

IMPROVING EXTERNAL ROTATION OF rTSA

Manitoba Orthopaedic Symposium

Winnipeg October 2018



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Western University

London CANADA

ROTH | M^CFARLANE

HAND & UPPER LIMB CENTRE

ST. JOSEPH'S HEALTH CARE LONDON

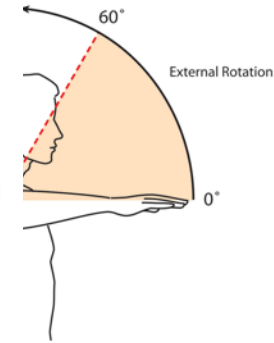
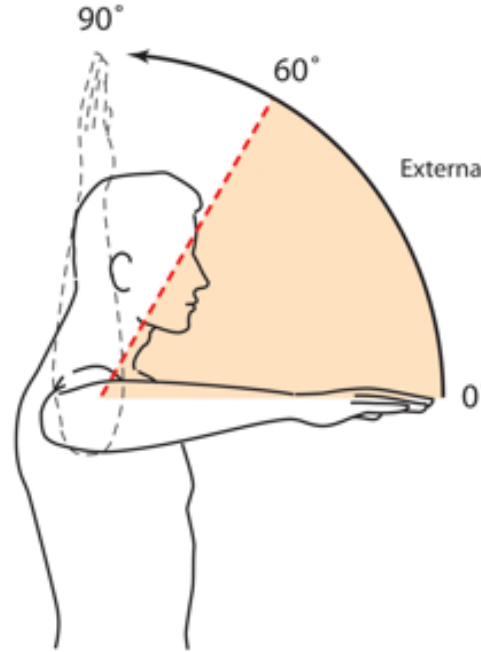
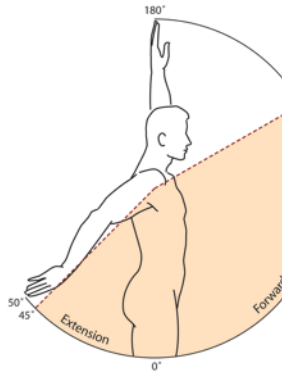
DISCLOSURE

- I have something relevant to disclose:
 - Consultant: Exactech
 - Royalties: Exactech

OUTLINE

- Muscle Physiology
- Biomechanics
- Implant Factors
 - Offset
 - Version
- Patient Factors

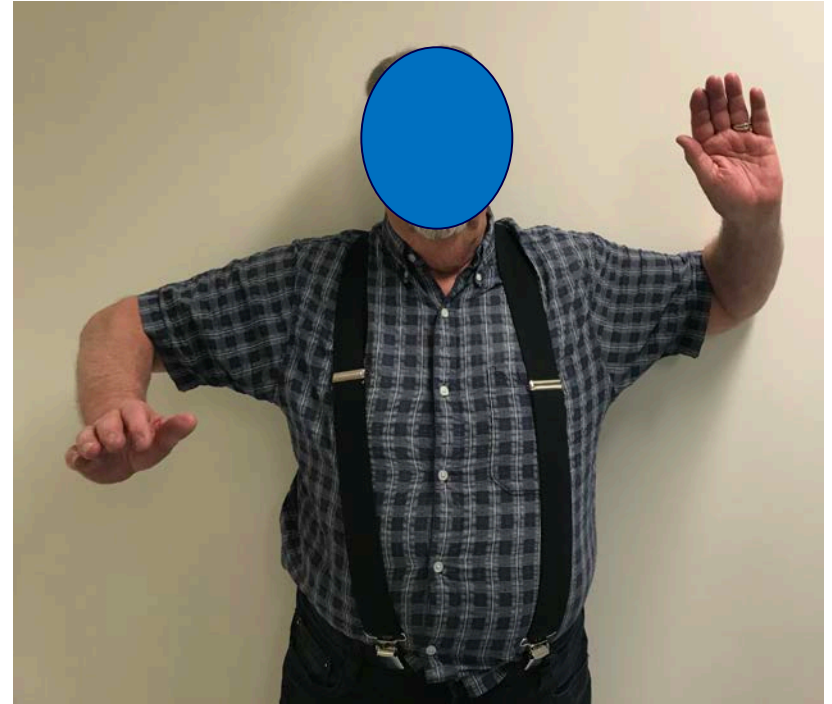
FUNCTIONAL MOTION for ADLs

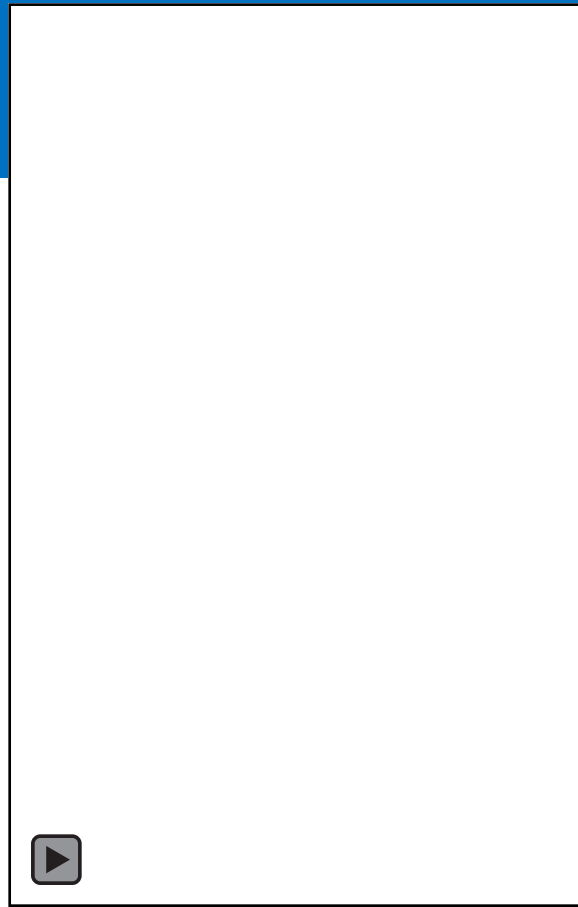
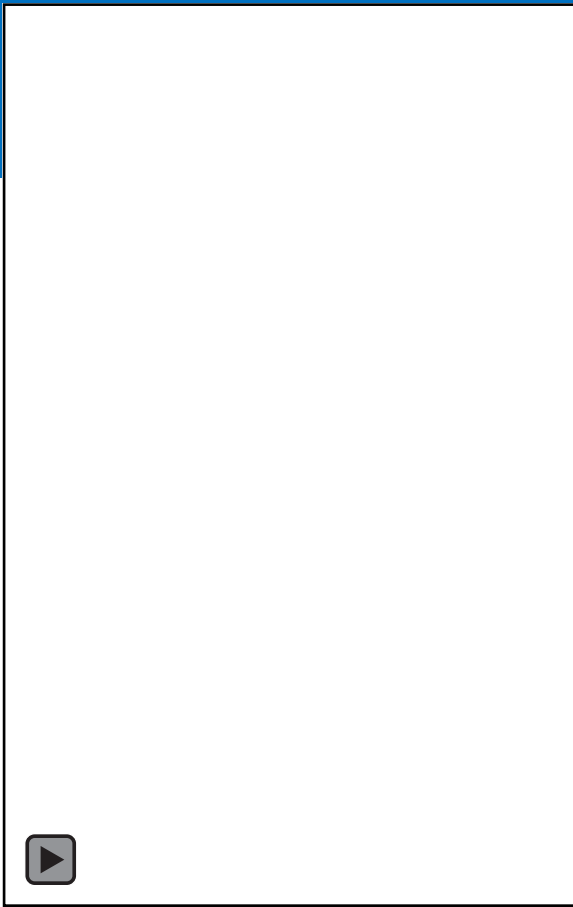


