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Reverse with Humeral Bone Loss Implant or Bone Graft



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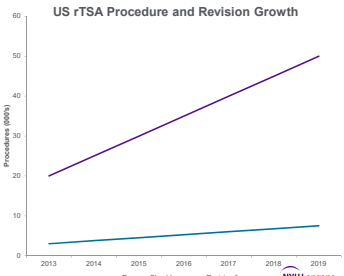
Disclosure

- I receive royalties from Exactech for design of a shoulder arthroplasty system
- I serve on the Boards/Advisory Boards of Hip Innovation Technology, J3 Personica, Gold Humanism Foundation, Apostherapy and the Musculoskeletal Transplant Foundation

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A growing number of revisions...

- rTSA procedures continue to grow
- Future will see substantial increases of revisions with humeral bone loss with as many as 10k cases by 2019.



US rTSA Procedure and Revision Growth

Year	Reverse Shoulders (000s)	Revision* (000s)
2013	~20	~2
2014	~25	~3
2015	~30	~4
2016	~35	~5
2017	~40	~6
2018	~45	~7
2019	~50	~8

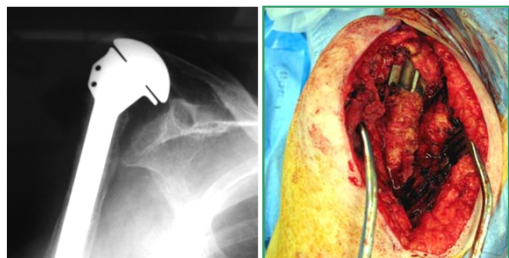
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Proximal Humeral Bone Deficiency

- Revision procedures with stem removal
- Tuberosity resorption/failed healing
- Fx Deformity
- Tumor Resections
- EHS (Exploding Humerus Syndrome)
(Both Planned or Unplanned)

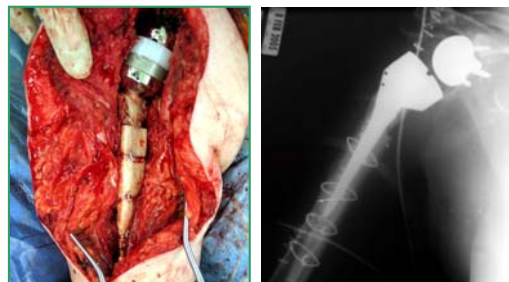


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Bone Loss

- Primarily in revision cases
- Important for restoration of length and lateral offset (deltoid function)
- Essential for stability

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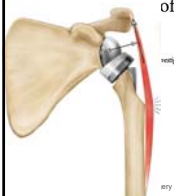
Is the tuberosity important?

11/17 (65%) dislocation cases had no tuberosities

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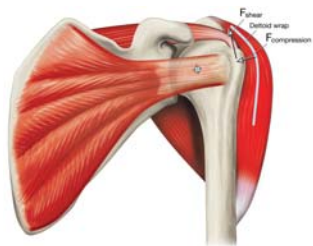
Reverse Shoulder Arthroplasty for the Treatment of Nonunions of the Surgical Neck of the Proximal Part of the Humerus (Type-3 Fracture Sequelae)

Patric Raiss, MD, T. Bradlee Edwards, MD, Manuel Ribesin de Silva, MD, Thomas Bruckner, PhD, Markus Lorenz, MD, and Gilles Wildi, MD
Investigation performed at the Centre Orthopédique Saint-Lyon, France, and the Klinik für Orthopädie und Unfallchirurgie, Universität Heidelberg, Germany





Deltoid wrapping improves joint stability

- Middle deltoid wraps around the greater tuberosity; wrapping causes compression and enhances joint stability.



