Purpose: Current micro-RT systems use either stationary collimators or dynamic hexagonal collimators. Even though dynamic multileaf collimators (MLCs) offer superior target conformity and beam modulation, no such system is currently available for small animal systems. This study aims to develop binary micro MLCs (bmMLCs) to be incorporated into an open source combined micro-PET/CT/RT system with IMRT capability.

Methods: A bmMLC system was designed using Flexinol actuator wire which features muscle-like contraction when electrically driven. An assembly was constructed by attaching brass leaves to supporting steel tubes with springs which can translate within larger concentric steel tubes on a customized collimator support structure. The actuator wires were connected to the inner steel rods. When electricity was passed through the wire, it contracted pulling the assembly against the spring on supporting rod to open the leaves. Individual collimator leaves were arranged to move in opposing directions and stacked in an interleaved position.

Results: A proof of concept prototype has been successfully tested using a two leaf-system. In order to get a treatment width of 0.25cm at isocenter, brass leaves that are 2cm long, 0.05cm wide and 2.4cm thick (for 99.99% attenuation of 250kVp X-ray) were used. The full scale collimation system was designed using 20 leaves on each side. Leaves were designed to translate 1cm producing a maximum field size of 5x10cm2 at the isocenter of the RT system. Opening and closing time of collimator leaves was less than a second which is sufficient for the expected low dose rate from the X-ray source.

Conclusions: The first dynamic bmMLC system for a micro-RT system is being developed to enable IMRT applications. The mechanical characteristics of the bmMLC system are currently being evaluated and optimized. Future work will include development of software to drive the collimator movement for use in treatment planning.