Namdari, 2012

INTRODUCTION

- **Loss of aER is disabling**



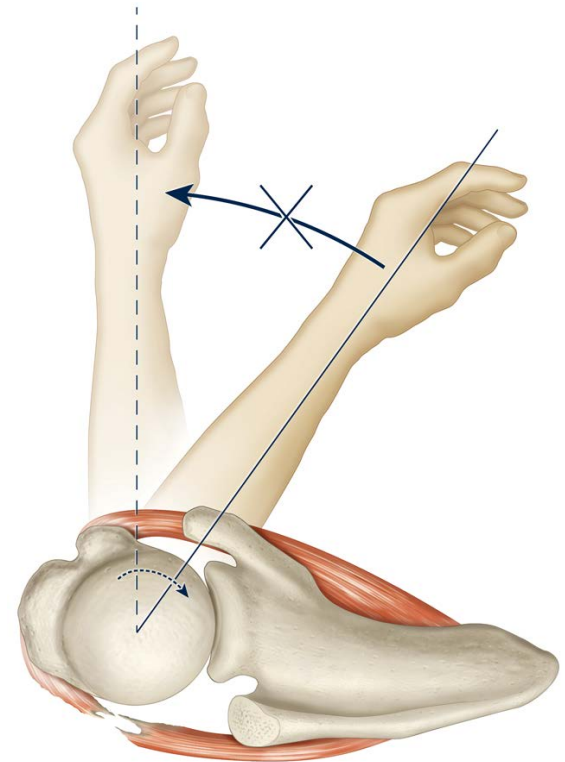


POST OP aER: UNPREDICTABLE

Study	No.	Follow-up (mos.)	Δ aER
Sirveaux, 2004	77	44	8°
Boileau, 2006	42	40	2°
Levigne, 2008	337	47	2°
Stechel, 2010	25	48	20°
Bacle, 2017	87	150	0°

