

### Diagnostic Validity of the CT Capsular Sign for the Detection of Ipsilateral Femoral Neck Fractures Associated with Femoral Shaft Fractures

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**Purpose:** Missed ipsilateral femoral neck fractures (IFNFs) in patients with femoral shaft fractures can lead to substantial dysfunction. Multiple methods of analyzing the bony anatomy have been described to diagnose these injuries. More recently the “CT capsular sign” that evaluates capsular distention of the hip in the axial soft-tissue window has been reported. We sought to independently evaluate this diagnostic tool to describe its effectiveness.

**Methods:** 1244 consecutive femoral shaft fractures treated at 7 Level I trauma centers were identified for evaluation. We excluded age <18 years (n = 60), associated acetabular or femoral head fracture (n = 93), prior femoral head/neck fracture or surgery (n = 58), no or low-quality preoperative CT of bilateral hips (n = 80), low-energy or gunshot wound mechanism (n = 186), <6-week follow-up (n = 172), and Kellgren-Lawrence arthritis  $\geq$  grade 3 (n = 8). Preoperative radiographs and CT scans of the pelvis were independently reviewed by surgeons blinded to treatment and IFNF diagnosis. Capsular distention was measured as per Park et al, with a side-to-side difference >1 mm considered to be a positive finding. IFNF was defined as femoral necks treated with fixation for suspicion of IFNF by the operative attending (based on operative notes) or subsequent fracture identified during the first 6 weeks postoperatively for those not fixed.

**Results:** 587 femoral shaft fractures were evaluated. 71% of patients were male and 77% of the fractures were closed. Mechanisms of injury were motor vehicle collision (59%), motorcycle crash (22%), and other high-energy mechanism (19%). 69 patients (12%) had IFNFs. Using multiple evaluators to add data for statistical power, a total of 1034 measurements were made. A positive CT capsular sign had a sensitivity, specificity, positive (PPV), and negative predictive value (NPV) of 0.72 (range, 0.64-0.80), 0.84 (0.81-0.86), 0.39 (0.34-0.43), and 0.96 (0.94-0.97), respectively. Of the 69 femoral neck fractures, 9 were diagnosed intraoperatively after nailing (2) or postoperatively (7). Seven of these 9 had a positive CT capsular sign.

**Conclusion:** Although not perfect, the CT capsular sign is a useful diagnostic tool to rule out ipsilateral femoral neck fractures in patients with high-energy femoral shaft fractures with an NPV of 0.96.