Management of Glenoid and Humeral Bone Loss in Shoulder Instability

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GOALS of Shoulder Replacement

Relieve pain

Improve motion

Improve function
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**How Can We Achieve GOALS?**

Exposure

**Anatomic Reconstruction**

Restore G-H Relationships

Fixation

**Anatomic Reconstruction**

- Understand the *normal* proximal humerus anatomy
- Use a prosthetic system that *adapts* to the patient’s anatomy

**Surface Arc**

Surface arc = \(180 - 360\arcsin(1-\text{HH/RC})/\pi\)

\[
\text{HH : RC} = 75 \pm 0.4
\]

Surface Arc = 150° ± 5°
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**Articular Surface**

Diameter of Head
- Variable
- 36.5mm to 51.7mm

Thickness of Head (Head Height)
- Variable
- 12mm to 18mm

Math:
50 mm Diameter = 25 mm Radius
25 x .75 = 19 mm
HHeight = 19 mm

Surface arc = 180 - 360 arcsin(1-HH/RC)

**Head Size**

Ratio of Head Height and Radius of Curvature = .75

**Orientation of Articular Surface**

**INCLINATION**

Variable
114° - 147° (mean:130°)

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### Orientation of Articular Surface

**RETROVERSION**
- Variable
- 6.5° - 47.5° (mean 17.9°)

### OFFSET of the Humeral Articular Surface

- **Medial Offset**
  - Range: 2.9mm to 10.6mm
  - Mean: 6.9mm
- **Posterior Offset**
  - Range: -0.8mm to 6.1mm
  - Mean: 2.6mm

### Humeral Anatomy

**VARIABLE**
- Inclination
- Retroversion
- Medial Offset
- Posterior Offset

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FIXED

RATIO:
Diameter of Curvature
Humeral Head Height
(Thickness)

HH : RC = .75 ± 0.4

The Goal Achieved:
Bilateral Total Shoulder Replacements

Humeral Component
Evolution?

Should We Change Anything?

Survivorship of the humeral component in shoulder arthroplasty

1584 Shoulder Arthroplasties → Neer and Cofield
- 108 revisions
- Survival 94.8% at 5 years
- Younger age, male gender, replacement for posttraumatic arthritis, uncemented components increased likelihood of component failure

Long Stem

Long-stemmed humeral components in primary shoulder arthroplasty

27 Shoulder Arthroplasties
- 9 year follow up
- 70% satisfaction, Constant score 57 points
- No complications
- 22 (69%) radiolucency, 12 (32%) endosteal erosion, 7 (19%) at risk for loosening.

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Radiographic survival in total shoulder arthroplasty

Humeral Stem: 3% “At Risk” for Loosening
No Revisions for Loosening

Cranial Migration of Humerus:
Total: 69%
37% Mild
44% Moderate
19% Severe
No difference in outcomes

Results of Cemented Total Shoulder Replacement with a Minimum Follow-up of Ten Years

Humeral Stem: No Loosening

Short Stem Implants

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Total Shoulder Arthroplasty Utilizing Mini-Stem Humeral Components: Technique and Short-Term Results

Biomet Mini Stem - First 49 cases 67yo (46-83) 2 yr fu
TSA Uncemented Stems 52-66mm Length
UCLA 27.5  Constant 91
11/49 1mm radiolucent line. No subsidence. 5/49 placed in varus

Early-Term Results of Total Shoulder Arthroplasty Utilizing a Mini-Stem Humeral Component
Dines et al 2013 AAOS(Paper 573)
100 Patients. Age 67.8 (46-87). F/u 3.6 years (2 to 5.3).
The stems range from 79 to 83 mm. UCLA 27.5 Constant 91
3 reoperations (Anterior Instability(subscap rupture), Posterior Instability, infection)
8% RLL <1mm, < 3 Zones

Stemless Implants

Does size matter?

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Why Consider Short Stems

– Decrease Intraoperative Humerus Fractures (1.5%)

– Decrease Postoperative Humerus Fractures (2.3%)

– Potential Bone Preservation

– Easier Revision

Importance... Periprosthetic Fractures Associated with Primary Total Shoulder Arthroplasty and Primary Humeral Head Replacement

A Thirty-three-Year Study

Surgically challenging with less optimal outcomes

Other Long Term Concerns

– Proximal Humerus Bone Loss (Stress Shielding)

– Humeral Stem Loosening

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Revising the “Well-fixed” Stem

Can Lead to Limited Recon Options

LGN Cisternos JSES 2015

Why Less May Be More?

“Stemless arthroplasty arose from a desire to avoid stem-related complications, provide ease of revision, and maintenance of optimal bone quality in revision operations.”

What we are not talking about...

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Conclusions

• 40 revision shoulder arthroplasties performed
  • 17 from stemmed arthroplasties
  • 23 from surface replacement arthroplasties

• Stemmed Arthroplasty Revision Group:
  • Higher operative time
  • Increased Need for humeral osteotomy
  • Increased Need for structural allograft
  • Increased number of intraoperative fractures

• Higher Constant Score in the Surface Replacement Group

• STEM DOES MATTER!

Conclusions

• 26/427 patients with creation of a humeral window
  • No malunion or loosening

• BUT HOW DO THESE PATIENTS DO CLINICALLY?

Other considerations

• Implant Stability

• Ease of Implantation

• Clinically different?

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Stress Shielding

Computer Modeling Study
- 3 Reconstructed (standard, short, stemless) finite element models from CT
- Quantified average bone stress
- Short stem and standard had significantly reduced stress compared to the normal humerus and stemless models (p<0.001)

Putting it all together
- Less Proximal Bone Loss
- Osseointegration is satisfactory
- Stress Shielding Improved
- Revision may be easier
- OUTCOMES?

Stem-less Humeral Arthroplasty

>10,000 ECLIPSE implanted (Europe 05, Canada 09)
NOT Available in USA

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Eclipse

Level IV Case Series
- 78 patients
- Mean age 58
- 72 month f/u

Outcomes
- Constant score 38% to 75.3% (p<0.001)
- Improved ROM
- No change in outcome depending on bone quality
- No change in outcome hemi vs. total??
- 12.8% complication rate
- Revision Rate 9% (None for loosening)

Conclusion:
- Function and radiographic results equal to 3rd and 4th generation stems
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Convertability?

Prosthetic Head = Patient's Anatomy

Key: Fixed ratio between radius of curvature and head height

Does the length matter?

Increasing use of short stems or stem-less will continue…

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Future

✓ Is there an ideal patient for stemless vs short stem?

✓ How does this alter revision?

✓ What do we do with our younger high-demand?

✓ Reverse short stem / stemless?

Thank you!

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