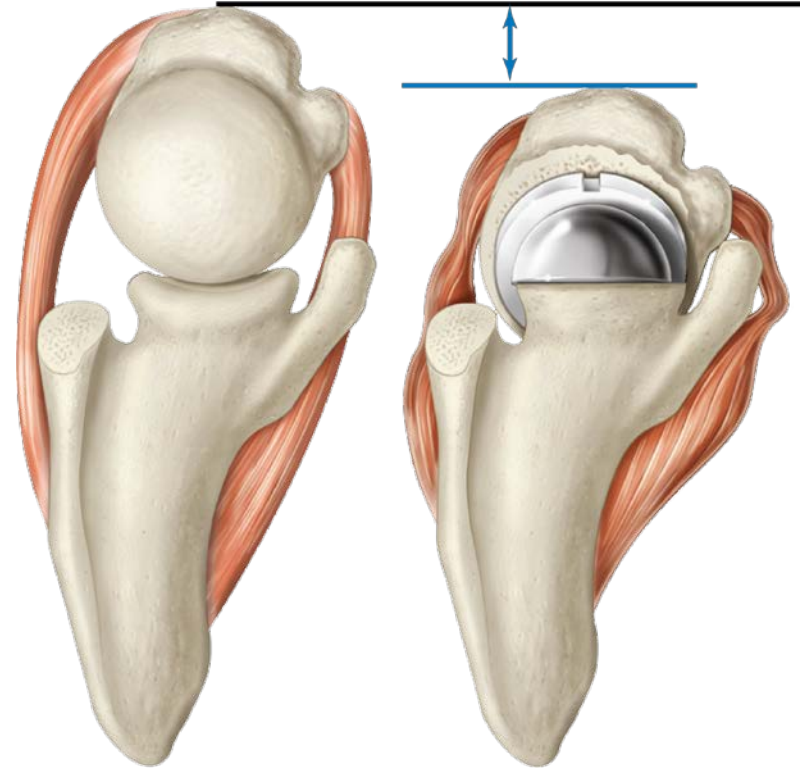
INTRODUCTION

- **The rotator cuff may already be impaired by the pathology.**



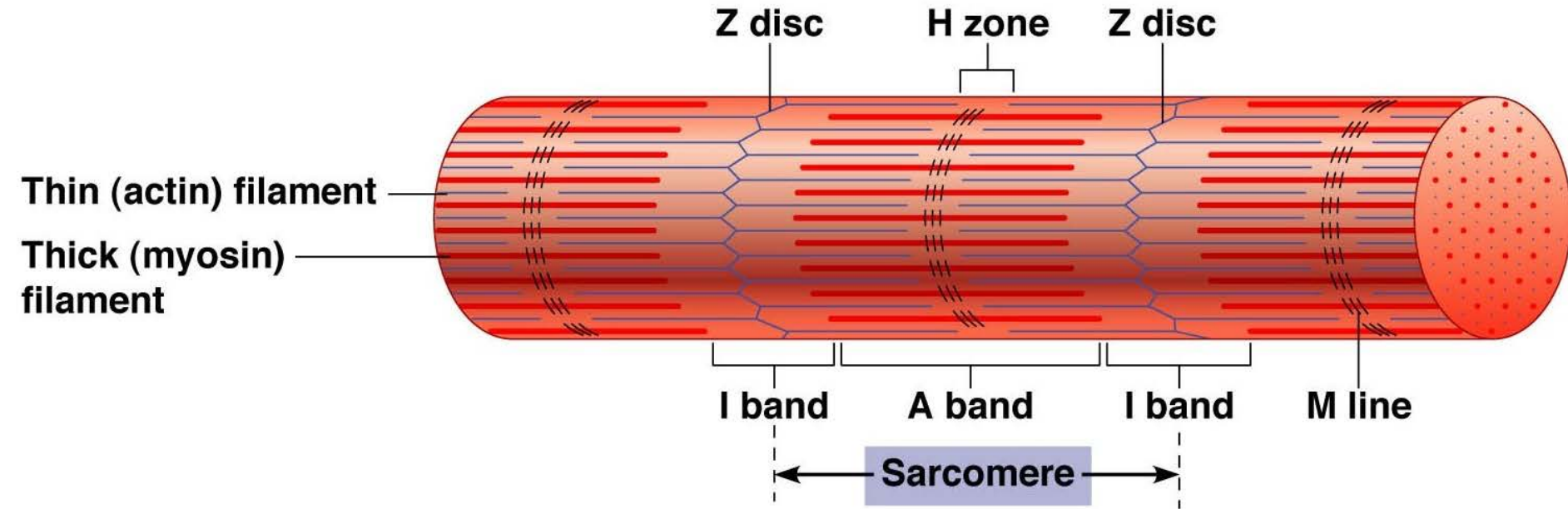
INTRODUCTION

- **rTSA is associated with shortening of the external rotator muscles**



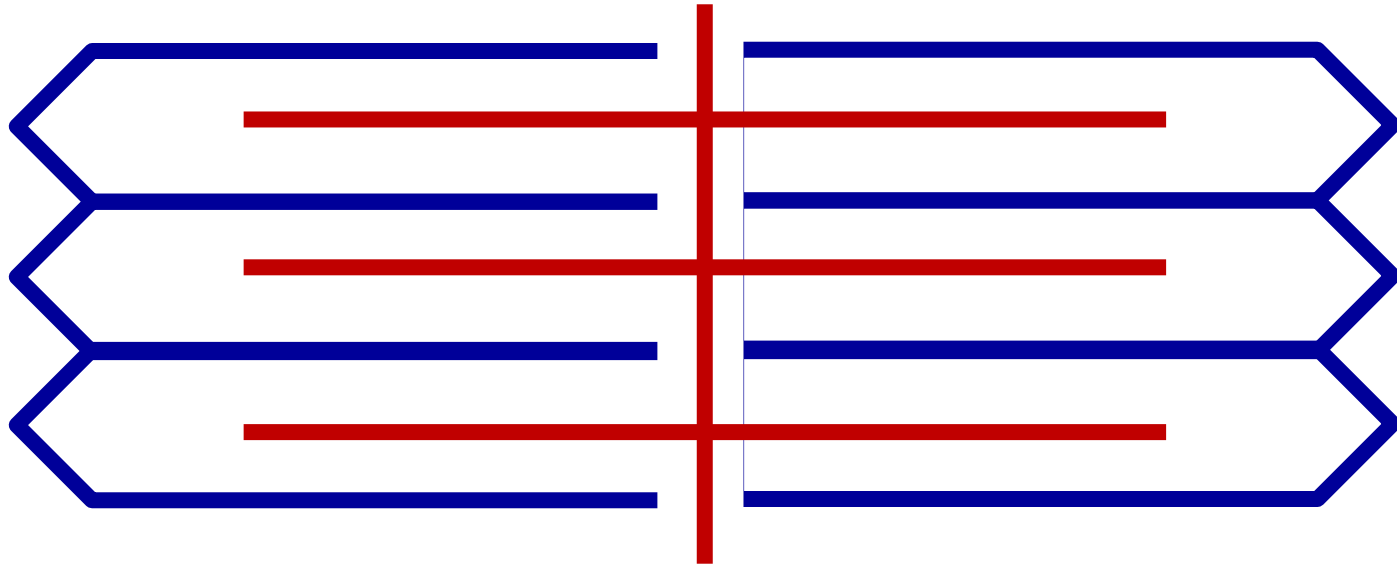
MUSCLE PHYSIOLOGY

The Sarcomere



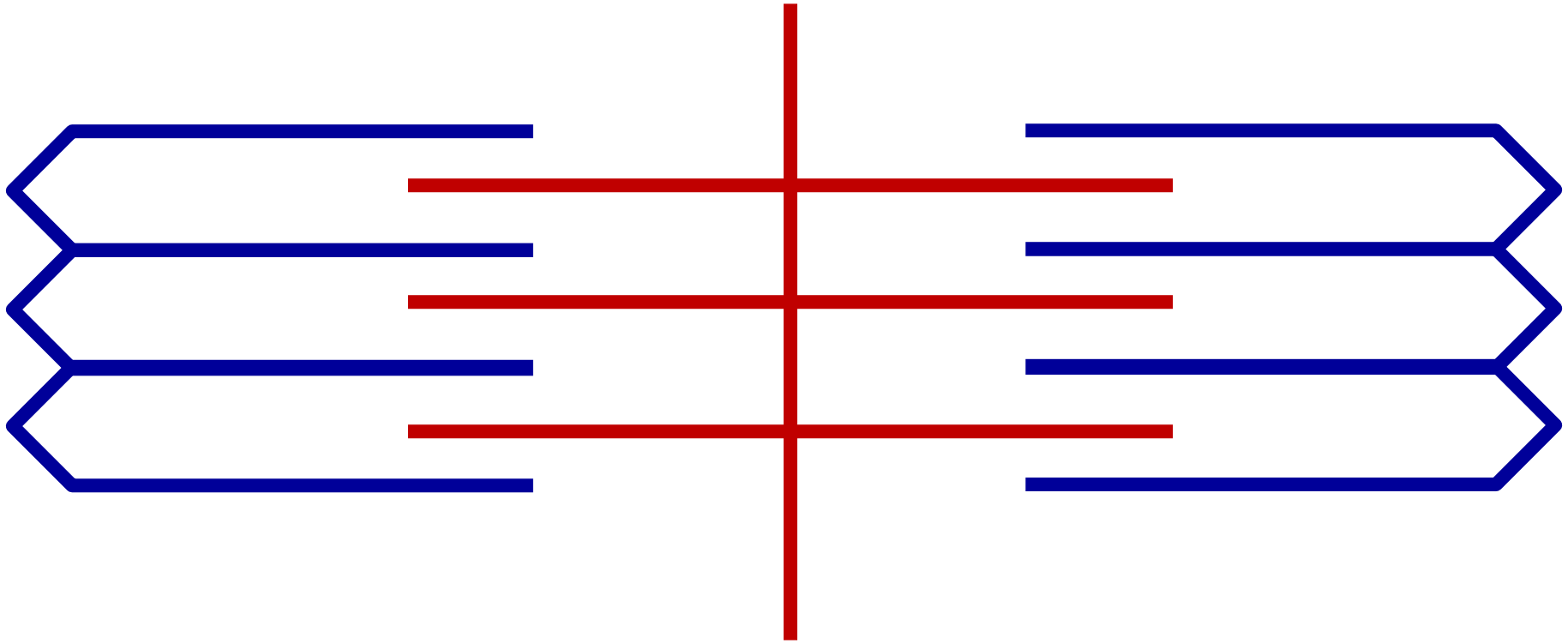
MUSCLE PHYSIOLOGY

Shortened Sarcomere

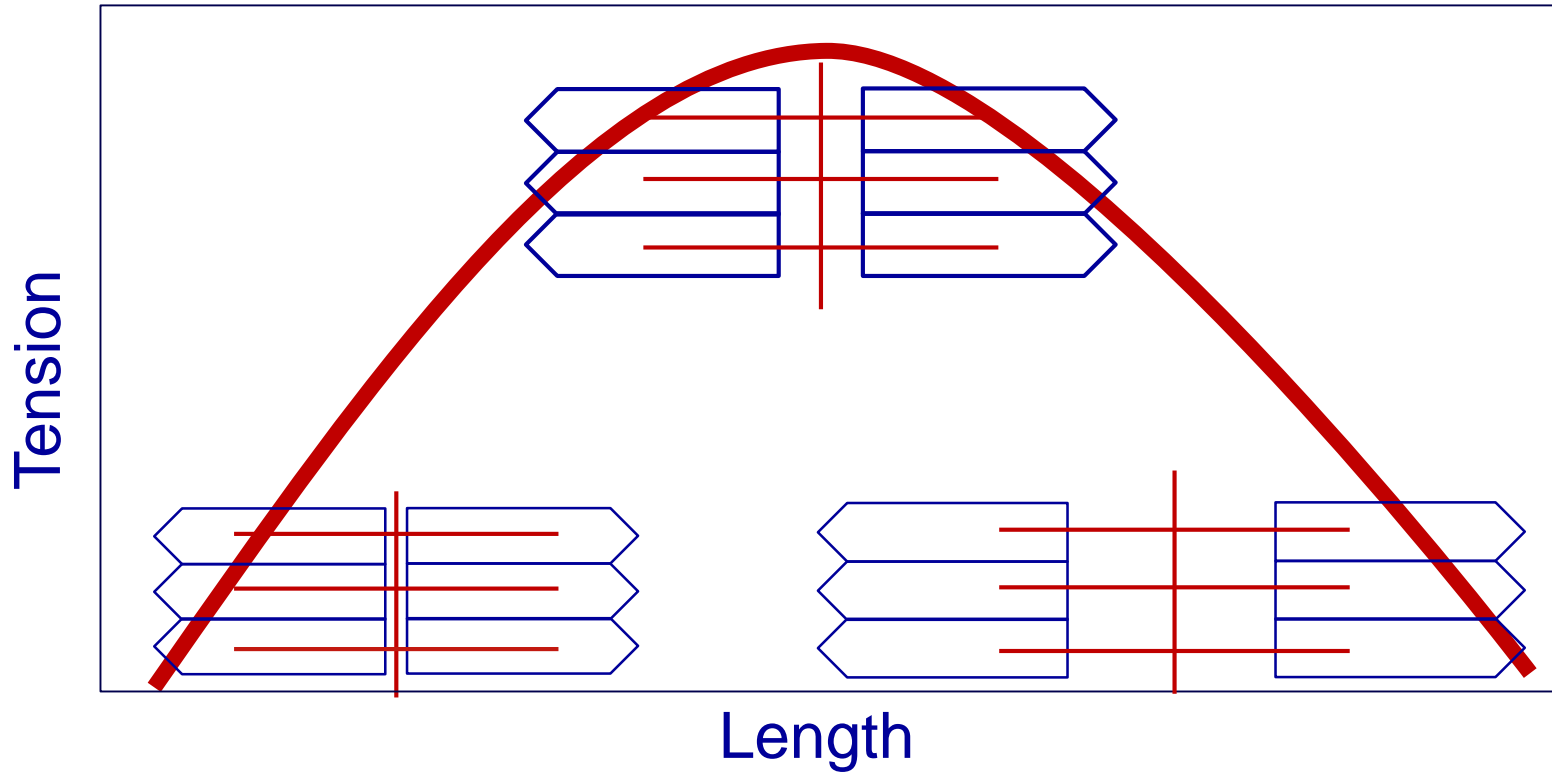


MUSCLE PHYSIOLOGY

Lengthened Sarcomere



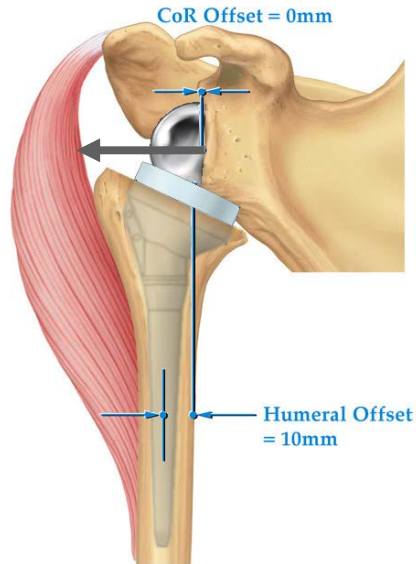
BLIX CURVE



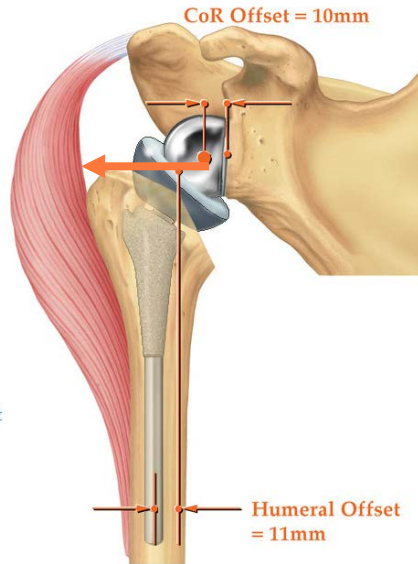
IMPLANT FACTORS

- **Lateral Offset:**
 - Humerus
 - Glenosphere

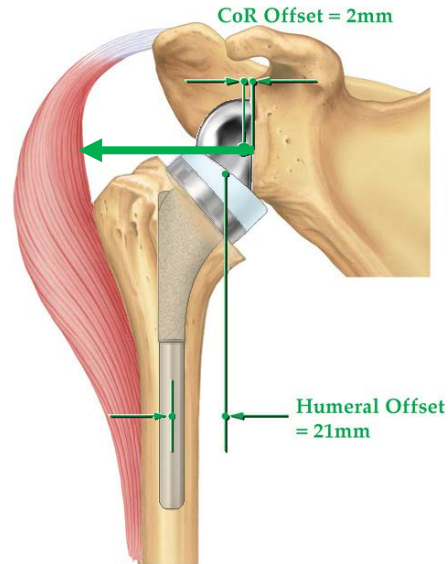
rTSA PROSTHESIS DESIGN CLASSIFICATION



