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New England Shoulder and Elbow Center

Evolution and Biomechanics into the Modern Reverse Shoulder Arthroplasty

8/18/2020

PRO SPORTS ORTHOPEDICS

Sarav S. Shah MD
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New England Baptist Hospital Boston, MA USA
Merrimack College, Team Physician
Brandeis University, Team Physician

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Quick Introduction: Dr. Shah

TRAINING

HOSPITAL FOR SPECIAL SURGERY
Fellow, Shoulder/Elbow Arthroscopic and Reconstructive Surgery

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Fellow, Orthopaedic Sports Medicine

HOFSTRA NORTHWELL SCHOOL OF MEDICINE
Resident, Department of Orthopaedic Surgery

EDUCATION

DREXEL UNIVERSITY COLLEGE OF MEDICINE (M.D.)

VILLANOVA UNIVERSITY (B.S. Biology)
B.S/M.D. Combined 7-year accelerated program

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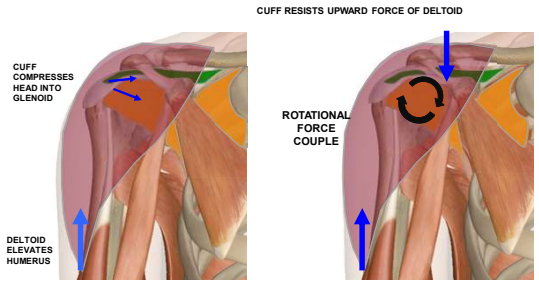
Normal Biomechanics



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The Problem:
Cuff Tear Arthropathy

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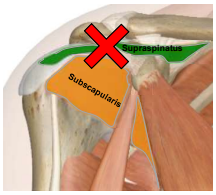
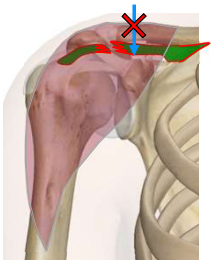
Loss of Force Nucleus

NEER 1983
"….AS THE INITIAL EVENT IN THE DEVELOPMENT OF DEGENERATIVE ARTHRITIS…."





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Cuff-Tear Arthropathy*

BY CHARLES S. NEER, II, M.D.†, EDWARD V. CRAIG, M.D.†, AND HIROAKI FUKUDA, M.D.†, NEW YORK, N.Y.

Destruction of Closed Joint Space

- Loss of Negative Pressure
- Synovial Fluid Escape
- Cartilage Atrophy
- Subchondral Collapse

Pathology Includes:

- Instability
- Superior Head Displacement
- Arthrosis
- Loss of Motion and Strength
- Pseudoparalysis

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Treatment Options for Cuff Tear Arthropathy (CTA) Prior to Reverse Total Shoulder (RSA)

- NON-OPERATIVE
- ARTHRODESIS
- RESECTION ARTHROPLASTY
- TSA/HEMIARTHROPLASTY

HIGH COMPLICATION AND FAILURE RATE
HIGH PATIENT DISSATISFACTION

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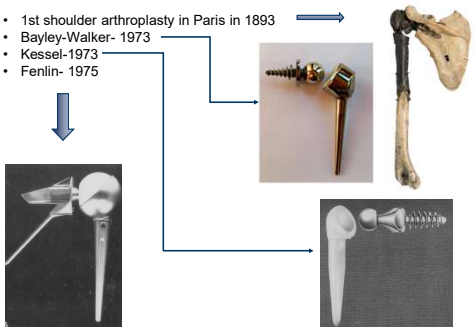
Historical Overview

- 1st shoulder arthroplasty in Paris in 1893
- Bayley-Walker- 1973
- Kessel-1973
- Fenlin- 1975



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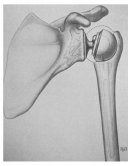
Historical Overview

Neer 1973-1981
Outcomes poorer when the rotator cuff was not functional

Dislocation and scapular fixation remained a concern with this implant

Neer Mark I



Neer Mark III

Neer CS 2nd, Watson KC, Stanton FJ. J Bone Joint Surg Am. 1982 Mar;64(3):319-37. Recent experience in total shoulder replacement.
Neer CS 2nd, Craig EV, Fukuda H. J Bone Joint Surg Am. 983 Dec;65(9):1232-44. Cuff-tear arthropathy.

