

RTSA

- Sit on Top Humerus -

Thomas W. Wright MD
University of Florida
Department of Orthopaedics

Disclosure

- Design surgeon for Exactech Equinox System
 - Royalties
 - Research institutional support

3 Years Ago

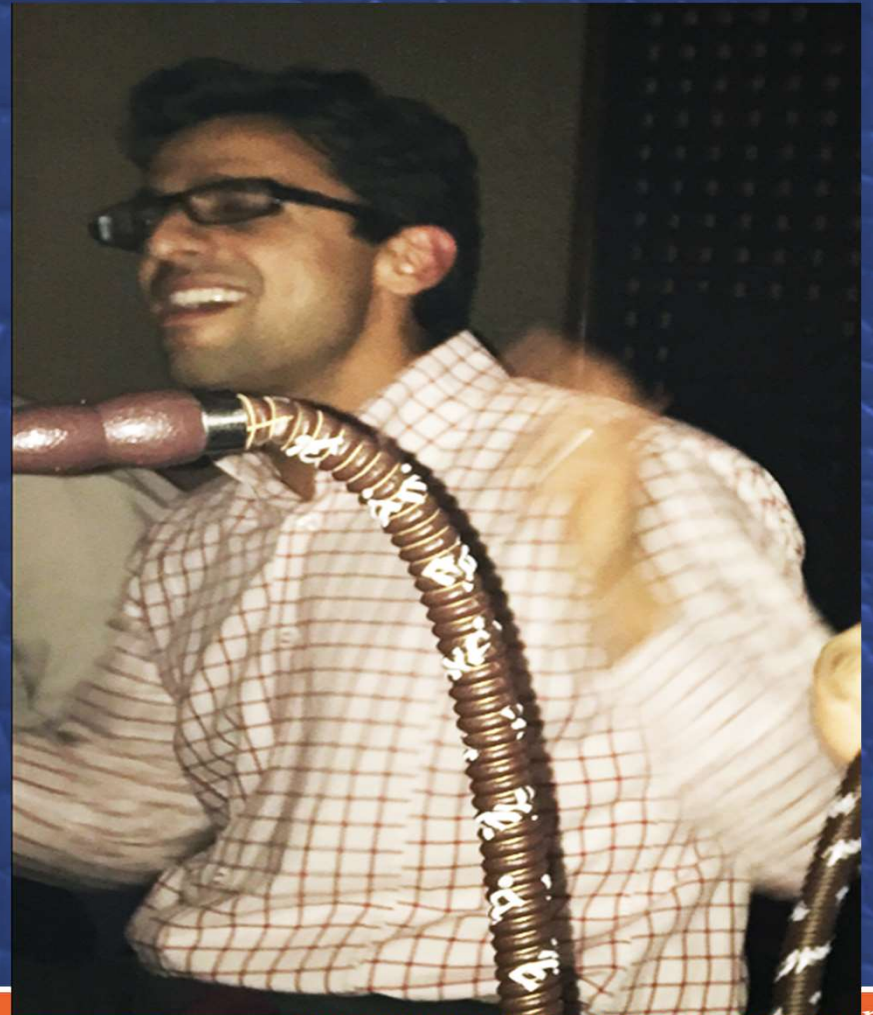
- This debate was put to bed
- Frankle sit inside argument was destroyed
- Humerus Sit on top clear victor!!!



Outside Hit Man



Big Issues!!



Unsavory Characters



More Undesirables



Baby as a Human Shield!!



Previous Presentation Is!!!