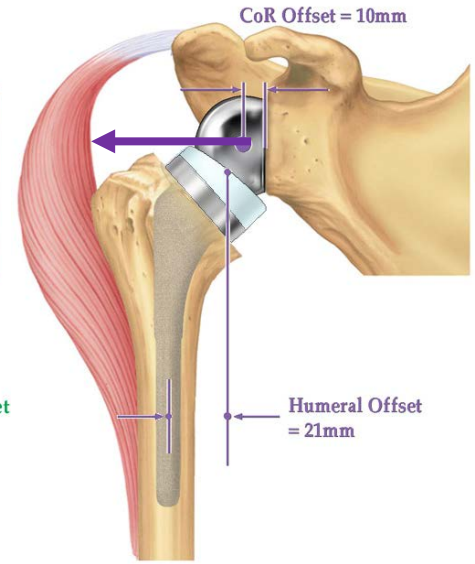
Medial Glenoid/Medial Humerus



Lateral Glenoid/Medial Humerus



Medial Glenoid/Lateral Humerus



Lateral Glenoid/Lateral Humerus

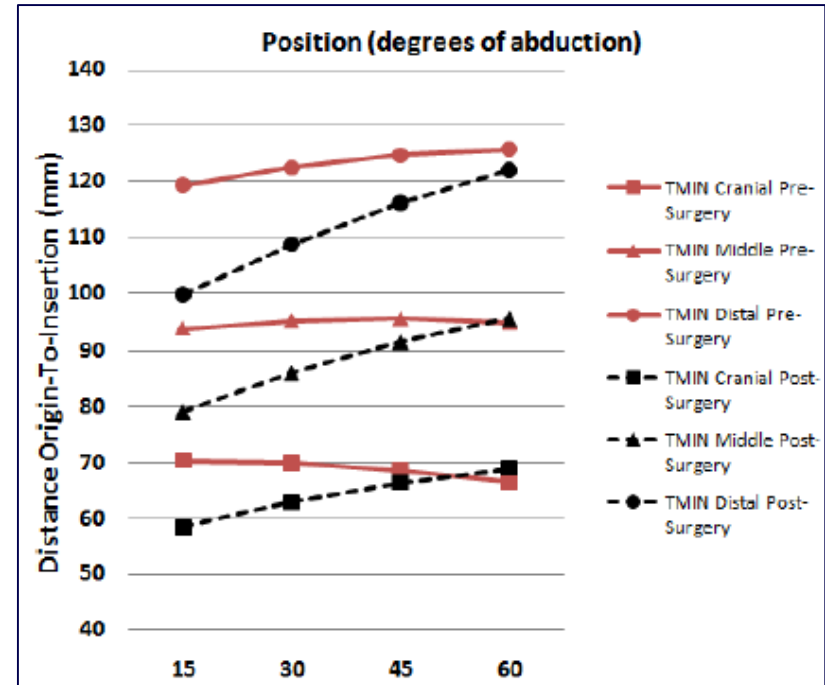
Reverse Shoulder Arthroplasty Prosthesis Design
Classification System

Howard D. Riccarton, D.O., Pierre-Michel Flurin, M.D., Thomas W. Wright, M.D., Joseph D. Zuckerman, M.D., Matthew A. Hamilton, Ph.D., and Christopher P. Roche, M.S., M.B.A.

Reverse shoulder arthroplasty leads to significant biomechanical changes in the remaining rotator cuff

Sebastian Herrmann^{1*}, Christian König², Markus Heller², Carsten Perka¹ and Stefan Greiner¹

- CT reconstructions:
 - RC is shortened by 7-20mm from 0-30°