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Grammont Reverse Shoulder Prosthesis

Paul Grammont- revolutionized shoulder arthroplasty

1. Prosthesis inherently stable
2. Weightbearing part convex, and supported part concave
3. Center of Glenosphere at or within the glenoid neck
4. Center of rotation medialized and distalized
   1. Increased Middle Deltoid Lever Arm

1991-Delta III (Second Generation)

***2003 FDA APPROVAL of RSA IN U.S.

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BIOMECHANICS OF REVERSE TSA

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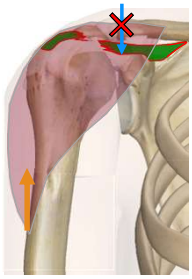
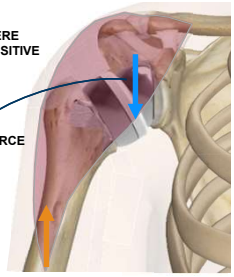
RSA BIOMECHANICS



GLENOSPHERE PROVIDES A POSITIVE STOP

RESTORE FORCE COUPLE



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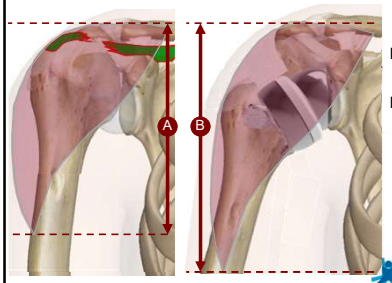
RSA 2 Main Functions



RESTORE STABILITY

RESTORE FUNCTION

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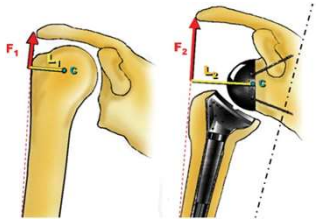
Biomechanical Effects of RSA



- The lever arm distance (L) is increased and deltoid force (F) is increased by inferiorizing and medializing the center of rotation
- Restoration of scapular abduction
  - Torque (F x L) in abducting the arm is increased
  - Deltoid tension increased

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Lessons learned using the Grammont style prosthesis have led to New Designs

- Glenosphere lateral offset
- Neck-Shaft Angle
- Glenosphere Baseplate Positioning
- Onlay Humerus humeral-based lateralization (LH)
- Glenosphere eccentricity

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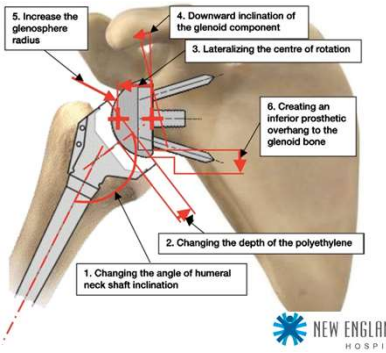
Parameters in Modern RSA



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RSA Biomechanical Considerations

- Deltoid Tension/Function
- Center of Rotation (COR)/Lateral Offset
- Glenosphere Baseplate Positioning
- Neck-Shaft Angle
- Stability
- Onlay Humerus

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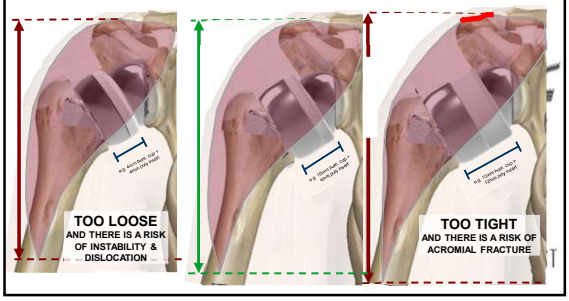
DELTOID TENSIONING

CRUCIAL TO RESTORING ACTIVE ELEVATION AND IMPLANT STABILITY...



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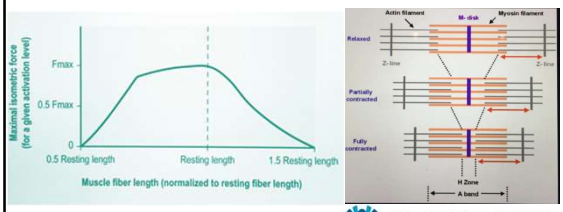
BLIX LENGTH-TENSION CURVE

OPTIMAL TENSION OF THE SARCOMERE



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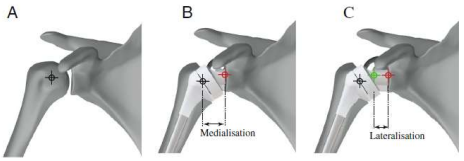
Center of Rotation



A. Black bull's-eye indicate joint center of rotation position for anatomical shoulder
B. Red bull's-eye indicate joint center of rotation position for reverse shoulder
C. Green bull's-eye indicate joint center of rotation position for reverse shoulder with lateral-offset design

Ackland DC, Patel M, Knox D. Prosthesis design and placement in reverse total shoulder arthroplasty. *J Orthop Surg Res.* 2015;10:101.

