Basic Fluoroscopic Approach for Percutaneous Fixation of the Sacrum/Sacroiliac Joint

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Atlanta Trauma Symposium
April 23, 2016

Sacroiliac Joint (SIJ) Pain
• SI joint mediated pain defined as etiology in 15-30% of Chronic LBP cases [Spine 2009]
• SIJ pain traditionally treated with open arthrodesis vs. non-operative care
• Non-operative care = Pain management and physical therapy
  • Prescription/Non-prescription analgesics
  • Radiofrequency ablations
  • SIJ injections
• Open arthrodesis reserved for refractory cases due to surgical complications, prolonged hospital stays and poor results
• Economic burden: $1.6 billion per 100,000 commercial payer beneficiaries based on 3-year insurance payment estimates [ClinicoEconomics & Outcomes Research 2014]

Percutaneous SIJ Fixation
• Risks of percutaneous fixation:
  • Penetration of intervertebral root, thereby damaging sacral nerves
  • Vertebral canal
  • Variability of sacral anatomy (14.5% dysmorphia) [Hasenboehler 2011]
• Frequency of aberrant screw placement
  • 2.1%-6.8% screws malpositioned [JOT 2002]
    • 0.08% revision rate
  • Up to 42% screws malpositioned [J Trauma 2010]
    • 19% revision rate
Relevant Sacral Anatomy

- Sacral pedicle:
  - Junction between sacral body and alar wings
  - L5-nerve/alve vessels anteriorly/cephalad
  - S1 root posteriorly and caudal
  - Cauda equina posteriorly
  - Directly cephalad to first sacral foramen
  - Narrowest portion of sacral ala

- Safe Zone/Vestibular Concept:
  - SI screws must pass through outer table of ilium and traverse sacral ala
  - Average slope of sacral ala at pedicle 45.09 degrees (range 25-65)
  - Average maximum height at geometric center cross-section 27.76 mm
  - Average width at geometric center in cross section 28.05 mm

Intraoperative Fluoroscopy

- Described procedures:
  - Biplanar Inlet and Outlet Views only
  - Inlet and Outlet Views via single C-arm fluoroscopy with
    True Lateral View: Triplanar Fluoroscopy
  - Above utilized with one or more C-arms
  - Positioning traditionally supine
  - CT scan-guided placement
  - Current literature suggests fluoroscopy provides adequate
    visualization if triplanar technique utilized
  - Published fluoroscopy times:
    - 86 sec/implant in cadaveric testing (MICCAI 2000)
    - 126 sec/implant (BMC Musculoskeletal Disorders 2014)

Basic Sacral Views
Apologies to Jeffery Mast

Intraoperative Imaging Technique

• Primary surgeon utilizes a third novel triplanar view, the vestibular or “root view”
• Prone placement of patient secondary to surgeon preference
• Convert traditional direct lateral view to an oblique lateral generally aiming 30-45 degrees caudal to cephalad and 20-30 degrees posterior to anterior
• Resultant image, referred to as the “root view,” presents a sacral vestibular pathway consistent with the “safe zone;” thereby reducing the risk of anterior/posterior extraosseus screw placement

Intraoperative Imaging Technique

• Surgeon inserts a guide pin percutaneously down to the ilium
• Radiolucent handle utilized to achieve a perfect “bulls eye”
• Pin is tapped into place and “dueling c-arms” are utilized to obtain simultaneous pelvic inlet and outlet views
• Obtain inlet/outlet pelvic views while traversing joint
• Remainder of procedure varies by implant
Results: Demographics

- Average age 45.3 years (range 15 – 77)
- Gender
  - 38.6% Male (49/127)
  - 61.4% Female (78/127)
- BMI
  - Average 28.4 kg/m²
  - 30.4% Obese (> 30 kg/m²)
Results: Fluoroscopic Time

- Fluoroscopy time available in 77 cases
  - 124 Implants (113 Screws, 11 Cages)
  - 67.9 seconds per implant
    - 70.1 seconds per screw
    - 53.8 seconds per cage

Results: Fluoroscopic Time

Average FT/Implant by Resident Surgeon PGY

- PGY1: 86.3
- PGY2: 77.1
- PGY3: 83.3
- PGY4: 31.2
- PGY5: 57.5

Results: Postoperative CT Evaluation

COMPPLICATIONS
- Implant revision rate secondary to aberrant screw placement 0.02% (4/179)
Conclusions

- With our approach:
  - Successfully limit radiation exposure to approximately one minute (less than 60 seconds in most cases) for the entire procedure
  - Offer a more consistent, approachable method for percutaneous SI screw fixation with a gradual learning curve
  - Increase reliability of screw placement

Zone II Sacral Fracture