2011

Impact of Inferior Glenoid Tilt, Humeral Retroversion, Bone Grafting and Design Parameters on Muscle Length and Deltoid Wrapping in Reverse Shoulder Arthroplasty

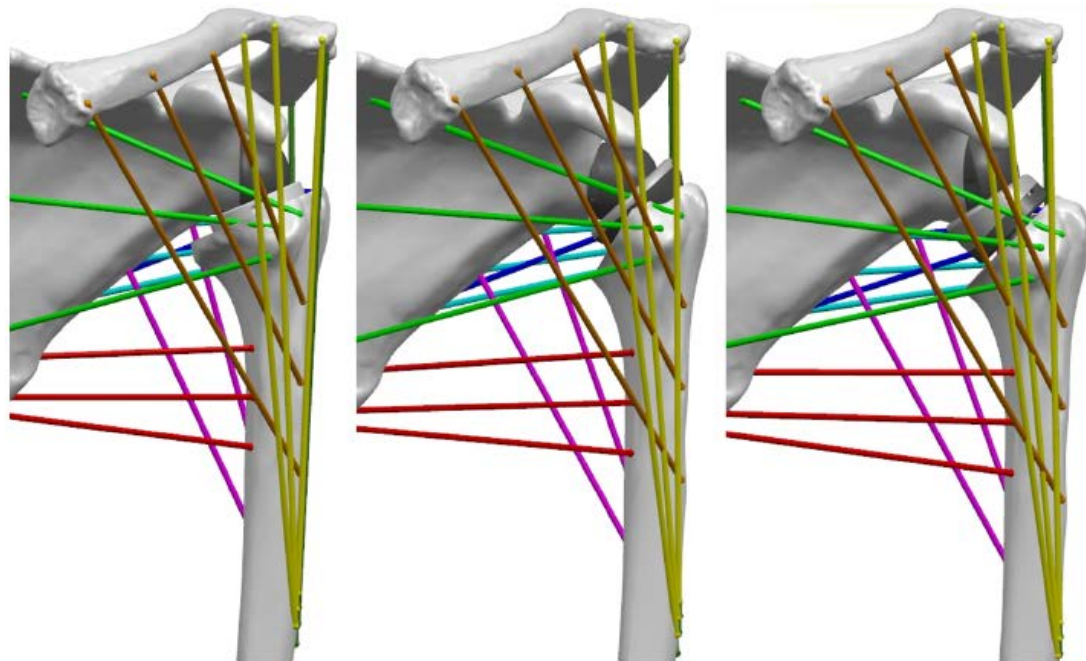
Computer model analyzed:

Technique Variables:

1. Inferior Glenosphere Tilt
2. Humeral Retroversion
3. Bone Graft vs No Bone Graft

Prosthesis Designs:

1. Grammont (MG/MH)
2. RSP (LG/MH)
3. Equinox (MG/LH)



Roche 2013

Impact of Inferior Glenoid Tilt, Humeral Retroversion, Bone Grafting and Design Parameters on Muscle Length and Deltoid Wrapping in Reverse Shoulder Arthroplasty

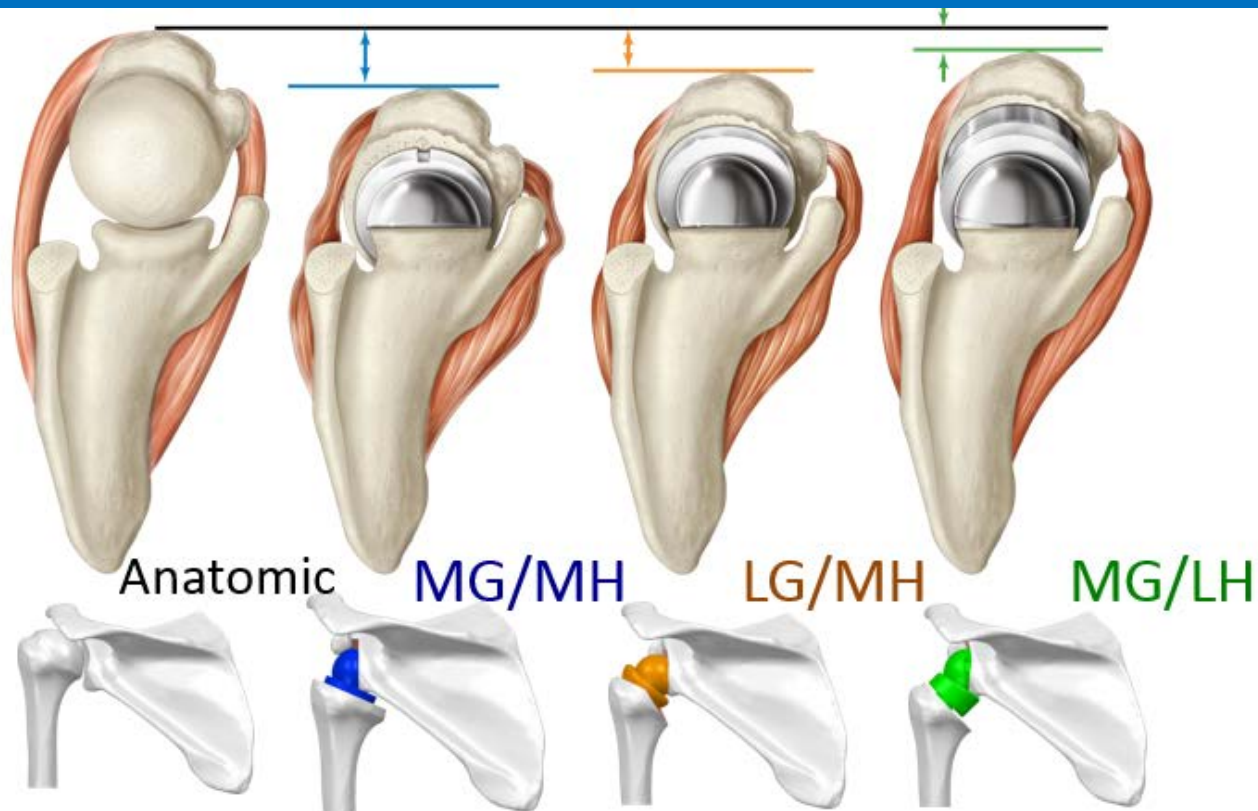
- All rTSA prostheses shorten the RC
- Lateralized Humerus:
 - least RC shortening: 8.5 to 22%.