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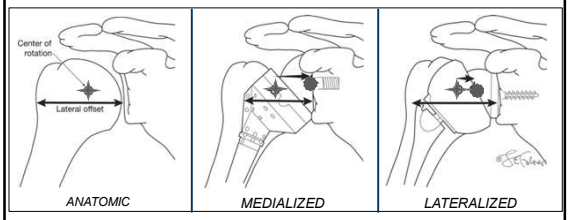
Lateral Offset/Center of Rotation



COR on a Lateralized Design is medial to Anatomic COR

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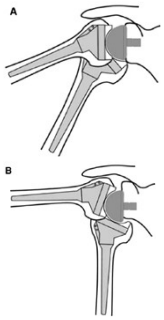
Inferior Baseplate Positioning

•Allows increased space between glenosphere and scapular neck decreasing risk of scapular notching

**Computer model studies show that shifting the baseplate inferiorly is single most significant factor in mitigating impingement of the scapula
**Confirmed by clinical series (Simovitch et al.)

•Additional clearance between the greater tuberosity and coracoacromial arch allowing greater impingement free ROM in abduction



- Gutierrez S, Levy JC, Frankle MA, Cuff D, Keller TS, Pupello DR, et al. Evaluation of abduction range of motion and avoidance of inferior scapular impingement in a reverse shoulder model. J Shoulder Elbow Surg. 2008;17(4):608–15.
- Simovitch RW, Zumstein MA, Lohri E, Helmy N, Gerber C. Predictors of scapular notching in patients managed with the Delta III reverse total shoulder replacement. J Bone Joint Surg Am. 2007;89(3):588-600.

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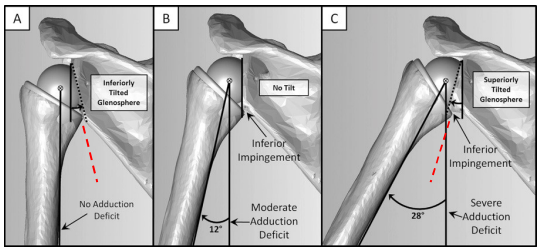
Tilt of Baseplate



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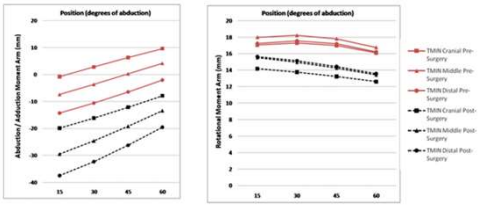
Medialization of Center of Rotation



•Slackens intact rotator cuff musculature and decreases their moment arms decreasing their effectiveness
•Studies have shown up to a 36% decrease in the moment arms of intact rotator cuff musculature.

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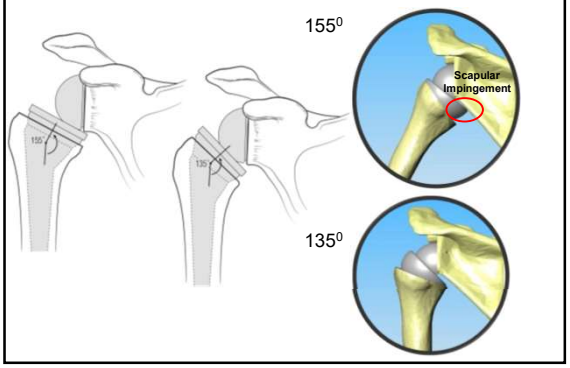
Neck-Shaft Angle



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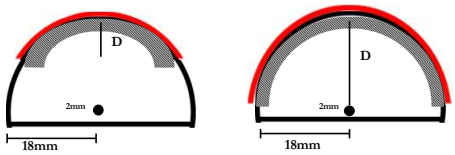
PROSTHETIC CONSTRAINT



STABILITY IS INCREASED WITH A **DEEPER SOCKET**

DEPTH/RADIUS RATIO

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Static/Dynamic Stability

- Static Stability through implant contour
  - –Unequal radius of curvature of physiologic glenoid and humeral head leads to increased range of impingement free motion and increased instability
- Grammont's reverse prosthesis was designed with equal radii of curvature
- Dynamic Stability through Deltoid compression (Proper Deltoid tensioning is key)

