Ultra-Low-Dose Postoperative CT Protocol After Acetabular Fixation Has Excellent Intra- and Inter-Observer Reliability

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Purpose: Radiation in medicine is a concerning topic. CT scans account for the single largest radiation exposure in trauma patients. The lowest radiation dose capable of providing comprehensive information should be utilized. We aimed to identify a protocol with the lowest possible radiation dose for CT imaging of postoperative acetabular fractures without compromising intra- and inter-observer reliability of surgeons evaluating fracture reduction and intra-articular implant penetration.

Methods: Ten fresh frozen cadavers (thorax to mid-femur) with 20 acetabuli were used. A priori power analysis was performed indicating a minimum of 18 specimens required to achieve a power of 80%. Four common fracture patterns were created and typical fixation constructs were placed. Intentional malreduction and joint penetration were performed in some of the specimens. Each specimen was scanned with decreasing radiation dose by varying a number of protocol factors such as mAs, kVP, pitch, window filters, and others. The scans were then reviewed by 5 fellowship-trained orthopaedic traumatologists comparing against the standard, full dose CT scan of each specimen. Four parameters were assessed: (1) articular step-off, (2) articular gap, (3) intra-articular implant penetration, and (4) surgeon confidence. To control for variation in independent full scan reviews, all raters were asked to measure the above parameters on a single predetermined slice as well. Readings were noted to be in agreement if measurement was ≤2 mm.

Results: Intra-observer reliability for step-off, gap, and intra-articular implants ranged from 80% to 100% ($P < 0.001$) across all raters. Inter-observer evaluation of a single, predetermined slice was 100% (average difference in rater measurements between the full dose protocol and lowest radiation protocol was 0.42 mm). The lowest radiation dose with >80% inter-observer reliability was a soft-tissue algorithm viewed in a bone window with 1.25-mm slices at 0.0625 mm pixels, 40 mAs, and 516 pitch (ultra-low-dose CT protocol), which represents 1/10 the radiation of a full dose pelvic CT scan.

Conclusion: Evaluating acetabular fracture reduction and fixation is possible with drastically reduced radiation dosage compared to the standard pelvic CT. Utilizing the ultra-low-dose CT protocol represents 1/10 of the radiation of a full dose CT scan, while still providing excellent intra- and inter-observer reliability.