- **Fake News!!**

Sit On Top VS Sit Inside

U Florida Gators



VS

U South Florida Bulls



Orthopaedics and Rehabilitation

Introduction

Sit On Top Humerus



Sit Inside Humerus



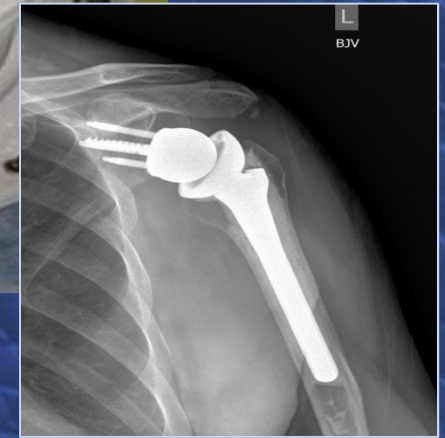
VS

Sit on Top Humerus



VS

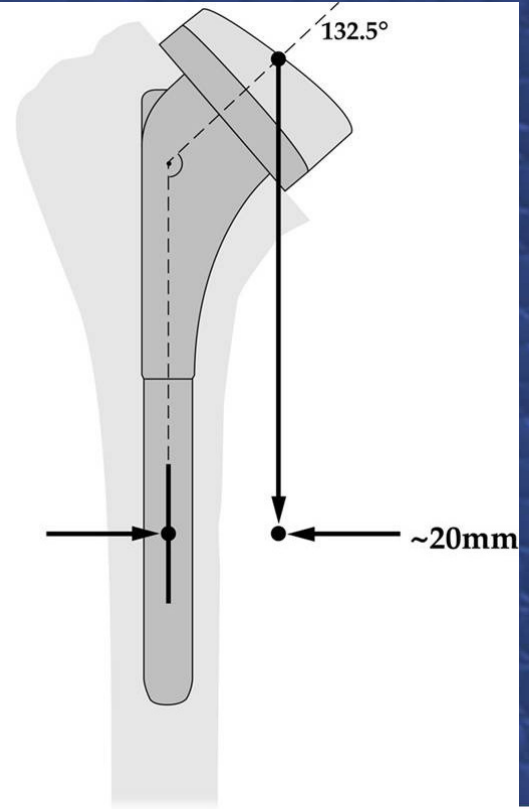
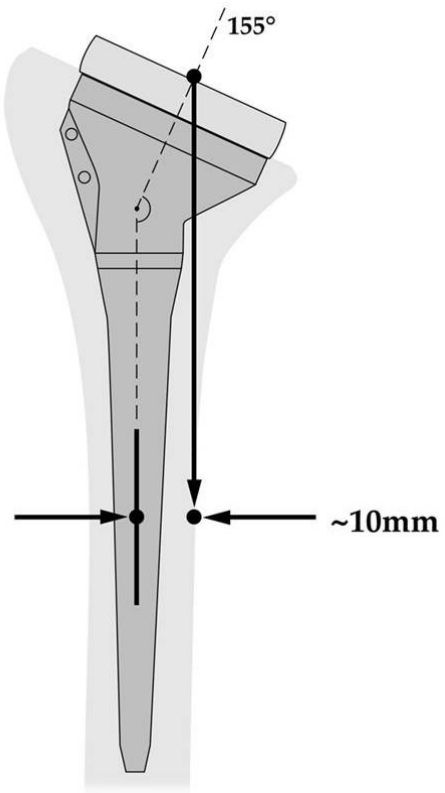
Sit Inside Humerus



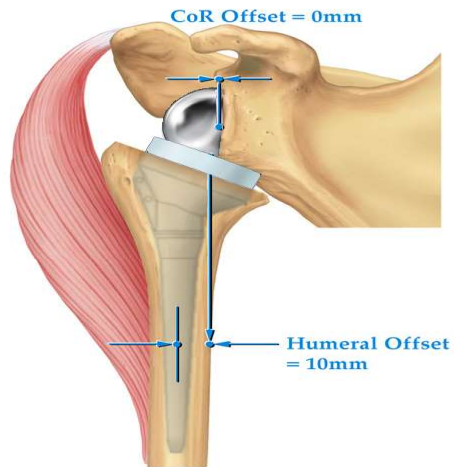
Premise

- Do you like looking at world from sitting on the toilet versus sitting in the toilet.
 - If so you will like the sit on top humeral implant