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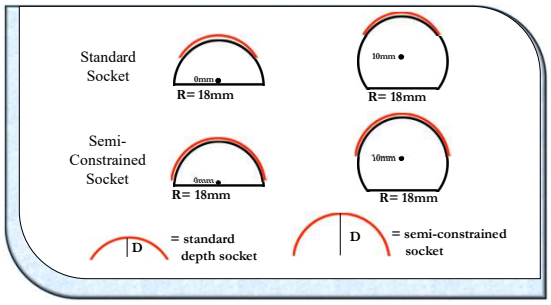
Stability

DEPTH of socket / radius of glenosphere



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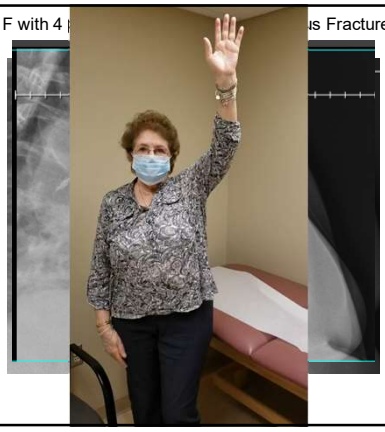
64 M with C

29

75 F with 4



us Fracture

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Complications Post Reverse TSA

Complications Post RSA

1. Scapular Notching (SN)***
2. Instability***
3. Acromial/Scapular Spine stress fractures***
4. Periprosthetic Infection (PJI)
5. Mechanical Failure (MF) (glenoid and humeral component)
6. Neurologic Injury (NI)
7. Fracture (Glenoid or Humerus)
8. Deltoid Injury
9. Algodystrophy
10. Hematoma
11. Heterotopic Ossification

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Problems, complications, reoperations, and revisions in reverse total shoulder arthroplasty: A systematic review

JOURNAL OF SHOULDER AND ELBOW SURGERY

Matthias A. Zumstein, MD[a,b], Miguel Pinedo, MD[a,d], Jason Old, MD, FRCSC[a,c], Pascal Boileau, MD[a,*]

2011

- Global problem rate of 44% and a complication rate of 24%
  - Notching- 35%
  - Instability- 4.7%
  - Infection- 3.8%

Reoperation Rate: 3.3% and Revision rate: 10.1%

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Modern RSA

- Majority of published studies on RSA have historically reported on a Grammont-style RSA [glenosphere with medialized center of rotation (MG) and inlay humeral component that medializes the humerus (MH)]
- Lessons learned using this style of prosthesis have led to the introduction of new designs with multiple options
  - glenosphere lateral offset and eccentricity,
  - different neck-shaft angulations,
  - humeral-based lateralization (LH)
- These design modifications translate into different biomechanics compared to the first generation of RSA.

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Primary reverse shoulder arthroplasty using contemporary implants is associated with very low reoperation rates

JOURNAL OF SHOULDER AND ELBOW SURGERY

Jason R. Kang, MD, Matthew J. Dubiel, MD, Robert H. Cofield, MD, Scott P. Steinmann, MD, Bassem T. Elhassan, MD, Mark E. Morrey, MD, John W. Sperling, MD, Joaquin Sanchez-Sotelo, MD, PhD*

2019

- Primary RSA performed with contemporary implants and surgical techniques seems to be associated with a very low rate of reoperation (2.37%)
- The most common reasons for reoperation were humeral component fracture for 1 particular implant, humeral loosening, dislocation, infection, and glenoid failure, each occurring at a rate under 1%.

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Prosthesis Design

Prosthesis design

•Center of rotation (CoR) and prosthesis design (defined according to Routman et al.
- Glenosphere with a CoR of ≤5mm to the glenoid face is considered a medialized glenoid (MG)
- Glenosphere with a CoR >5mm lateral to the glenoid face is considered a lateralized glenoid (LG)

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Neck Shaft Angle

**Many newer designs allow a 145 or 147 Neck Shaft Angle

135

- Pros/Cons
  - Lower incidence of scapular notching
  - Potential for decreased stability in Internal Rotation (IR)
  - Increased ER at side
  - Potential limitation of ER in 90 degrees ABduction

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- Pros/Cons
  - Functionally lengthens the deltoid improving ability to perform forward elevation & ABduction based tasks w/o an intact rotator cuff
  - Decreases the external rotation (ER) moment arms of the teres minor and posterior deltoid, resulting in reduced ER with the arm at the side

