


Modified Triplanar Fluoroscopic Approach in Percutaneous Fixation of Sacroiliac Joint



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Disclosures

None



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)



Minimally Invasive Techniques



- Primarily percutaneous screw or cage fixation across SIJ
- Bridges gap between non-operative treatment and open arthrodesis
- Safer, but as effective as open fusion (CORR 2014) with patient selection paramount (J Neurosurg Spine 2015)
- Cost savings (*ClinicoEconomics 2013*):
 - extrapolated lifetime cost of treating Medicare patients with MIS fusion was \$48,185/patient compared to \$51,543/patient for nonoperative care
 - resulting in a \$660 million savings to Medicare (196,452 beneficiaries at \$3,358 in savings/patient)

Percutaneous SIJ Fixation



- Risks of percutaneous fixation:
 - Penetration of intervertebral root, thereby damaging sacral nerves
 - Vertebral canal
 - Variability of sacral anatomy (14.5% dysmorphism) (*Hasenboehler 2011*)
- Frequency of aberrant screw placement
 - 2.1%-6.8% screws malpositioned (*UOT 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 root/iliac vessels anteriorly/cephalad
 - S1 root posteriorly and caudad
 - 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 and pedicle via "safe zone" to entry S1 or S2 vertebral segment
- Anatomical measurements (*UOT 2000*):
 - 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, patient specific mapping, robotic assisted
- 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)

Technique Overview



- Primary surgeon utilizes a third novel triplanar view, the vestibular or “root view” allows:
 - Increased accuracy with regards to placement of percutaneous fixation devices
 - Decreased radiation exposure for patient and surgeon
 - Easier approach and procedure for novice and experienced surgeons

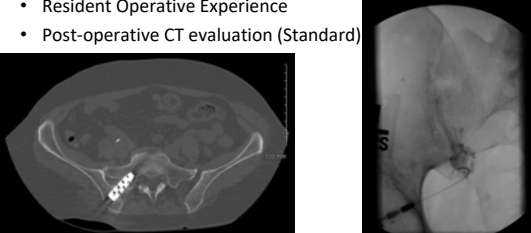

Technique Utilization



- Retrospective chart & radiography review of 179 patients undergoing percutaneous SI screw fixation secondary to SIJ pain (Single Surgeon, AMC)
- 52 patients excluded
 - 25 Triplanar with true lateral view
 - 7 PSIS starting points
 - 20 insufficient medical records
- 127 Patients utilizing triplanar root view
 - 200 Implants (189 Screws, 11 Cages)


Treatment Protocol

- Treatment Protocol Includes:
 - Preoperative SIJ arthrogram injection
 - Consistent Intraoperative Imaging Technique
 - Resident Operative Experience
 - Post-operative CT evaluation (Standard)




Intraoperative Imaging Technique

- Surgeon utilizes modified 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



Intraoperative Imaging Technique



Intraoperative Imaging Technique



Intraoperative Imaging Technique



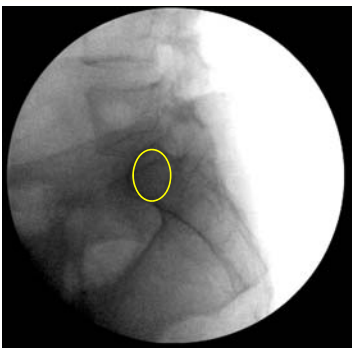
Intraoperative Imaging Technique



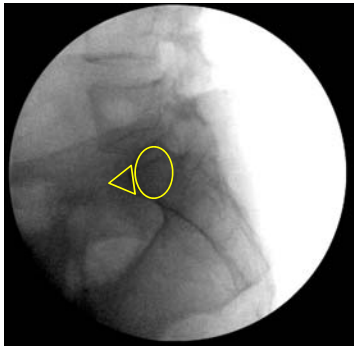
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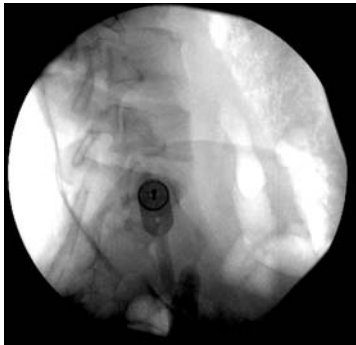
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Intraoperative Imaging Technique



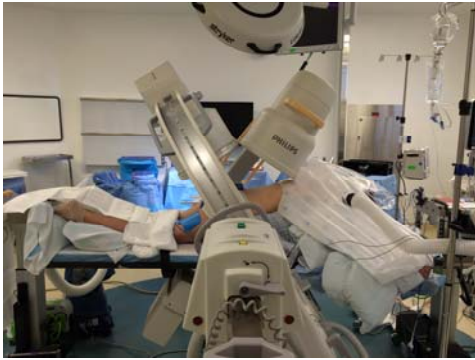
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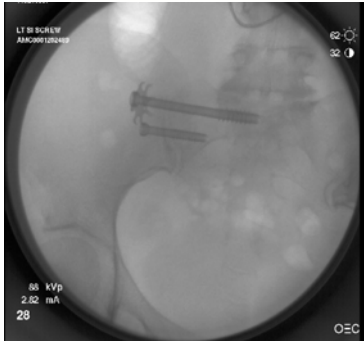
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Intraoperative Imaging Technique



Results: Postoperative CT Evaluation



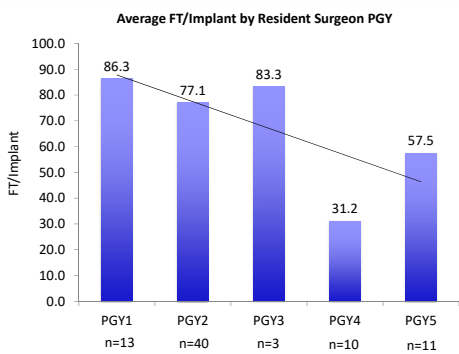
- 9 Positive postoperative CT scans
 - 9 screws located or presumed located beyond sacral foramen cortical border
 - 4 revised secondary to radiculopathy
- Implant revision rate secondary to aberrant screw placement 2.2% per patient (175/179) and 2.0% per implant (4/200)

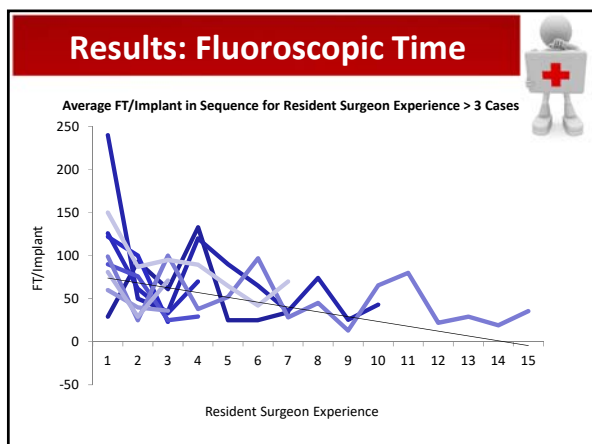
Results: Fluoroscopic Time



- 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
- Published fluoroscopy times:
 - 86 sec/implant in cadaveric testing (MICCAI 2000)
 - 79% Accurate placement
 - 126 sec/implant (BMC Musculoskeletal Disorders 2014)

Results: Fluoroscopic Time





- ### Conclusions
- This fluoroscopic approach:
 - Successfully limits radiation exposure to approximately one minute (compared to average 71 seconds in tibial IMN, Kirousis 2009) for the entire procedure
 - Offers a more consistent, approachable method for percutaneous SI screw fixation with a short learning curve
 - Increases reliability of screw placement

