AbstractID: 7427 Title: Fast Dose Calculation for Pigmented Villonodular Synovitis Treated with P-32 Radiocolloids

Purpose: Pigmented Villonodular Synovitis (PVNS) is a joint disease that usually afflicts the knee. It is characterized by overgrowth of the joint's lining tissue, creating friable frond-like appendages and resulting in monoarticular joint pain, effusion, and ultimately joint damage. The goal of therapy is to treat the synovial surface, controlling the growth and sclerosing the friable vessels. "Radioisotope synovectomy" procedure with P-32 injected into the knee joint is an excellent candidate for such treatment due to the proper half life and steep dose gradient of P-32 beta decay. However, it is often difficult to estimate the dose distribution in the irregular-shape joint space for the beta emission. In this work, we develop a fast and accurate Monte Carlo based dose calculation, and validate it with spherical phantoms.

Method and Materials: A "dose matrix kernel" is simulated with Monte Carlo code (BEAMnrc) for single-voxel P-32 source, with the matrix size 15×15×15 in 1 mm voxels. After CT scan with contrast, the patient knee joint space (P-32 region) is segmented out. Three-dimensional dose distribution is then obtained by convolving the P-32 region with the pre-calculated dose kernel with consideration of the medium scaling factor for heterogeneity correction. This dose calculation method is validated using spherical phantoms of various diameters.

Results: Compared with the literature, the doses calculated from our method agree with others within 1% at the sphere centers and within 5% at the boundary. For the patient case, the dose calculation shows a non-uniform distribution over the joint surface. The average dose can differ more than 50% from an estimation using spherical geometry with equivalent volume.

Conclusion: It is important to calculate P-32 dose distribution in 3D using actual geometry. The developed method is fast and relatively accurate. Further validation is under progress using TLD and film dosimetry.