Preoperative Evaluation of Glenoid Anatomy

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2017 Current Solutions in Shoulder and Elbow Surgery
Tampa, FL

The University of Utah Department of Orthopaedics

Disclosures

- Consultant for Mitek and Cayenne
- Royalties/MAB – Imascap, Conextions, Kator, Genesis, Intrafuse, Shoulder Innovations

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Introduction

- Glenoid implantation→ CHALLEGING!
- Posterior erosion – Neer 1982
- Ho,Iannotti – JBJS AM 2016
- Baseplate malposition→ loosening, notching, stability, ROM
- Understanding preoperative glenoid anatomy critical
- Questions –
  - What imaging studies do we need?
  - What do we need to measure and how do we classify?
  - What do we do with the information???→optimize indications/ surgical technique

What studies do you really need?

- Standard 4 view xray only
- 2D CT
  - Eroded glenoids
- MRI
  - Evaluate cuff – supra/subscap
  - Lowe et al JSES 2016 – reliability of MRI to CT; High agreement for A and B1; MRI less accurate distinguishing B2,C
- 3D CT?
  - Benefits over 2D
    - No cuts are out of plane
    - Allows identification of maximum wear (Hoenecke et al JSES 2010)

Xrays on all
Minimal erosion – no further imaging
Concern of cuff involvement in 1 OA – MRI
Moderate/severe erosion – 2D/3D CT

Preoperative Glenoid Anatomy - Metrics

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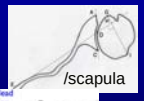
Axial Plane Glenoid Measurements

RETROVERSION

Paleoretroversion: AB
Neoretroversion: BC
Intermediate retroversion: AC

SUBLUXATION


/glenoid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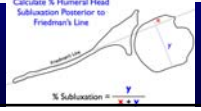
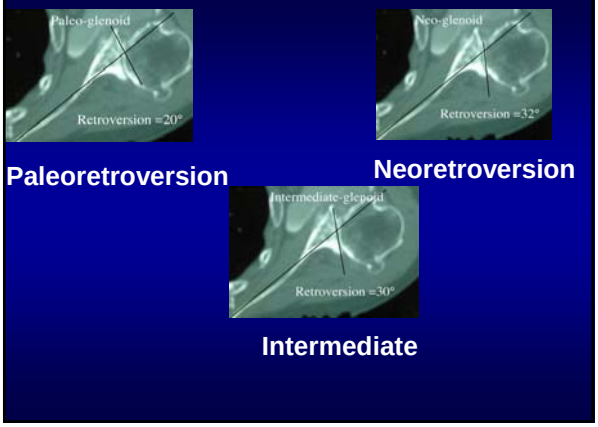




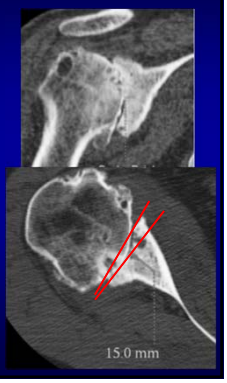
Paleoretroversion

Neoretroversion

Intermediate

Clinical application of version

- Improves surgical technique
  - Starting center location
    - Friedman's line; err towards slightly anterior
  - Greatest vault depth
    - Ave normal depth
  - Determine reaming depth/version correction
  - Quality of subchondral bone support
    - Knowles et al. JSES 2015 – densest bone posteroinferior; neoglenoid

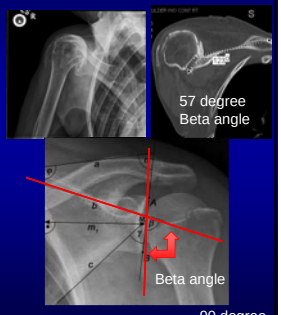


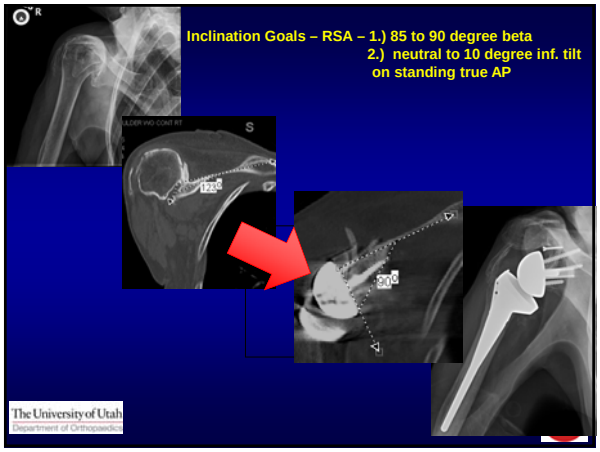
Clinical application of accurate version

