Purpose: The purpose of this study was to compare the techniques and protocols used in clinical radiation therapy and recently developed preclinical image guided micro irradiation to establish a link between small animal conformal irradiation and clinical treatment protocols. This work will establish protocols that, according to treatment site, will facilitate the translation of conclusions from radiobiological experiments to clinical applications, fostering the advancement of radiotherapy.

Methods: Data was gathered using our small animal image guided micro irradiation device, the microIGRT, as an example of preclinical techniques which mimic equivalent clinical treatment protocols. The microIGRT utilizes fractionated treatments, multibeam irradiations, modulated beams, image guided treatment verification, and doses to emulate clinical protocols. Consequently, it is well suited to establish parametric comparisons between clinical and preclinical techniques. In this study, we concentrated on two treatment sites, brain and lung, to define treatment conformality index, homogeneity, penumbra, PDD, and fractionated doses to establish a link to guide radiobiological experiments using clinical protocols as a gold standard.

Results: Three and five beam irradiations were delivered to a small animal body and head phantom with radiochromic film to simulate lung and brain treatment. A three beam irradiation to the lung yielded a 625 um penumbra. Compare this value with a human treatment penumbra of 1 cm, and penumbra scales as the ratio between body sizes. The homogeneity of our system is similar to the 10% typically used in clinical treatment planning.

Conclusions: By comparing preclinical and clinical treatment metrics, the extent of translation can be determined and improved, leading to better understanding of preclinical results and improved correlation with clinical procedures. This will lead to more clinically based preclinical experiments and improve translation efficiency between the two testing environments, thus providing new clinical treatment strategies and improved human cancer treatment.