

The notable low tolerance of rat skin and bone marrow to synchrotron radiation: A bio-safety evaluation of single dose synchrotron radiation X-ray on young rat legs

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Synchrotron Radiation (SR) imaging *in vivo* is a novel experimental technique owing to its excellent imaging resolution and sensitivity. Since SR X-ray has high intensity, high collimation and monochromaticity, the tolerance of tissues to SR X-ray is unknown. In this study, we used SR X-ray to treat limb of rats to explore the tolerance of SR X-ray and to establish the safety threshold dose of SR X-ray *in vivo*.

Male Sprague-Dawley (SD, 5 weeks old) rats were randomly divided into 6 groups, which respectively subjected to 0, 0.1, 0.5, 1, 5 and 20 Gy single irradiation dose on left tibia and femur metaphyseal. The irradiation was performed in BL13W beam line at Shanghai Synchrotron Radiation Facility (SSRF). The number of red blood cell, white blood cell and platelet in circulating blood was examined up to 3 months. The responses of bone marrow and skin to SR X-ray were determined up to 6 months.

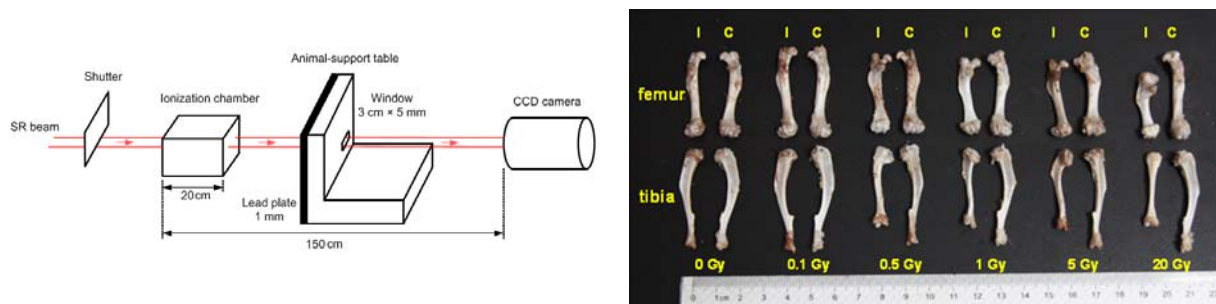


Fig.1 left was the illustration of irradiation device, right showed the discrepancy of femur and tibia length between ipsilateral and control lateral after 3 months of SR X-ray irradiation.

We found that 20 Gy treated group showed an acute decrease of lymphocytes and platelet at 2 days compared to the control ($n=14$, $p<0.05$) and it recovered after 7 days. Visible morphology changes including fair loss, moist desquamation and inhibition of bone growth were detected in 0.5, 1.5 and 20 Gy group, but not in 0.1 Gy treated group ($p<0.001$). Joint deformity could occur in 0.5, 1 and 5 Gy treated group while it was absent in 20 Gy treated group whose bone growth was quickly ended by severe ionizing radiation injury. Moreover, tumor formation was not observed in any groups up to 6 months.

We concluded that the safety threshold dose of SR X-ray for the skin and the bone marrow of young SD rats is between 0.1 Gy and 0.5 Gy. The reduction of lymphocytes and platelet occurred after local 20 Gy SR X-ray treatment, suggesting 20 Gy local irradiation can cause an influence at whole-body level.