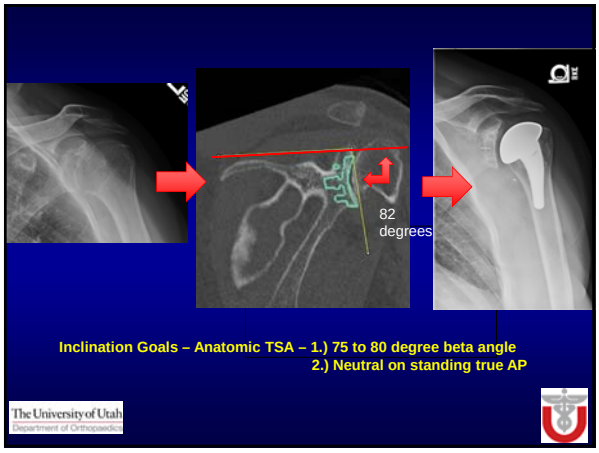
- Improves surgical indications
  - Goal of anatomic TSA - < 15 retro
  - High side reaming - < 25 retro
    - 15 to 20 degrees of correction
    - Clavert JSES 2007 – peg penetration
  - Augmented anatomic glenoid/bone graft w/anatomic glenoid
    - Young, higher demand
    - >25 to 30 degrees intermediate version
  - RSA w/ bone graft
    - Older, lower demand
    - >25 to 30 degrees intermediate version

Coronal Plane Glenoid Measurements

- Beta angle – Maurer et al JSES 2012
  - Angle between floor of supraspinatus fossa and superior/inferior glenoid tubercle
  - 75 degrees average (both fx and Walch A glenoids)
  - Beta angle – most reproducible measure of inclination







Clinical Application of Inclination

- RSA
  - Guitierrez, Frankle. JBJS Am 2008
    - Inferior tilt reduced abduction/adduction deficit
  - Guitierrez, Frankle. JSES 2011
    - Inferior tilt – most evenly distributes forces across baseplate; superior tilt – most uneven
  - Randelli et al. Musculoskeletal Surg 2014
    - 10 degree inferior tilt = reduced dislocation risk
- Anatomic TSA
  - Young et al JBJS 2012
    - 704 TSA for OA; 17% RTC dysfunction at 9 years; Superior tilt associated with secondary cuff dysfunction
  - Walch et al JBJS 2012
    - 518 TSA; 3 patterns of loosening; superior tilt associated with sup tilt on immediate postop

Preoperative Glenoid Anatomy – Classification Systems

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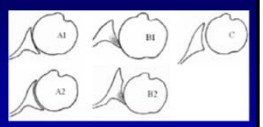
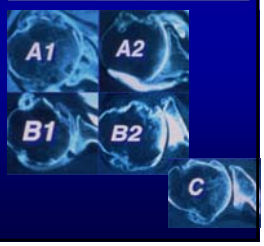
Walch Classification

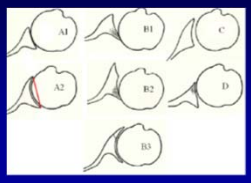
- J Arthroplasty 1999 – Primary OA
- Based upon humeral subluxation
  - A – no subluxation/centered (A1 – minor, A2 – severe)
  - B – posterior subluxation (B1 – no bony erosion, B2 – poserior erosion/ biconcave)
  - C- dysplastic; >25 degrees of retroversion not cause by erosion
- PROBLEM – fair inter-rater reliability (Scalise et al JSES 2008)

