Purpose:
Microbeam radiation therapy (MRT) is a preclinical and radical radiotherapy treatment that has significant potentials for clinical applications. Animal studies have shown that, although only a small fraction of the tumor volume is within the paths of the microbeams, the entire tumor can be eradicated with no damage to the function of normal tissues. However the lack of MRT delivery systems prevents most cancer researchers from MRT laboratory research and hinders the translation to clinical application. We propose to develop the world first desktop image-guided MRT system for cancer research now and potential clinical treatment in the future.

Methods:
The key challenge for a desktop MRT system is dose rate and the enabling technology is the recently emerged carbon nanotube (CNT) based spatially distributed x-ray source technology. We have performed the corresponding simulations on the x-ray tube electron optics and the anode heat dissipation. Monte Carlo simulation was used to evaluate the dosimetric characteristics of the system. A prototype MRT device was also constructed to validate the system design and the simulation results.

Results:
We have already carried out initial feasibility studies and the results indicate that this novel nanotechnology-enabled desktop MRT system is capable of producing characteristic MRT radiation comparable to the MRT radiation produced by the synchrotron facilities.

Conclusions:
We strongly believe that there is a great potential to translate this promising MRT treatment from animal research to widespread clinical application. Because of the relative low cost and compactness of the proposed MRT system, once developed, the MRT treatment technology can be made readily available and affordable for widespread research and clinical application in US and beyond to benefit all cancer patients.