Cureus

Target Volume Delineation Patterns in Knee Osteoarthritis Before and After an Educational Program

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Abstract

Purpose: Knee osteoarthritis (OA) is a common disease in the United States, and low dose radiotherapy (LDRT) is a promising option for this disease. While practicing Radiation Oncologists have extensive experience in target delineation of cancers throughout the body, there is relatively little experience with this modality in treating OA, where target volumes often encompass the synovium. An educational program covering target delineation in OA has been established, titled RT-ABC. This study was performed to assess community patterns of contouring practice and the impact of this course on contouring accuracy.

Methods: A course on target delineation for knee OA was conducted, with voluntary participation in the study. Participants contoured clinical target volumes (CTVs) for a case of knee OA with effusion of the joint sac, both before and after the course. The cranial and caudal distances from the joint line to CTV edge were measured and classified as ideal (8.5-10 cm cranial, 3.5-5 cm caudal), within acceptable limits (ideal range plus 1 cm), or beyond acceptable limits. Participant CTVs were compared to the gold-standard CTV (as defined by Steike et al. ASTRO 2025) to assess for Dice Similarity Coefficient (DSC) and Hausedorf Distances (HD). Descriptive statistics and matched-pair T-tests were conducted.

Results: 13 Radiation Oncologists completed CTVs before and after the course. The average craniocaudal span of participant contours was 14.5 cm (SD=1.7), with 9.0 cm above the joint (SD=1.5) and 5.5 cm below the joint (SD=1.9). CTV's were significantly improved as measured by both DSC (1=perfect match with gold standard CTV; mean 0.859 vs. 0.795, p=0.024) and mean HD (lower distance is desirable; mean 4.95 mm vs. 6.79 mm, p=0.046). The cranial extent of contours had 11/13 within acceptable limits both before and after the course; of these, they improved from 3/11 within the ideal range to 6/11. The caudal extent of the contours improved from 10/13 within acceptable limits to 13/13; of these, 7/13 were within ideal range. Maximum Hausedorf distances (locations of greatest discrepancy of contours) also occurred in undercoverage of synovium posterior to the joint.

Conclusion: In this study, we identified the most common variations in target delineation of knee OA to be in 1) the craniocaudal extent of contours and 2) inadequate coverage of synovium posterior to the joint. Physician contours significantly improved after a contouring course.