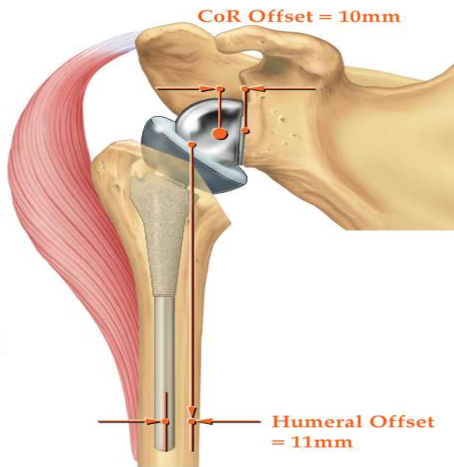
Humeral Lateralization



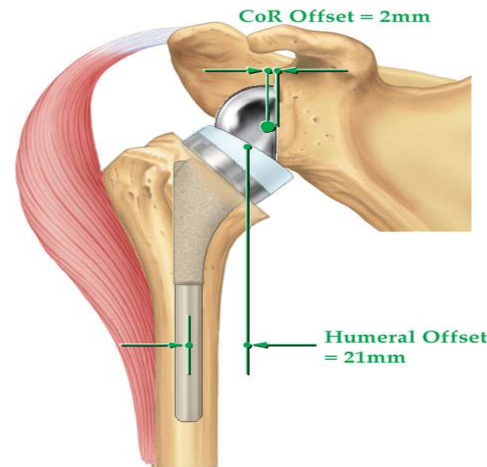
Four Classes of RTSA



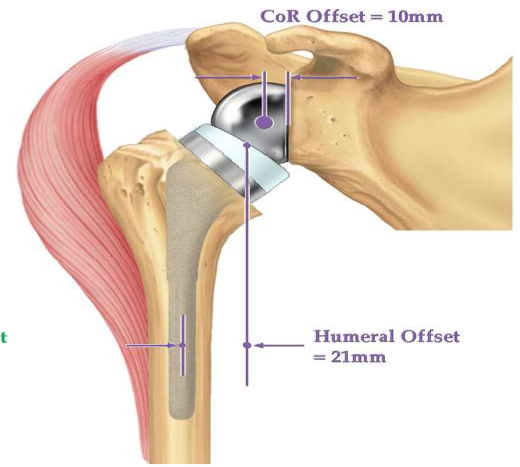
Medial Glenoid/Medial Humerus



Lateral Glenoid/Medial Humerus



Medial Glenoid/Lateral Humerus



Lateral Glenoid/Lateral Humerus

Why sit on Top?

- Easy
- Fast
- **Lateralizes humerus!**
- Can be used common platform stem
- Minimizes bone resection

Fast

- Free hand or guide anatomic cut
- No secondary metaphyseal reaming
- Lightly ream diaphysis, broach and done

Lateralized Humerus - Advantages

- Better tension remaining cuff
- Better deltoid wrapping angle
- Greater stability
- More efficient deltoid – better moment arm
 - Decreased stress acromion
- Low notching rate