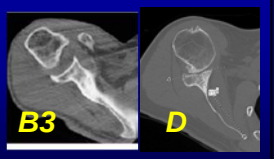




B3, D

- Bercik, Walch JSES 2016
  - B3 – monoconcave; posteriorly worn w/ atleast 15 degrees of retroversion or 70% subluxation or both
  - D – glenoid anteversion or humeral head subluxation < 40% (anterior subluxation)
  - IRR - .39 (fair) to .7 (substantial) comparing original to updated
- Chan,Walch, Athwal JSES 2017
  - 42 B3 glenoids; 3D CT
  - 24 degrees retro; 8 degrees inclined; 80% subluxed on scapula
  - Uniconcave, retroverted
  - As retro increases-sublux increases





Clinical application of 2D version

- Walch et al. Results of anatomic nonconstrained prosthesis in primary osteoarthritis with biconcave glenoid. JSES 2012;21:1526-33.
  - Ave 6.5 years postoperative from TSA with reaming
  - 16% revision; 20% loose glenoids
  - 50% glenoid loosening w/ intermediate version >30
  - 11% posterior dislocation if sublux ratio >80

Higher failure rate of anatomic with B2 or B3

Consider BIORSA, Augmented Anatomic Glenoid in cases of B2/B3 - intermediate version >27; scapula subluxation >70

Sirveaux Classification

- Sirveaux et al. JBJS Br 2004
- Classification of CTA – glenoid erosion pattern
- Kappe et al JSES 2011
  - Best among available schemes

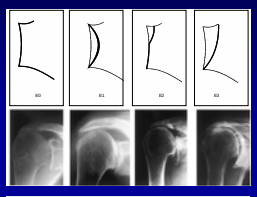
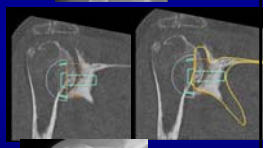


Table IV Sirveaux classification

Type	Description
E0	Upward migration of humeral head without erosion of glenoid
E1	Concentric erosion of glenoid
E2	Erosion of superior part of glenoid
E3	Erosion extends to inferior part of glenoid

Clinical Application Sirveaux Classification

- Importance
  - 1.) Baseplate positioning – avoid superior tilt
  - 2.)Requirement for grafting
    - E0 – no
    - E1 – central
    - E2 – sometimes superior
    - E3 – superior central
- Sirveaux et al JBJS Br 2003
  - 80 RSA
  - Greater notching in E2,E3 compared to E0,E1



Conclusions

- Accurate assessment of glenoid preoperative anatomy→measurements and classifications
  - Xrays only if minimal erosion; MRI if cuff symptoms or weak if primary OA
  - 2D CT for mod/severe erosion; consider 3D w/planning
- Primary OA
  - Intermediate Version –
    - if correct within 15 retro then TSA with reaming
    - Version > 25 to 30 – augmented anatomic or BIORSA
  - Inclination – Beta angle – 75 to 80; neutral on true AP
  - Walch A1, B1 – standard TSA; A2, B2, B3 –Augmented anatomic or BIORSA

Conclusions

- Cuff arthropathy
  - Intermediate version – unclear optimal; attempt to correct to neutral to 10 retro
  - Inclination – 10 degree inferior tilt on true AP; beta angle 85 to 90
  - Sirveaux – E0/1 – standard baseplate; E2/3 – consider bone graft/lateralized sphere

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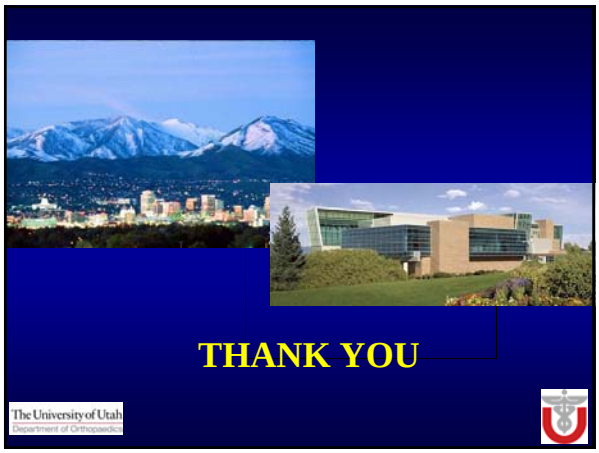
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