2

An unsolved problem in radiation oncology is how to optimize intensity modulated radiation therapy (IMRT) plans to reduce hematologic toxicity (HT) in patients undergoing concurrent chemotherapy and pelvic radiation therapy (CRT). Optimized BMS-IMRT techniques may permit the delivery of more intensive chemotherapy, increasing the therapeutic ratio of CRT for pelvic malignancies in general. This would be **significant** in that optimizing one therapeutic modality (radiation) could facilitate delivery of a second modality (chemotherapy), for a wide range of cancers (e.g., cervical, endometrial, vulvar, vaginal, anal, rectal, prostate, etc.). Our overall goal is to develop a technique that can reduce HT in patients with pelvic malignancies. We propose to accomplish this by using novel methods to (1) identify critical pelvic BM subregions in which radiation dose has the strongest effect on HT (2) determine whether these critical subregions are hematopoietically important. In doing this, we will explore the fundamental question: how is the spatial distribution of BM radiation dose statistically and physiologically related to myelosuppression in patients receiving CRT?