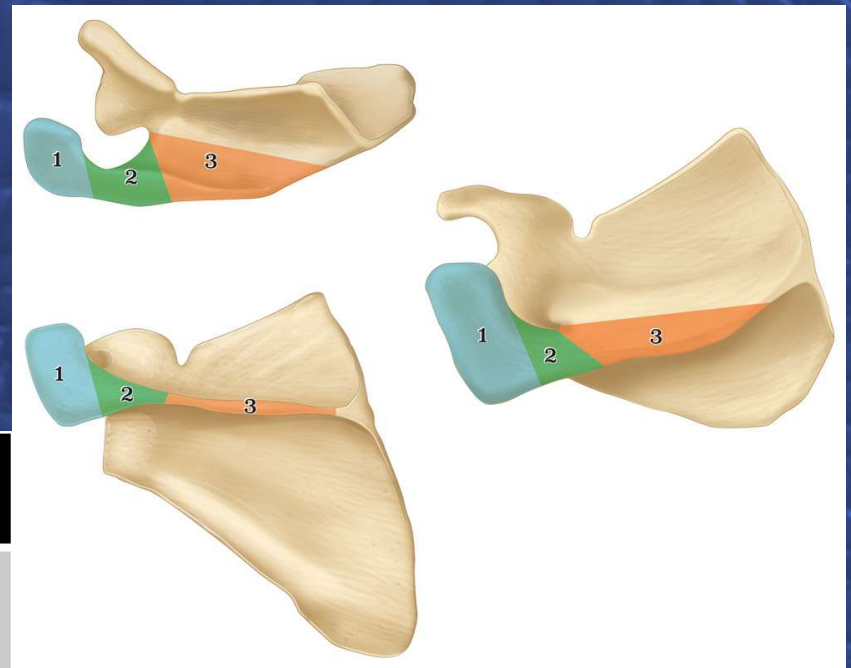
Humeral Lateralization

- Allows you to keep the glenoid COR medial
 - Improving deltoid abduction moment arm
 - Reducing glenoid implant / bone shear forces
 - Lowers acromial stress fractures
- Tensions the cuff
- Wraps the deltoid



Results: Radiographic Document Fx Rate

- 61/4,125 primary rTSA – radiographic fracture acromion or scapula
- Fracture rate 1.48% - ave 12.9 ± 17.9 months
- 24% due to traumatic event



	Type 1 Fxs	Type 2 Fxs	Type 3 Fxs
Percent Distribution	16.7% (n=10)	53.3% (n=32)	30.0% (n=18)

Finite Element Analysis

- Wong et al. used a FEA to isolate the impact of:
 - A. Glenoid inferior offset
 - B. Glenoid COR lateralization
 - C. Humeral Stem Lateralization
- Correlated location of high-stress regions with each implant variable

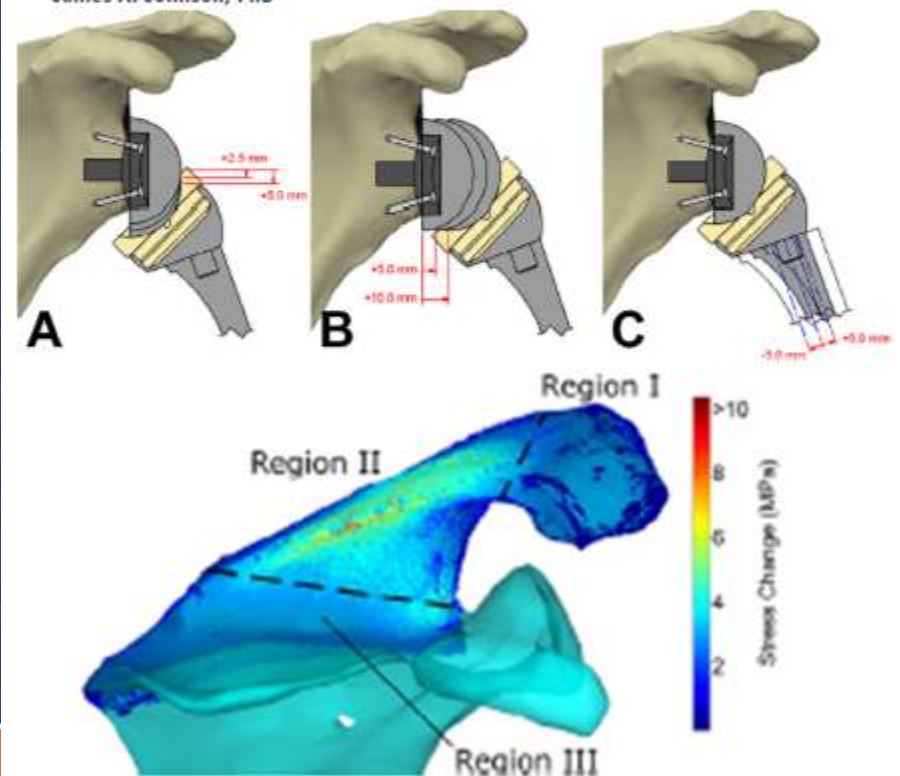
J Shoulder Elbow Surg (2016) 25, 1899–1905



JOURNAL OF
SHOULDER AND
ELBOW
SURGERY
www.elsevier.com/locate/ymse

Implant positioning in reverse shoulder arthroplasty has an impact on acromial stresses

