Biomechanical Considerations for the SI Joint

Castellvi Spine
May 13, 2017
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Disclosure
Research Funding
Aesculap
Alphatec Spine
Globus
K2M
Medtronic
Orthokinetica
Ratchiotek
Stryker Spine

Porsche 911 Cooling System
Type 993 and previous (1963-1997)
Type 996 (1998-2005)
Spine Biomechanical Testing

• Method of Comparative Testing
  – Flexion extension and lateral bending (pure moment testing – flexibility protocol)
  – Axial torsion and axial compression (are also important)

"Pure Moment" Testing
What bending moment does each intervertebral level see?

Panjabi, 1988

Modified without permission from Panjabi, 1988
**Sacroiliac Joint Fusion**

**Minimally Invasive iFuse Implant System®**

**Vs. Open SI Fusion:**
- Smaller incision
- Reduced blood loss
- Short procedure ~ 1 hour
- No need for bone grafting

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**Why the unique triangular design?**
- Cannulated screw may loosen

**Design: Triangle vs. Round**
- Porous titanium plasma coating allows for biologic fixation
- Larger surface area designed to stabilize and fuse the heavily loaded SI joint
- 3X stronger than screw

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Anatomy & Biomechanics of the SI Joint

Sacroiliac Ligaments

- Ventral
- Dorsal

Vascular Anatomy

- Mid-line cut looking lateral
- Superior Gluteal Artery
SI Joint Motion

Multi-planar motion
- Simultaneously rotate and translate through 3 axes of motion

Motions (<4° in any plane)
- Nutation/Counternutation
  - Primary motion
  - Males: 1 - 2°
  - Females: 2 - 4°

Sacral Translation
(A-P motion) up to 1.6mm

Biomechanical Goal of Rigid Fixation

- Fixation design rational
  - Provides immediate stabilization and fixation
  - Adjunct to fusion, i.e. “stiffens” FSU

- Clinical relevance
  - Reduce instability of pathologic FSU (+ ROM)
  - Correlated clinical outcomes to stiffness

- Metric
  - ROM

Good Idea?
Comparison Treatments

1. Intact
2. Intact (Resection)
3. Destabilized
4. Instrumented SI

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Defining SI Joint Orientation

Biomechanical Study Design

Motion of the SI joint

- Primary motion is nutation, which is a nodding type of motion
  - 1-2 degrees for males
  - 2-4 degrees for females
- Center of Rotation is the S1 neuroforamen

Frost et al. 2006
Conclusion

- Adjacent levels changes (L5-S1)
  - Not able to detect changes in pure moment testing
- Due to relatively small magnitudes of gross joint motion
  - Should we define as instability?
  - May still have implications for the presence of pain in spite of a small ROM
- Specific biomechanical considerations
  - Consider plane of loading for the joint
  - Many models utilize single leg stance

Thank you!