Table 5 Average Muscle Length Relative to Normal Shoulder as Each Reverse Shoulder is Externally Rotated from 0° to 40° with the Arm at 0° Abduction

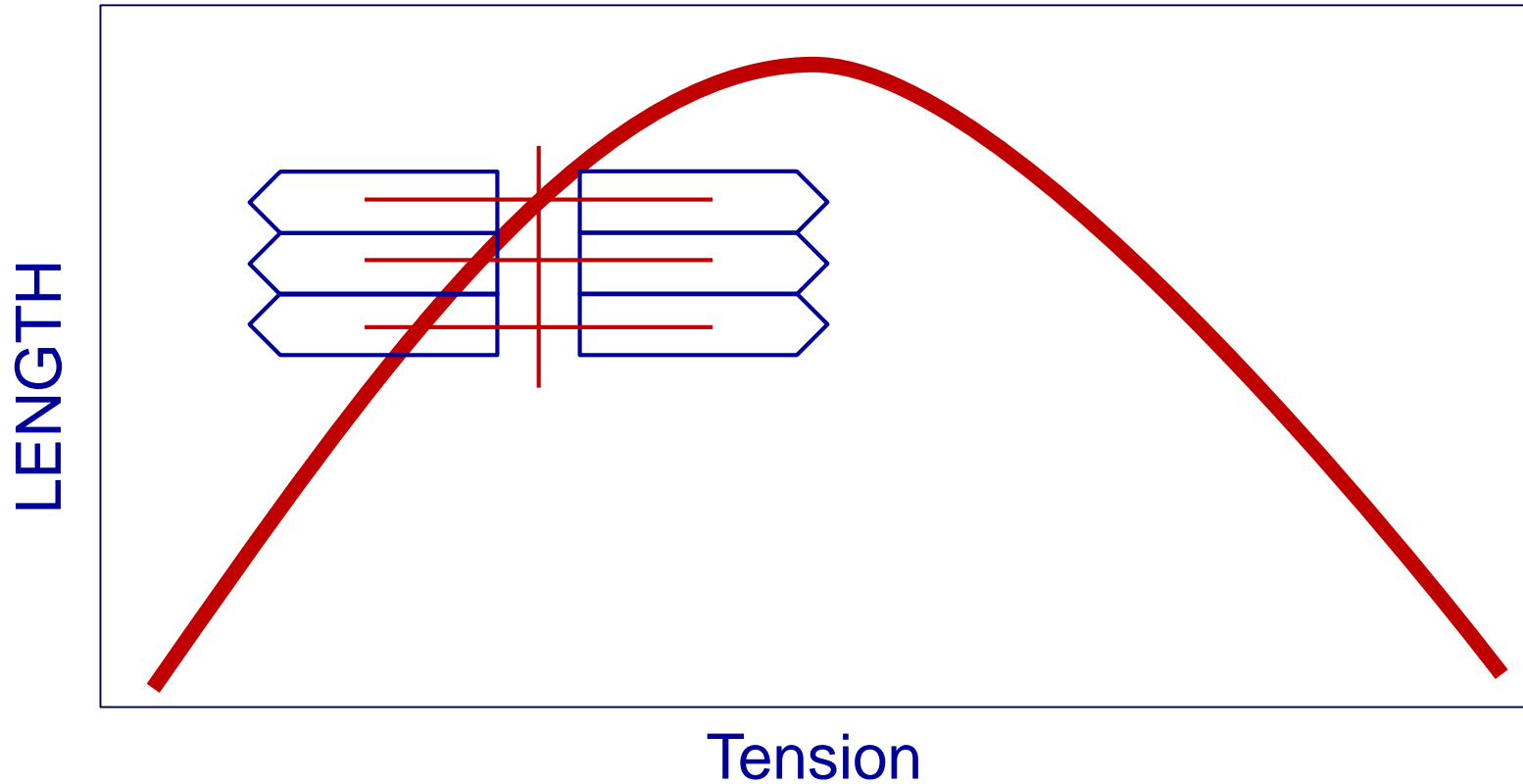
	Ant. Deltoid	Mid Deltoid	Post. Deltoid	Subscap	Infraspin	Teres Major	Teres Minor	Pec Major
36 Grammont, 0° tilt, 20° retro	13.6%	15.7%	10.1%	-17.3%*	-21.0%†	-21.6%†	-36.9%‡	6.8%
36 Grammont, 15° tilt, 20° retro	13.5%	15.7%	9.6%	-19.1%*	-22.9%†	-23.7%†	-40.0%‡	6.2%
36 Grammont, 0° tilt, 0° retro	13.2%	15.7%	10.4%	-21.6%†	-15.7%*	-24.4%†	-28.2%†	5.1%
36 Grammont, 0° tilt, 40° retro	13.6%	15.7%	9.7%	-13.6%*	-25.4%†	-18.5%*	-45.3%‡	8.5%
36 Grammont, graft, 0° tilt, 0° retro	13.4%	15.7%	11.9%	-15.4%*	-10.4%*	-17.3%*	-17.6%*	6.6%
36 Grammont, graft, 0° tilt, 20° retro	13.8%	15.7%	11.6%	-11.0%*	-14.6%*	-14.5%*	-26.4%†	8.3%
36 Grammont, graft, 0° tilt, 40° retro	14.2%	15.6%	11.1%	-7.4%	-19.0%*	-11.4%*	-34.7%‡	10.0%
36 Grammont, graft, 15° tilt, 20° retro	14.9%	16.8%	12.1%	-13.0%*	-16.9%*	-17.0%*	-30.0%‡	8.8%
32 RSP, 0° tilt, 20° retro	12.8%	14.7%	11.0%	-10.1%*	-13.6%*	-13.2%*	-24.7%†	7.4%
38 Equinox, 0° tilt, 20° retro	16.6%	18.3%	14.3%	-8.5%	-12.4%*	-12.3%*	-22.4%†	11.4%

*Muscle shortening > 10%; †Muscle shortening > 20%; ‡Muscle shortening > 30%.

