



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




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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

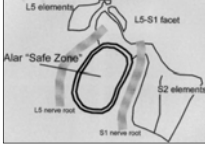


- Risks of percutaneous fixation:
 - Penetration of intervertebral root, thereby damaging sacral nerves
 - Vertebral canal
 - Variability of sacral anatomy (14.5% dysmorphism) (Hasenboehler 2011)
- Frequency of aberrant screw placement
 - 2.1%-6.8% screws malpositioned (JOT 2002)
 - 0.08% revision rate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

Relevant Sacral Anatomy




- Sacral pedicle:
 - Junction between sacral body and alar wings
 - L5 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 (JOT 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

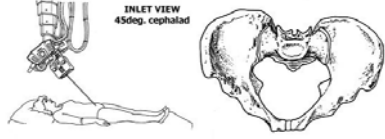


- Described procedures:
 - Biplanar Inlet and Outlet Views only
 - Inlet and Outlet Views via single C-arm fluoroscopy with True Lateral View: Triplanar Fluoroscopy
 - Above utilized with one or more C-arms
 - Positioning traditionally supine
- CT scan-guided placement
- Current literature suggests fluoroscopy 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



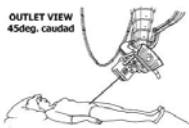
Inlet view:




**INLET VIEW
45deg. cephalad**



Outlet View:



**OUTLET VIEW
45deg. caudad**



Apologies to Jeffery Mast

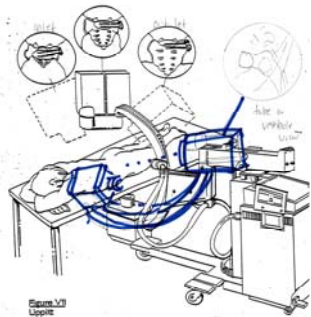


Figure 17
Lippitt
Positioning of the Patient and Use of the Image Intensifier for the Sacroiliac Joint Fixation

The diagram illustrates a patient lying on a table in a prone position for a sacroiliac joint procedure. A C-arm image intensifier is positioned around the patient. Several inset diagrams show different views of the sacroiliac joint: a top-down view, a side view, and a view from the C-arm's perspective. A small 3D figure of a person with a red cross on their chest is in the top right corner of the slide.

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

The slide features a small 3D figure of a person with a red cross on their chest in the top right corner.

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

The slide features a small 3D figure of a person with a red cross on their chest in the top right corner.


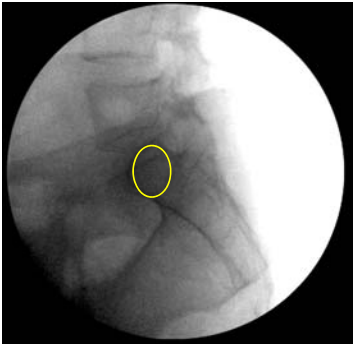
Navigation/Robotic



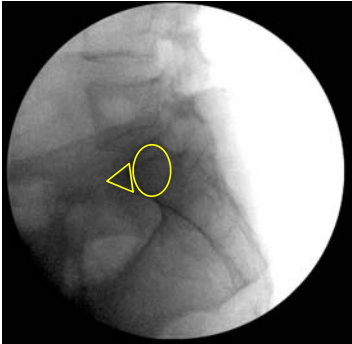
Intraoperative Imaging Technique



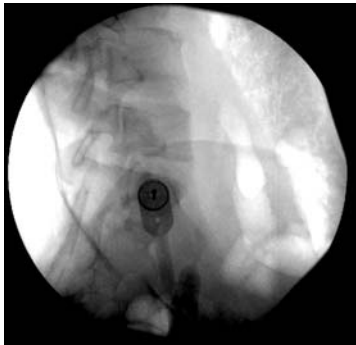
Intraoperative Imaging Technique



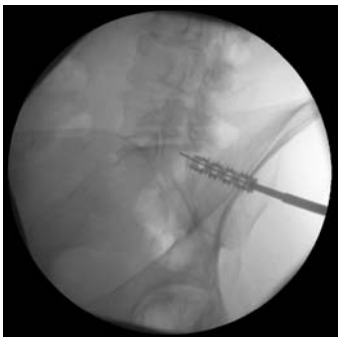
Intraoperative Imaging Technique




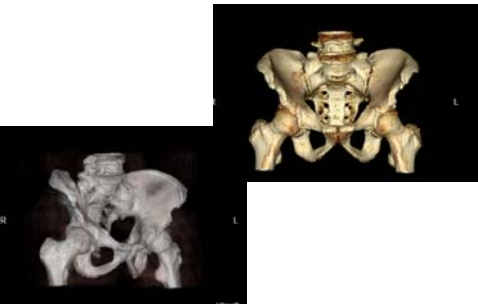
Intraoperative Imaging Technique




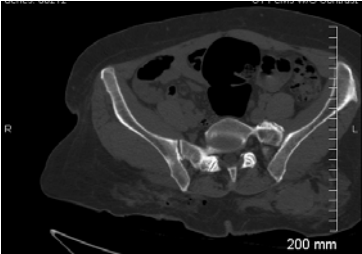
Intraoperative Imaging Technique



Pitfalls: Bertolli's




Pitfalls: Gas



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)

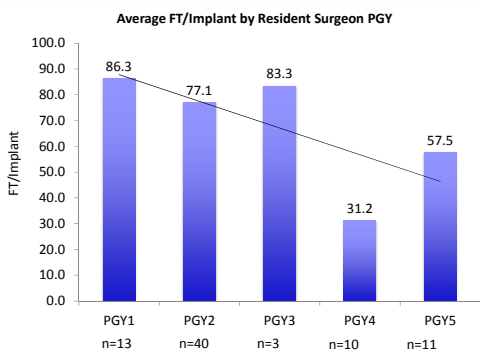


Results: Fluoroscopic Time



- 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




Results: Postoperative CT Evaluation



COMPLICATIONS

- 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