ER with the arm abducted at 90 is a major factor in the ability to perform activities of daily living (ADL) such as hair care and facial grooming
----In a computer model, the 135-model led to a substantial limitation of ER in abduction
----Only the 145-model maintained ER in abduction

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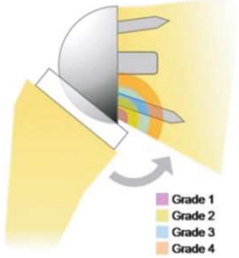
Scapular Notching Post Reverse TSA



Nerot Sirveaux's classification of inferior scapular notching

- Mollon et al. found significantly lower postoperative scores on the Shoulder Pain and Disability Index and Constant-Murley with SN vs no notching
- Patients with SN were found to have significantly lower active abduction/forward flexion, less strength, and significant higher complication rates

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Scapular Notching Post Reverse TSA

	Studies Included	Shoulders	Scapular Notching Present	Rate (Percentage)
Overall	113	8258	2431	29.43% (2431/8258)
Stratified by Grade	94	6898	2086	--
Grade I	-	-	1206	57.81% (1206/2086)
Grade II	-	-	460	22.05% (460/2086)
Grade III	-	-	274	13.13% (274/2086)
Grade IV	-	-	146	7.0% (146/2086)

Table 1. Scapular notching rates overall and stratified by grade. The majority of notches [79.87% (1666/2086)] were classified as low grade (grade 1 or grade 2).

RCT showed to minimize notching is inferior glenosphere overhang > 3.5mm

Glenosphere size, Eccentric placement, and surgical technique are all options to achieve the same goal of inferior overhang to minimize notching

Prothesis Design	Studies Included	Shoulders	Scapular Notching Present	Rate (Percentage)	p-value
LG/MH	15	1002	148	14.8%	0.001 vs MG/LH; 0.91 vs LG/LH; <0.001 vs MG/MH
MG/LH	11	1730	181	10.5%	0.02 vs LG/LH; <0.001 vs MG/MH
LG/LH	5	279	42	15.0%	<0.001 vs MG/MH
Subtotal	31	3011	371	12.3%	<0.001 vs MG/MH
MG/MH	71	4115	1750	42.5%	

Author	Studies Included	Shoulders	Scapular Notching Present	Rate (Percentage)	p-value vs Zumstein et al.
Zumstein et al.	21	782	277	35.4%	-
Current Study	113	8258	2431	29.4%	<0.001
Current Study: Subtotal of Non-Grammont designs	31	3011	371	12.3%	<0.001

Shah SS et al. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication. J Shoulder Elbow Surg Open Access 2020.

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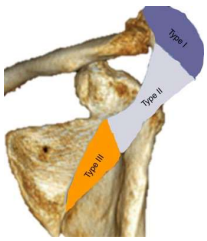
Acromion/Scapular Spine Fracture Post Reverse TSA



Levy classification of Acromion/Scapular Spine Fracture

- Uniformly achieved worse function than during their initial postoperative period with limited active forward elevation, and final clinical outcomes scores are reduced compared with RSA without fracture
- SSFs (Levy type III)- vast amount of deltoid origin is involved with this fracture type, thus heighted concern for non-functional deltoid with potential malunion/non-union

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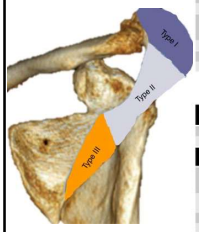
Acromion/Scapular Spine Fracture Post Reverse TSA



	Studies Included	Shoulders	Acromial/Scapular Fx	Rate (Percentage)	p-value
Current Study Overall	120	14235	371	2.6%	0.06
Zumstein et al.	21	782	12	1.5%	
Current Study: Subtotal of non-Grammont designs	30	5420	133	2.5%	0.11 vs vs Zumstein et al.
Stratified by type	116	12688	327	-	-
Acromial Fx	-	-	205	1.6% (205/12688)	-
Scapular Spine Fx	-	-	122	1.0% (122/12688)	-

Primary versus Revision	Studies Included	Shoulders	Acromial/ Scapular Fractures	Rate (Percentage)	p-value
Primary RSA	82	7244	181	2.5%	0.76
Revision RSA	21	707	19	2.7%	-

Prothesis Design	Studies Included	Shoulders	Acromial/ Scapular Fractures	Rate (Percentage)	p-value
LG/MH	16	2534	72	2.8%	0.13 vs MG/LH; 0.18* vs LG/LH; 0.47 vs MG/MH
MG/LH	13	2746	60	2.2%	0.37* vs LG/LH; 0.41 vs MG/MH
LG/LH	3	140	1	0.7%	0.26* vs MG/MH
Subtotal	-	5420	133	2.5%	
MG/MH	45	2817	71	2.5%	

Shah SS et al. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication. J Shoulder Elbow Surg Open Access 2020.