IMPLANT AND CUFF TENSION



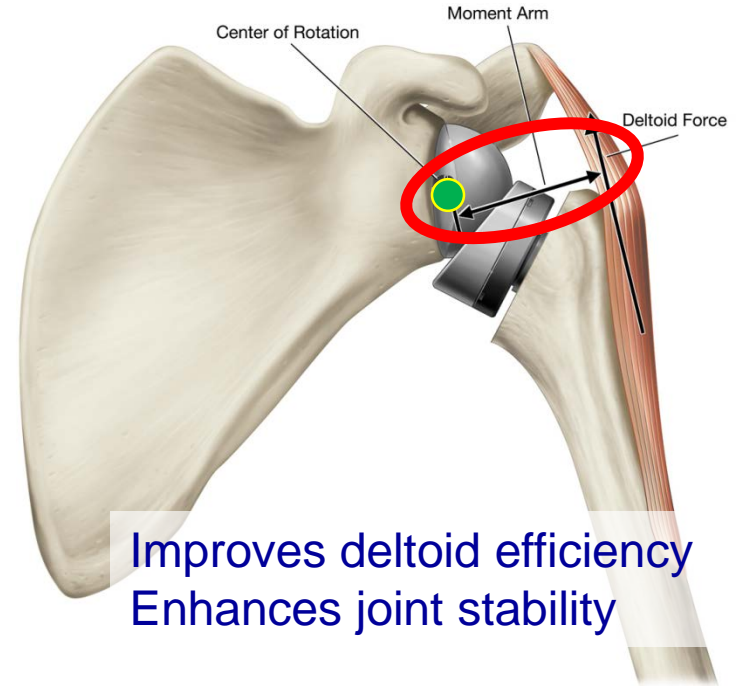
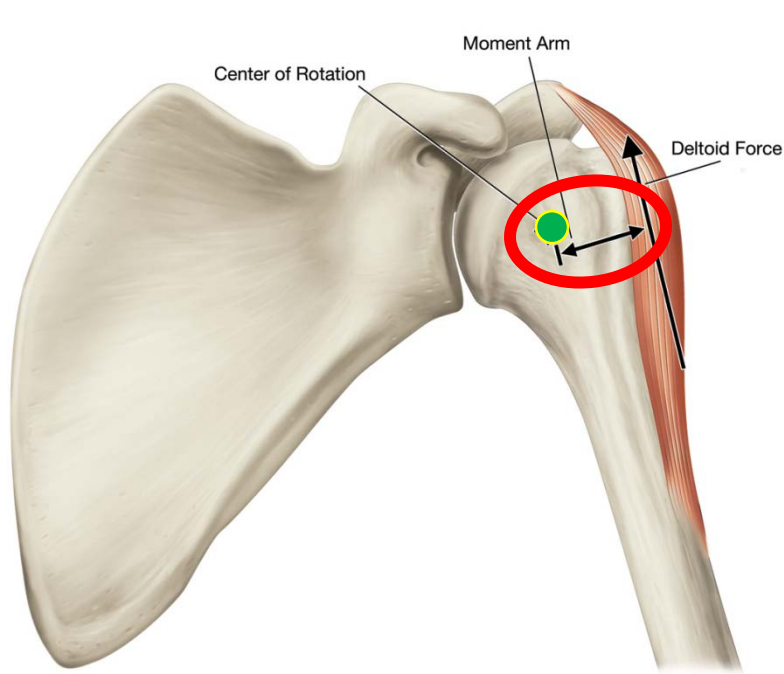
BLIX CURVE



MOMENT ARMS



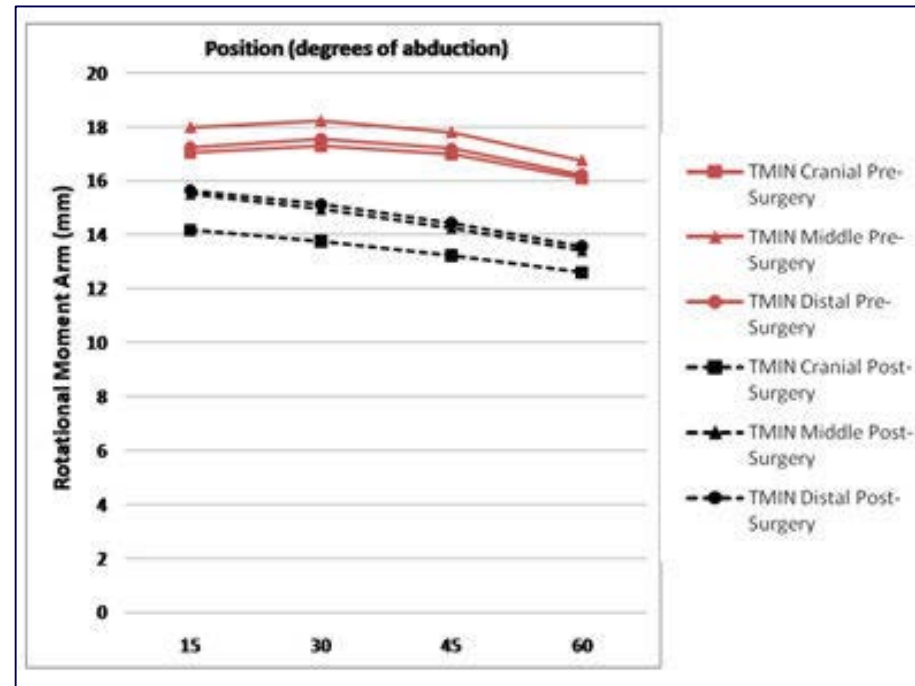
OFFSET: COR & Deltoid Moment Arm



Reverse shoulder arthroplasty leads to significant biomechanical changes in the remaining rotator cuff

Sebastian Herrmann^{1*}, Christian König², Markus Heller², Carsten Perka¹ and Stefan Greiner¹

- CT reconstructions:
 - RC is shortened by 7-20mm from 0-30°
 - RC ER moment is decreased