The Choice

Bone graft
vs.
Implant



Sanchez-Sotelo (2017)

Frankle (2009)

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Basic Assumption: JDZ

- Bone loss is better addressed with implants than bone grafting.... with some exceptions*

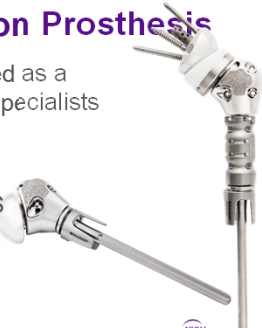
* Lessons learned from the experience with THR and TKR

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Humeral Reconstruction Prosthesis

- Platform revision system designed as a collaboration between shoulder specialists and oncologists
- rTSA prosthesis for use in the US for proximal humeral bone loss.
- First case 9/30/15
- >315 cases performed to date



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Humeral Reconstruction Prosthesis

- **Proximal Body Design:** Multiple sizes of proximal bodies available (XS, S, M, L, XL) to facilitate restoration of anatomic muscle wrapping to restore proximal humeral anatomy.

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Humeral Reconstruction Prosthesis

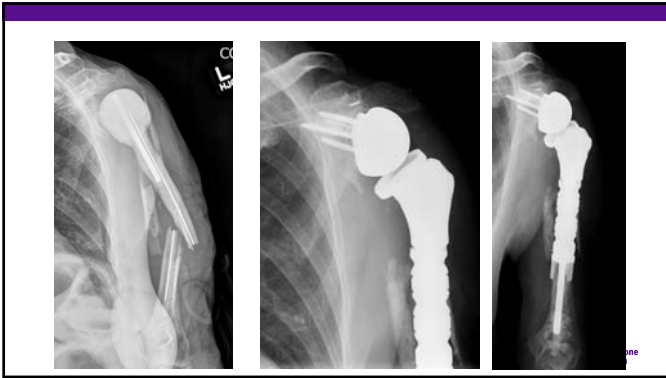
- **Proximal Body Design:** offers an alternative to tension the joint rather than the conventional method of building in the plane of the humeral head (does not lateralize and distalize).

+0mm +5mm +10mm +15mm

Humeral Reconstruction Prosthesis

- Modular proximal bodies and middle segments permit buildup in 12.5mm increments- 50 to 222.55 mm

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3 Ways to Achieve Joint Stability

Deltoid Wrap Proximal Bodies	Soft Tissue Attachment Infraspinatus A challenge at best	Constrained Liner/Lateral Glenosphere Constrained Liner
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The Implant – Bone Interface

- High stress/torque area
- Potential site of loosening → failure

A diagram of a shoulder implant stem. A purple arrow points to the interface between the stem and the bone, indicating a high stress/torque area and a potential site of loosening leading to failure.

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Design features for rotational stability

Cemented stem: resists flexion/extension and vargus/valgus forces

Collar mates with stem and bone: HA coating, large forces on all planes neutralized

Moment arm with collar

Moment arm without collar

Humeral Reconstruction Prosthesis

- Diaphyseal Collars:** Provided in 17.5 to 33.5mm diameters with a 1mm offset based upon the results of an anatomic study of 75 male/female humeri.

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Glenohumeral Anatomic Study
A Comparison of Male and Female Shoulders with Similar Average Age and BMI

Figures: Dual Offset Types of the Combined Distal Stem-Collar Offset Distal Stem (bottom) and Offset Diaphyseal Collar (right)

Figures: Multiple Dual Offset Combinations of Stem and Collar

Humeral Reconstruction Prosthesis

- Diaphyseal Collars:** Bench testing with collars demonstrated >350% torsional resistance in torque-to-initial slip and max torque-to-failure compared to a distally cemented stem without a collar.

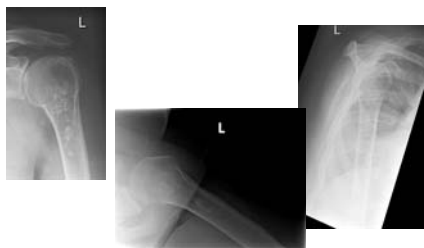
Improving Distal Fixation with Total Shoulder Arthroplasty in Cases of Severe Humeral Bone Loss

Amanda Jacobson, B.S., Nick Stroud, M.S., and Christopher P. Roche, M.S., M.B.A.

