



## Avoiding Scapular Notching

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## Problem or Complication?

- PROBLEM-intraoperative or postoperative event *not likely to affect the patient's final outcome*
- COMPLICATION-intraoperative or postoperative event *likely to have a negative influence on the patient's final outcome*

Zumstein et al JSES 2011



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## Scapular Notching

- 50% of Grammont design
- Boileau, et al 2006 JSES
  - "Glenoid notching is a documented feature of the Delta 3 prosthesis..."
- Zumstein, et al JSES 2011
  - most common postoperative problem
- Occurs early and often progresses





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## Factors

- Scapular anatomy
- Implant design
- Implant position

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## Patient Anatomic Factors

- Scapular neck anatomy
- Glenoid bone deficiency (superior)
- Body habitus-

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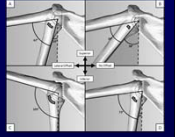
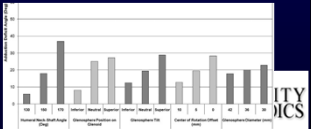
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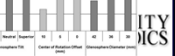
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## Adduction Deficit

- Gutierrez, et al JBJS-A 2008; CORR 2008
- Hierarchy for adduction deficit
  - Lower humeral neck-shaft angle (130°)
  - Inferior glenosphere position
  - Lateral offset of the center of rotation
  - Inferior glenosphere tilt
  - Larger diameter glenosphere size

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## Glenoid Technique

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## Glenoid Position

- Nyffeler, et al JSES 2005
- Inferior placement greatest effect on decreasing adduction deficit

	A (n = 5)	B (n = 8)	C (n = 8)	D (n = 8)
Abduction (°)				
Scapular plane	67 (56 to 78)	68 (55 to 82)	81 (70 to 90)	75 (68 to 82)
30° posterior	58 (48 to 74)	56 (35 to 74)	66 (48 to 85)	61 (50 to 80)
90° anterior	39 (23 to 46)	48 (25 to 46)	43 (24 to 55)	46 (35 to 52)
Adduction (°)				
Scapular plane	-25 (-20 to -30)	-14 (-7 to -22)	-1 (0 to -5)	-9 (0 to -12)
30° posterior	-30 (-20 to -46)	-18 (-5 to -30)	-6 (0 to -18)	-15 (-5 to -22)
90° anterior	-30 (-22 to -46)	-19 (-12 to -32)	-8 (0 to -8)	-11 (0 to -15)

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## Glenoid Lateralization

- Hettrich et al. JSES 2015
- Finite element contact-Tornier Aequalis reverse
- Glenosphere lateralization increases impingement free range of motion in adduction

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### Reverse Shoulder Arthroplasty for the Treatment of Rotator Cuff Deficiency

JBJS-A 2012  
A Concise Follow-up, at a Minimum of Five Years, of a Previous Report\*

Derek Cuff, MD, Rachel Clark, BA, CCRC, Derek Pupello, MBA, and Mark Frankle, MD

- Metal Lateralization- 9% notching



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### Bony Increased-offset Reversed Shoulder Arthroplasty

Minimizing Scapular Impingement While Maximizing Glenoid Fixation

Pascal Boileau MD, Grégory Moineau MD, Yannick Roussanne MD, Kieran O'Shea FRCSI


CORR 2012

- Scapular notching in 19%
- Grade 1 in 5, Grade 2 in 2, Grade 3 in 1

#### Does bony increased-offset reverse shoulder arthroplasty decrease scapular notching?

JSES 2015  
George S. Athwal, MD, FRCS\*, Joy C. MacDermid, PhD, K. Murali Reddy, MD, FRACS, Jonathan P. Marsh, MD, FRCS, Kenneth J. Faber, MD, MHPE, FRCS, Darren Drosdowech, MD, FRCS

- Standard RSA=75% vs BIO-RSA =40%
- BIO-RSA- grade 1 in 7, grade 2 in 1, no grade 3 or 4



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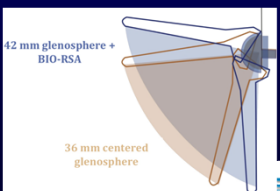
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### Glenosphere Size

- Berhouet et al- JSES 2014- Grammont design
  - Larger glenosphere diameter and lateralization increase impingement free abduction and adduction



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## Inferior Tilt

- No clinical effect on decreasing notching
  - Edwards, et al JSES 2012- Level I RCT
  - Kempton, et al JSES 2011- Level III retrospective case control

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## Humeral Inclination

- Lädermann, et al Int Orthop 2015
  - 3-D computer model compared in-lay Grammont stem to onlay stem with different inclinations (155°, 145°, 135°).
  - 135° model improved adduction by 28°
  - ER and extension lead to friction between the scapular pillar and the polyethylene insert which likely contributes to progressive polyethylene wear and scapular notching.
  - lower inclination angle = greater ER at the side and extension.

	In-lay Grammont	On-lay 145°	In-lay 135°
Adduction deficit	33.4°	5.9°	0°

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## Humeral Version

- Berhouet, et al- Ortho Trauma: Surg Research 2013
  - Aequalis reverse (Grammont style) 40 cadaver shoulders
  - 8 combinations of glenosphere
  - Humeral component position was evaluated with 0°, 10°, 20°, 30°, and 40° of retroversion.
  - Increased retroversion decreases IR and increases ER
  - Native retroversion gave best balance between rotation ROMs

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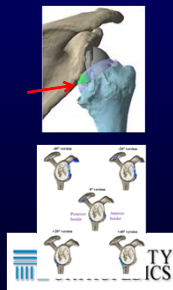
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## Humeral Version

- Kontaxis, et al- JSES 2017
  - Impingement free ROM in standard ROMs and ADLs in simulated RSA in 30 pathologic subjects
  - Maximizing ROM in standardized tests may not reduce the risk of impingement during ADLs maximum



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## Use of Patient-Specific Bony Anatomy, Implant Location and Shoulder Motion in Predicting Scapular Notching following Reverse Total Shoulder Arthroplasty- Ricchetti, et al

- Grammont design- 29 subjects
- Video motion analysis and CT used to determine areas of bony impingement and their relationship to scapular notching on post-operative CT.
- 17 patients (59%) had scapular notching; all along the postero-inferior scapular neck and 3 along the antero-inferior neck.
- Bony impingement
  - ER with arm at the side in 16/17 patients,
  - IR with arm at the side in 3/17 patients
  - Adduction in 12/17 patients.
- Impingement avoided by inferior or lateral position (mean 6.2±1.4 mm)
- Notching associated with insufficient inferior or posterior glenosphere placement




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## 3D Planning and PSI

- Levy, et al JSES 2014
  - In vitro cadaver study
  - PSI to implant baseplate; accurate at reproducing 3D plan
- Heylen, et al JSES 2016
  - 24 patients undergoing RSA
  - 12 w/ standard instruments; 12 w/ PSI
  - Larger std. dev of inclination in non-PSI
  - Extreme postop inclination angles less likely with PSI



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### Computer Assisted Pre-Op Planning

Bony Impingement Identification

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### Avoiding Scapular Notching

- Potentially avoidable sequelae of reverse shoulder arthroplasty
- If ignored can be a complication
- Pre-operative planning
- Operative strategy
  - Lower angle humeral socket
  - Inferior glenosphere placement
  - Lateralize glenosphere
  - Avoid excessive humeral retroversion

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### Is Notching a Complication?

- Time will tell
  - Younger more active patients
  - Polyethylene wear and osteolysis
  - Compromise baseplate fixation?
  - Humeral loosening?

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Thank You



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