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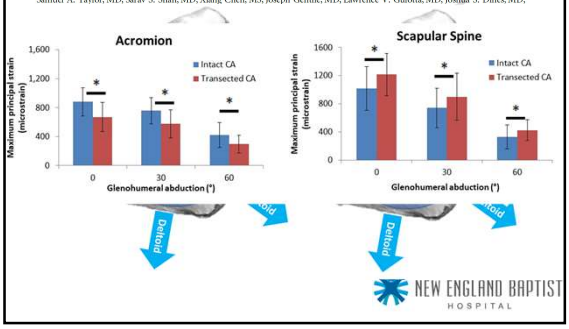
Scapular Ring Preservation

JB&JS

Coracoacromial Ligament Transection Increases Scapular Spine Strains Following Reverse Total Shoulder Arthroplasty

Samuel A. Taylor, MD, Sarav S. Shah, MD, Xiang Chen, MS, Joseph Gentile, MD, Lawrence V. Gulotta, MD, Joshua S. Dines, MD,



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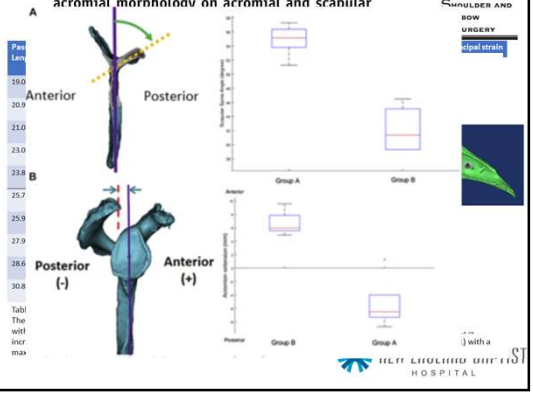
Influence of implant design and parasagittal acromial morphology on acromial and scapular



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Instability Rate Post Reverse TSA

Diagnosis	Studies Included	Shoulders	Instability Present	Rate (Percentage)	p-value
Cuff Tear Arthropathy	15	905	21	2.3%	**0.02 *vs* PHF; <0.001 *vs* FailA**
PHF	36	1654	67	4.1%	**0.03 *vs* FailA**
Failed Arthroplasty	29	1243	72	5.8%	0.62* *vs* Instability Arthropathy
Instability Arthropathy	4	80	3	3.8%	1.00* *vs* PHF; 0.44* *vs* CTA
Prothesis Design	**Studies Included**	**Shoulders**	**Instability Present**	**Rate (Percentage)**	**p-value**
LG/MH	22	1021	20	2.0%	**0.02 *vs* MG/LH**
MG/LH	16	1888	17	0.9%	**0.02 *vs* LG/MH**
LG/LH	1	45	2	4.4%	-
Subtotal	39	2954	39	1.3%	**<0.001 *vs* MG/MH**
MG/MH	73	2932	116	4.0%	
Author	**Studies Included**	**Shoulders**	**Instability Present**	**Rate (Percentage)**	**p-value *vs* Zumstein et al.**
Zumstein et al.	21	782	37	4.7%	
Current Study	137	9303	308	3.3%	**0.04**
Current Study: Subtotal of non-Grammont designs	39	2954	39	1.3%	**<0.001**

Instability rates, especially Modern Non-Grammont designs, have significantly decreased compared to Zumstein et al. (JSES 2011)

Higher Instability rates in LGMH versus MGLH (2.0% v 0.9%; p=0.02)

Shah SS et al. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication. J Shoulder Elbow Surg Open Access 2020.