Table 3 The torque to initiate slipping and the Peak Torque for the Humeral Reconstruction Prosthesis and the Cemented Humeral Long Stem

Sample	Humeral Reconstruction Prosthesis		Cemented Humeral Long Stem	
	Torque to Initiate Slipping (Nm)	Maximum Torque (Nm)	Torque to Initiate Slipping (Nm)	Maximum Torque (Nm)
1	22.8	48.3	14.0	14.0
2	34.3	49.4	5.1	7.0
3	24.2	39.0	10.0	12.5
4	33.7	45.4	3.1	10.4
5	29.4	39.2	2.8	18.8
Average	29.4 ± 5.9	44.3 ± 5.0	6.2 ± 4.1	12.1 ± 6.7
P-value (comparisons of stems)	0.0002	< 0.0001	0.0002	< 0.0001

65 year old with chondrosarcoma



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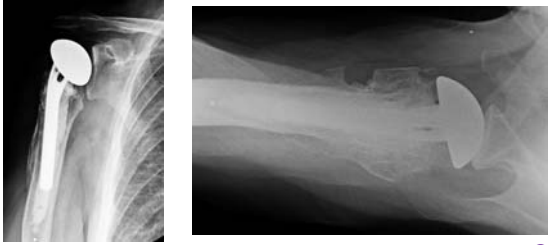




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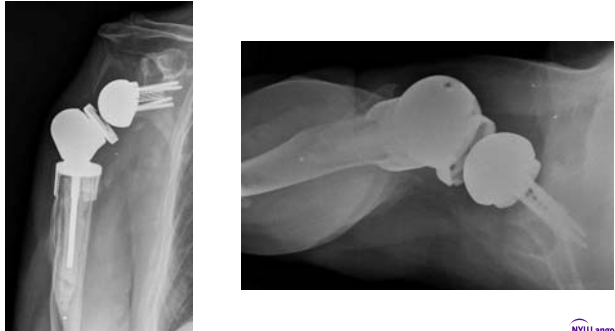


Cemented non-platform Hemi for Fx



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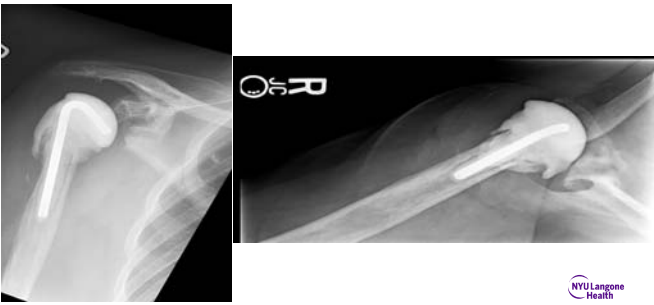


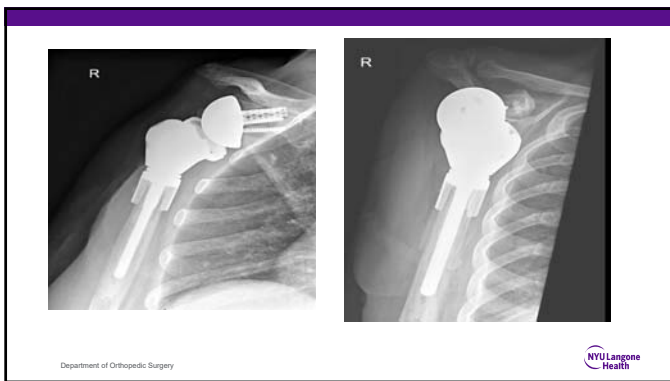


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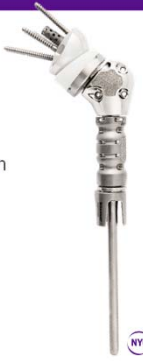
64 year-old with spacer after infection





Summary

- Humeral bone loss is a challenging problem
- High risk for instability
- Reconstruction must restore length and tension
- Options are bone vs. implant
- Long term outcomes remain a concern



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