

## SUBSPECIALTY PROCEDURES

## INTRAMEDULLARY NAILING TECHNIQUE FOR PROXIMAL HUMERAL FRACTURES USING A STRAIGHT ANTEGRADE NAIL WITH LOCKING TUBEROSITY FIXATION

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Published outcomes of this procedure can be found at: Springer Milan; 2014. p 91-112, *J Bone Joint Surg Am.* 2011 Dec 7;93(23):2172-9, and *J Shoulder Elbow Surg.* 2016 May;25(5):e130-8.

*Investigation performed at Western Orthopaedics, P.C., Denver, Colorado*

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**Abstract**

**Background:** Intramedullary straight nail fixation of proximal humeral fractures using a locking mechanism provides advantages compared with plating, including (1) less soft-tissue dissection, which preserves periosteal blood supply and soft-tissue attachments; (2) improved construct stability for comminuted fractures or osteopenic bone; and (3) shorter operative time for simpler fractures.

**Description:** The patient is placed in the beach-chair position with the head of the bed elevated approximately 45°. The fracture is reduced with use of closed or percutaneous methods, ideally, or with an open approach if required. Temporary fragment fixation with percutaneous Kirschner wires can be utilized. A 1-cm incision is made just anterior to the acromioclavicular joint, overlying the zenith of the humeral head and in line with the diaphysis. A guide-pin is then placed through this incision and is verified to be centrally located and in line with the humeral diaphysis on fluoroscopic views. The guide-pin is advanced into the diaphysis. A cannulated 9-mm reamer is inserted over the guide-pin to create a starting position. The nail is then inserted, with adequate fragment reduction maintained until the proximal nail portion is buried under the subchondral humeral head. The proximal screw trajectory and alignment are checked fluoroscopically. The proximal locking screws are pre-drilled and inserted first using percutaneous drill sleeves through the radiolucent targeting jig. The screw is inserted through the guide and is advanced into the nail until appropriately seated. This process is then repeated for the other proximal screws as necessary. Finally, the distal diaphyseal screws are pre-drilled and inserted in a similar percutaneous fashion using the jig, and the jig is removed. Final orthogonal images are obtained. Copious irrigation of the incisions is performed and they are closed and dressed with a sterile dressing. The operative arm is placed in an abduction sling.

**Alternatives:** Alternative treatment options for proximal humeral fractures include nonoperative treatment with use of a sling, percutaneous reduction and

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internal fixation with Kirschner wires, open reduction and internal fixation with a locking plate and screw construct, hemiarthroplasty, and anatomic or reverse total shoulder arthroplasty<sup>1</sup>.

**Rationale:** The presently described technique for proximal humeral fracture fixation using a straight, antegrade, locking nail allows for minimal soft-tissue disruption, preserving vascularity and soft-tissue support and achieving angularly stable fixation in often osteopenic bone. The superior and in-line entry point avoids complications of rotator cuff injury and/or subacromial impingement. The proximal locking screws avoid complications of screw penetration or migration. This technique is appropriate for surgically indicated Neer 2-, 3-, and 4-part humeral fractures, including in elderly patients, when the humeral head fragment remains viable<sup>1-5</sup>.

**Expected Outcomes:** Based on available Level-III and IV evidence using this technique, patients should expect recovered motion and the ability to perform daily activities independently, with a mean active elevation of 132° to 136°<sup>1,4,6</sup>, external rotation of 37° to 52°<sup>1,4,6</sup>, and internal rotation to L3<sup>1</sup>. Pain scores improved significantly from preoperatively to postoperatively, with a mean pain score of 1.4 on the visual analogue scale<sup>3,4,6</sup>. Patient-reported outcomes were good to excellent, with Single Assessment Numerical Evaluation (SANE) scores of 80% to 81%<sup>1,6</sup>, mean Constant scores from 71 to 81<sup>1,3,4,6</sup>, and high rates of patient satisfaction (97% satisfied or very satisfied)<sup>4</sup>. Studies also demonstrated good to excellent fracture healing, with no tuberosity migration and low rates of nonunion (0% to 5%)<sup>1,6</sup> and humeral head necrosis (0% to 4%)<sup>1,4</sup>. Revision rates ranged from 10.5% to 16.7%<sup>4,6</sup>.

#### Important Tips:

- The starting position of the guide-pin must be central and at the zenith of the humeral head on the anteroposterior Grashey and the scapular Y views, and the guide-pin must be aligned with the diaphysis prior to advancing it.
- Failure to bluntly dissect the percutaneous incisions risks injury to the axillary nerve.
- Verify correct version of the nail prior to drilling any screws, to avoid incorrect version and potential loss of functional rotation.

#### Acronyms and Abbreviations:

- ABD = abduction
- AP = anteroposterior
- CT = computed tomography
- ER = external rotation
- FF = forward flexion (forward elevation)
- IR = internal rotation
- SANE = Single Assessment Numerical Evaluation
- SSV = Subjective Shoulder Value
- VAS = Visual Analogue Scale

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