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Periprosthetic Infection Rate Post Reverse TSA

Primary Versus Revision	Studies Included	Shoulders	Periprosthetic Infection Present	Rate (Percentage)	p-value
Primary RSA	45	3065	73	2.4%	0.73
Revision RSA	20	1331	34	2.6%	
Diagnosis	**Studies Included**	**Shoulders**	**Periprosthetic Infection Present**	**Rate (Percentage)**	**p-value**
Cuff Tear Arthropathy/ Irreparable RCT	29	2575	64	2.4%	0.07 *vs* Acute Fx; 0.30* *vs* Fx Sequelae
Acute Fracture	10	329	3	0.9%	0.07* *vs* Fx Sequelae
Fracture Sequelae	7	161	6	3.7%	-
Author	**Studies Included**	**Shoulders**	**Periprosthetic Infection Present**	**Rate (Percentage)**	**p-value**
Zumstein et al.	21	782	30	3.8%	**0.02**
Current Study	65	4396	107	2.4%	

Higher RSA v TSA infection rate: Factors include increased implant surface, a large subacromial dead space, the compromised general health of patients, and complexity of indications

Higher infection rates in revision surgery compared with primary arthroplasty groups

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Glenoid and Humeral Loosening Rate Post Reverse TSA

	Radiolucent Lines	Loosening	Revision for Loosening
Glenoid Component	7.7% (103 / 1336)	2.3% (89 / 3995)	2.1% (62 / 2908)
Humeral Component	12% (292 / 2419)	1.4% (52 / 3817)	1% (30 / 2920)

Author	Studies Included	Shoulders	Glenoid Radiolucent Lines Present	Rate (Percentage)	p-value
Zumstein et al.	21	782	23	2.9%	**<0.001**
Current Study	12	1336	103	7.7%	

Author	Studies Included	Shoulders	Glenoid Loosening Present	Rate (Percentage)	p-value
Zumstein et al.	21	782	27	3.5%	**0.04**
Current Study	30	3995	89	2.3%	

Author	Studies Included	Shoulders	Humeral Loosening Present	Rate (Percentage)	p-value
Zumstein et al.	21	782	10	1.3%	0.85
Current study	29	3817	52	1.4%	

Addition of locking screw technology, hydroxyapatite coating, and increased size (5 mm) of peripheral screws have significantly reduced the rate of baseplate failure of a specific lateralized RSA design

Modern lower rates may be ascribed to significant advancements in biomaterials

Shah SS et al. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication. J Shoulder Elbow Surg Open Access 2020.

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Incidence of Neurologic Complications Post Reverse TSA

	Studies Included	Shoulders	Neurologic Injury Reported	Rate (Percentage)
Overall	48	4135	23	0.6% (23/4135)
Stratified by Specific Nerve	**Studies Included**	**Shoulders**	**Neurologic Injury Reported**	**Rate (Percentage)**
Axillary Nerve	45	2959	14	-
Musculocutaneous Nerve	-	-	8	57.2% (8/14)
Suprascapular Nerve	-	-	2	14.3% (2/14)
Radial Nerve	-	-	1	7.1% (1/14)
Ulnar Nerve	-	-	2	14.3% (2/14)
			1	7.1% (1/14)
Prothesis Design	**Studies Included**	**Shoulders**	**Neurologic Injury Reported**	**Rate (Percentage)**	**p-value**
LG/MH	-	464	1	0.2%	-
MG/LH	-	269	0	0.0%	-
LG/LH	-	37	0	0.0%	-
Subtotal	12	750	1	0.1%	**0.04*** *vs* MG/MH
MG/MH	31	1425	13	0.9%	-

Author	Studies Included	Shoulders	Neurologic Injury Reported	Rate (Percentage)	p-value
Zumstein et al.	21	782	9	1.2%	0.06
Current Study	48	4135	23	0.6%	
Current Study: Subtotal of Non-Grammont designs	12	750	1	0.1%	**0.02*** *vs* Zumstein et al.

Anatomical studies show that lateralization is less harmful in terms of stretch on the axillary nerve versus distalization

Subclinical neurological injuries by means of intraoperative neuromonitoring or post-operative EMG changes are common post RSA, while the incidence of clinically evident neurologic injury is quite rare

Indirect traction injuries are thought to be the main culprit for these lesions secondary to arm lengthening and/or external rotation during humeral and glenoid preparation

Shah SS et al. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication. J Shoulder Elbow Surg Open Access 2020.