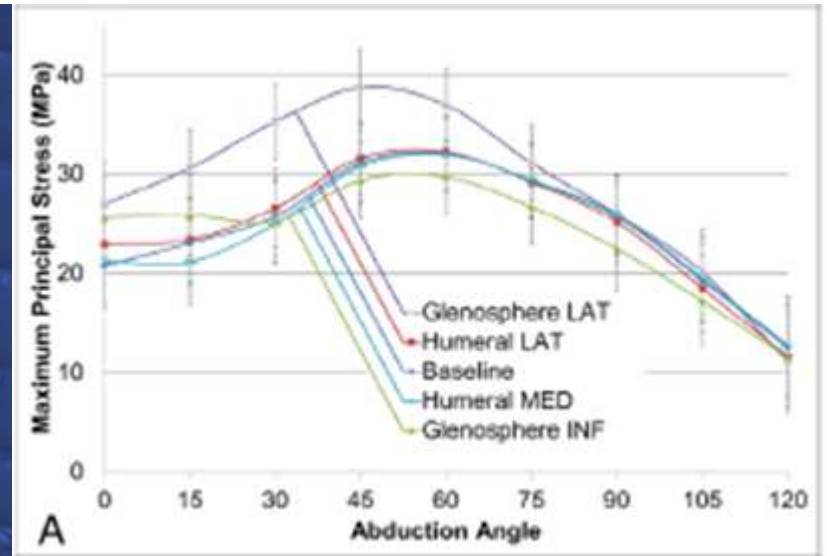
Murray T. Wong, BSc, G. Daniel G. Langohr, PhD, George S. Athwal, MD, FRCS, James A. Johnson, PhD*



Finite Element Analysis

- Glenoid COR lateralization - most significant variable increase scapular bone stress
- Humeral lateralization increased acromial stresses 1.7%
- Glenoid COR lateralization increased stresses by 7.7%

Lateralized glenospheres - shorter deltoid moment arms - greater deltoid force elevate arm



Conclusions

Studying the effects of RSA positioning on acromial stress patterns may help decrease the incidence of acromial fractures by implanting RSA components in a lower stress configuration while freely modifying noncritical parameters. In our model, lateralization of the glenosphere produced the highest stresses in the acromion in locations consistent with clinically observed acromial stress fractures after RSA.

Table I Cumulative effect on maximum principal stress (mean \pm 1 standard deviation) in the acromion for each component position compared with baseline

Comparisons	Glenosphere inferiorization	Standard deviation	Comparisons	Glenosphere lateralization	Standard deviation	Comparisons	Humeral medialization/lateralization	Standard deviation
0-2.5 mm	-0.4*	0.1	0-5 mm	1.8*	0.3	0 to -5 mm	-0.4*	0.1
0-5 mm	-0.7*	0.2	0-10 mm	4.1*	0.9	-5 to 5 mm	0.8	0.3
0-5 mm	0.0	0.1	5-10 mm	2.3*	0.5	0-5 mm	0.5	0.2

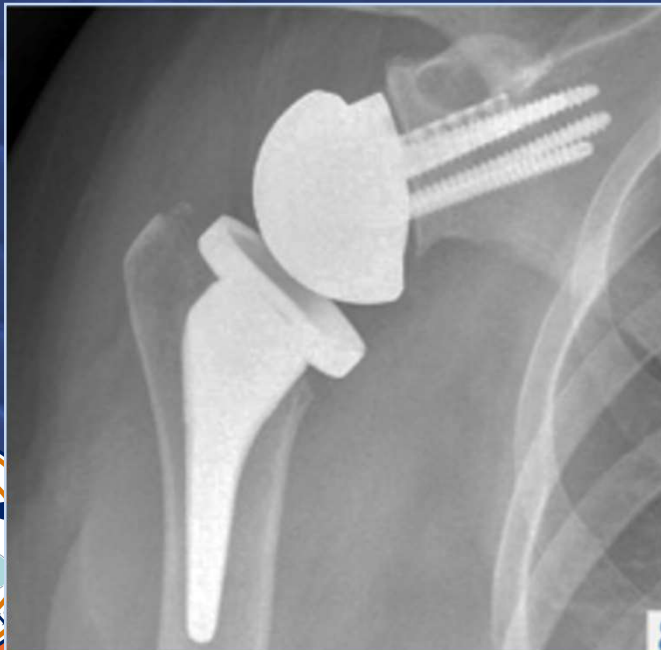
Moment Arms and Stress Fracture

- Sit on Top large deltoid moment arm
 - 4,125 primary rTSA patient
 - 61 Radiographic stress fx
 - 1.48% stress fracture rate

- Sit inside humerus lateral glenosphere – short moment arm
 - 10% stress fracture rate

Not All Sit on Tops are the Same

- Bowl placed medial – lateralizes humerus and less distalization

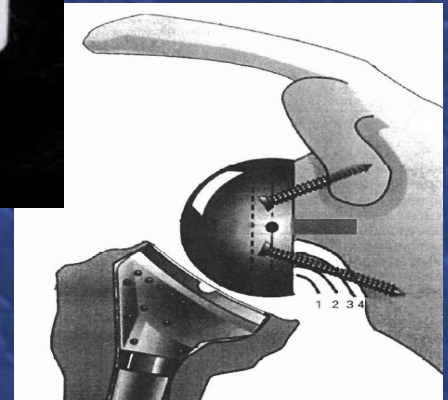


Bowl moved lateral – distalizes and medialized humerus



Scapular Notching 50-96%

- Vanhove Acta OB 2004, Boileau JSES 2006, Levigne JSES 2008, Kalouche Acta OB 2009
 - Incidence & extent of notching increases with f/u (7 yrs)
- Simovitch JBJS 2007
 - 77 shoulders, 2 yrs f/u
 - 44% notching
 - Lower Constant scores
 - Less ROM
- Cristofari JBJS 2010
 - 36 shoulders 6.6 yrs f/u
 - 53% notching
 - 64% baseplate loosening
 - 2.7% revision
- Sirveaux JBJSBr 2004
 - 77 shoulders, 3.7 yrs f/u
 - 63.6% notching
 - 6.2% baseplate loosening
 - Lower Constant scores



Lateralized Humerus-Disadvantages

- More difficult to repair subscapularis without tension
 - Repair tight subscap create iatrogenic Horn Blower's sign
 - Solution do not repair subscap – Horn Blower's very rare

Sit On Top

- Common platform stem
 - Quick revision
 - Decrease blood loss
 - Less cost
 - Less morbidity



Minimizes Bone Resection

- Sit on Top humeral implant removes less bone than sit inside
 - Sit on Top Equinox - 32mm bone removed
 - Sit inside
 - DJO – 38mm bone removed
 - Delta – 47mm bone removed
 - Roche et al Bulletin of the Hospital Joint Diseases 2013;71(Suppl2):S36-40

Easy

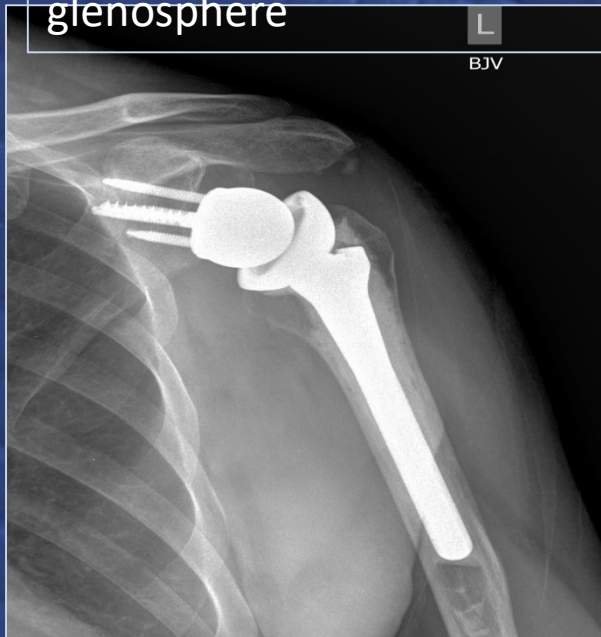
- Anatomic head cut but not more than 30 degrees retroversion.
- If no cuff may add 2 mm to resection