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Modalities for Assessing Glenoid Bone loss

3D Planning Software

- Caution is Warranted
  - Higher inconsistency in version and inclination (primary arthritis cases with either extra glenoid fragments or subtracted glenoid segments) for two software systems (Denard JSESOA 2018)
  - Overall accuracy appears good (same targets), the precision is clearly bad (too much dispersion around the target)
  - In 65% (Automated- Blueprint) and 45% (Manual Landmark-VIP) of cases either inclination or version varied by 5° or more compared to a 3D printed scapula

(Shah et al. "Variability in total shoulder arthroplasty planning software compared to a control CT-derived 3D printed scapula." Shoulder & Elbow. 2019)

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Sarav S Shah, MD 2020 Publications In Press/In Revisions

1. **Shah SS**, Lee S, Mithoefer K. Next-Generation Marrow Stimulation Technology for Cartilage Repair: Basic Science to Clinical Application. In Revisions. JBJS Reviews. 2020
2. **Shah SS**, Mithoefer K. Evolving Developments and Clinical Applications Utilizing Chondrons for Cartilage Repair. In Revisions. Cartilage. 2020
3. Lamplot JD, **Shah SS**, Chan JM, Hancock KJ, Rodeo SA, Allen AA, Williams RJ, Altchek DW, Dines DM, Warren RF, Cordasco FA, Gulotta LV, Dines JS. Arthroscopic-Assisted Coracoclavicular Ligament Reconstruction: Clinical Outcomes and Return to Activity at Mean Six-Year Follow-up. In Revisions. Arthroscopy. 2020
4. Lasceski C, Nacca C, **Shah SS**, Richmond JC. Thoughts on Anterior Cruciate Ligament Surgery over the Past 40 Years: Back to the Future. Journal of Clinical Orthopaedics. 2020; Jan-June;5(1):16-21.
5. **Shah SS**, Roche AM, Sullivan SW, ASES Multicenter Taskforce for RSA Complications, Lawrence V. Gulotta. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication: Part II. Accepted. JSES International Open Access. 2020
6. **Shah SS**, Gaal B, Roche AM, ASES Multicenter Taskforce for RSA Complications, Lawrence V. Gulotta. The Modern Reverse Shoulder Arthroplasty & An Updated Systematic Review for Each Complication: Part I. Accepted. JSES International Open Access. 2020
7. Saini S, **Shah SS**, Curtis AS. Scapular Dyskinesis and the Kinetic Chain: Recognizing Dysfunction and Treating Injury in the Tennis Athlete. Accepted. Curr Rev Musculoskelet Med. 2020
8. **Shah SS**, Fu MC, Ling D, Wong A, Warren RF, Dines DM, Dines JS, Gulotta LV, Taylor SA. The comparative impact of age on postoperative clinical outcomes following anatomic total shoulder arthroplasty and reverse total shoulder arthroplasty. Accepted. Orthopedics. 2020
9. **Shah SS**, Ferkel E, Mithoefer K. High Incidence of Shoulder Labral Tears Associated with Acute Acromioclavicular Joint Separations of All Injury Grades. Accepted. Orthop J Sports Med. 2020.
10. **Shah SS**, Mithoefer K. Current Applications of Growth Factors for Knee Cartilage Repair and Osteoarthritis Treatment. In Press. Curr Rev Musculoskelet Med. 2020. (PMID: 32710292)
11. **Shah SS**. Rotator Cuff Repair over Non-Operative Management: The Prudent Choice for Symptomatic Rotator Cuff Tears in the Shared-Decision Making Model: Commentary on an article by Amos Song, MD et al.: "Comparative time to improvement in nonoperative versus surgical treatment of rotator cuff tears". J Bone Joint Surg Am. 2020. (PMID: 32618928)
12. **Shah SS**, Gentile J, Chen X, Kontaxis A, Dines DM, Warren RF, Taylor SA, Jahandar A, Gulotta LV. Influence of Implant Design and Parasagittal Acromial Morphology on Acromial and Scapular Spine Strain after Reverse Total Shoulder Arthroplasty: A Cadaveric and Computer Based Biomechanical Analysis. In Press. Journal of Shoulder and Elbow Surgery. 2020. (PMID 32669200)
13. Taylor SA, **Shah SS**, Chen X, Gentile J, Gulotta LV, Dines JS, Dines DM, Cordasco FA, Warren RF, Kontaxis A. Scapular Ring Preservation: Coracoacromial Ligament Transection Increases Scapular Spine Strains Following Reverse Total Shoulder Arthroplasty. In Press. Journal of Bone and Joint Surgery. 2020. (PMID: 32310841)

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Thank You

Congrats to our graduating Orthopaedic Sports Medicine Fellows at New England Baptist Hospital. As we celebrate your successes, a bright future lies ahead of you. And thank you for honoring Sarav Shah as Teacher of the Year!

Best of luck to each of you in your new practices. We are all very proud of you!

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Thank You

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