Types of Humeral Implants

Sit on Top lateral humerus
(low neck angle), medial
glenosphere



Sit inside medial humerus
(low neck angle), lateral
glenosphere

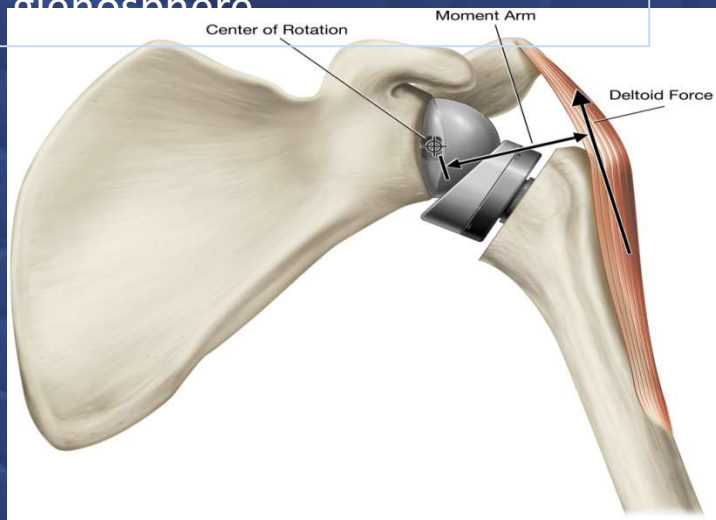


Sit inside medial humerus
(high neck angle), medial
glenosphere



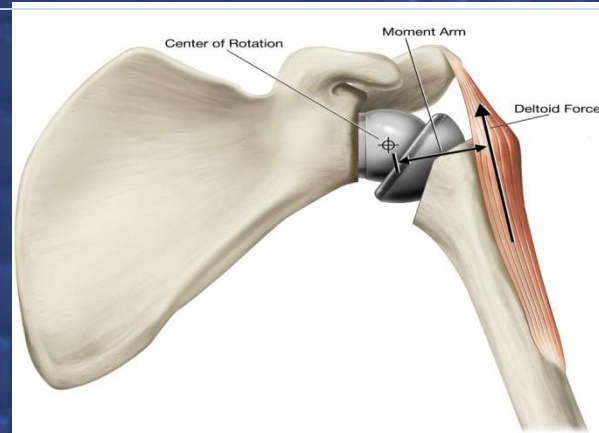
Types of Humeral Implants

Sit on Top lateral humerus (low neck angle), medial glenosphere



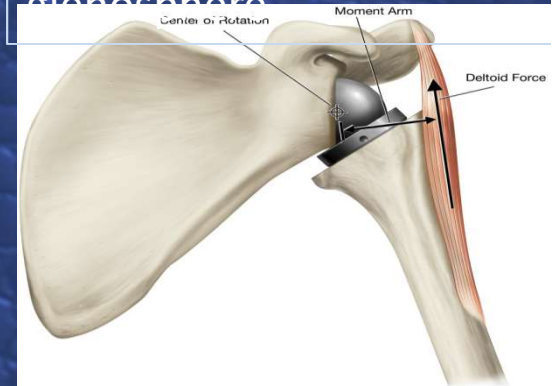
Maximizes Deltoid Wrapping angle

Sit inside medial humerus (low neck angle), lateral glenosphere



Decreased Deltoid moment arm

Sit inside medial humerus (high neck angle), medial glenosphere



Minimal Deltoid wrapping angle

Conclusion – If U Like

- Easy
- Fast
- Lateralized humerus
- Low Notching Rate
- Great deltoid wrap
- Outstanding Stability
- Efficient Deltoid
 - Low stress fracture rate
- Common platform stem
- Minimal bone resection

Dry Bottom – Sit On Top



And Hate a Wet Bottom – Sit Inside



Be a Winner!!!

- Sit on Top
- Go Gators



**Make Reverse Shoulder
Arthroplasty Great
Again
- Sit on Top**



Is There a Downside?

- Combining a Lateral humerus with a lateralized glenoid design (LG/LH) until recently has not been frequently done
 - Lateralizing both sides may be too much of a good thing
- Bony or metallic lateralization of the glenoid combined with humeral lateralization should be done with caution in at-risk patients