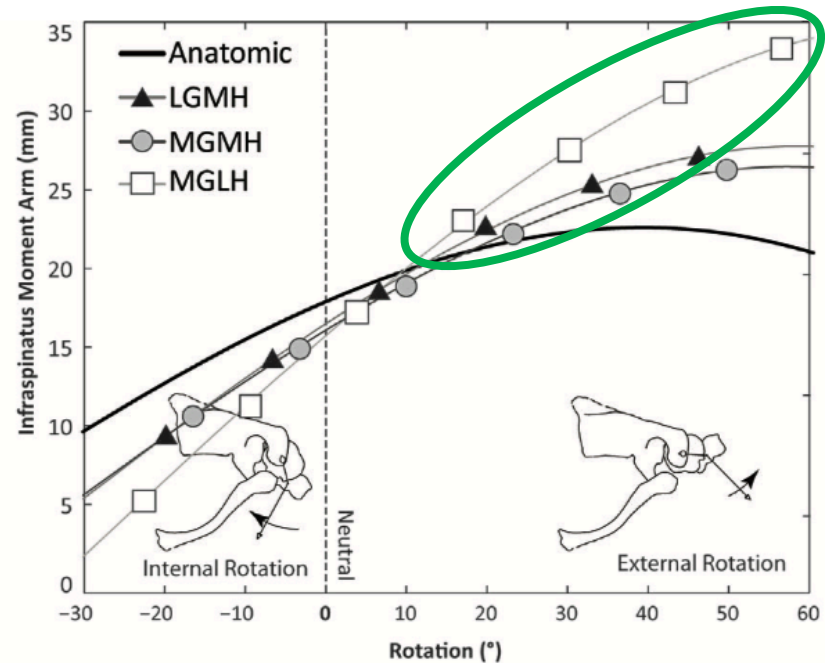


2011

Effect of Reverse Shoulder Design Philosophy on Muscle Moment Arms

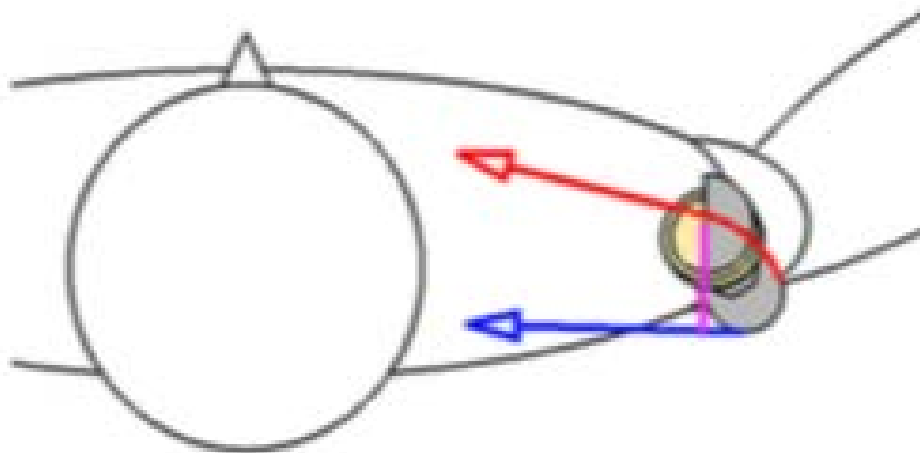
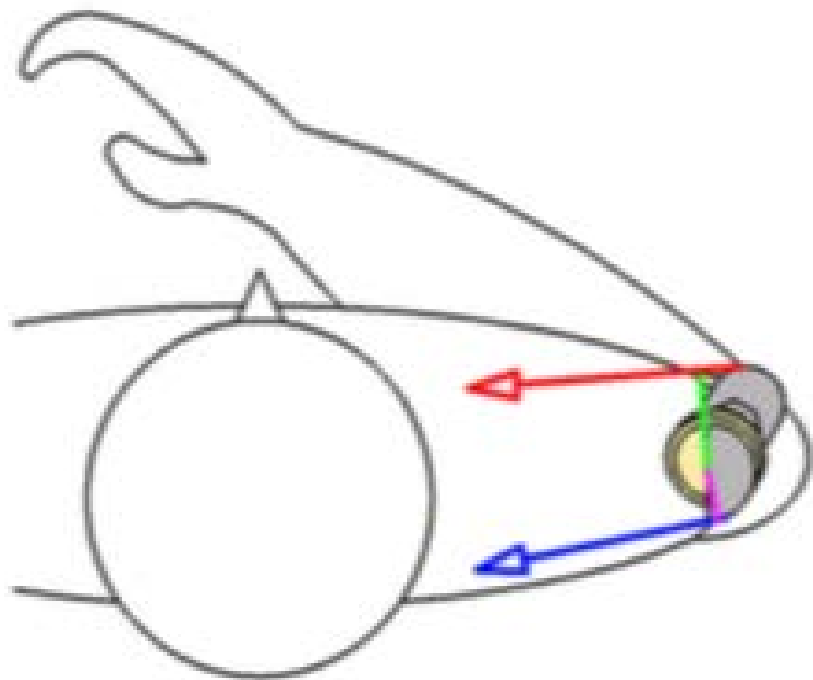
Matthew A. Hamilton,¹ Phong Diep,¹ Chris Roche,¹ Pierre Henri Flurin,² Thomas W. Wright,³ Joseph D. Zuckerman,⁴ Howard Routman⁵

- Computer model
- Medial Glenoid/Lateral Humerus (MGLH)
 - Greater moment arms:
 - Infrapinatus / Teres minor
 - Posterior deltoid



Does Humeral Component Lateralization Affect Rotator Cuff Torque?

Evaluation in a Cadaver Model



Chan 2017

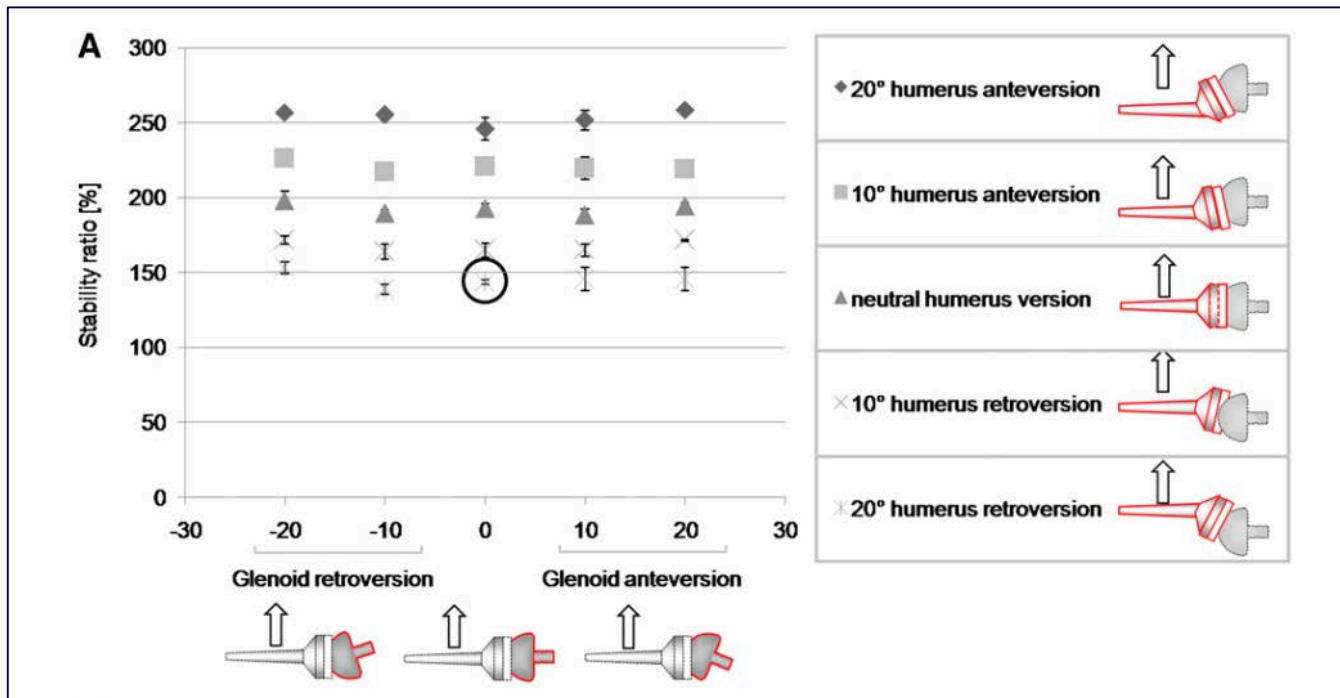
HUMERAL COMPONENT POSITIONING

Version



The effect of component positioning on intrinsic stability of the reverse shoulder arthroplasty

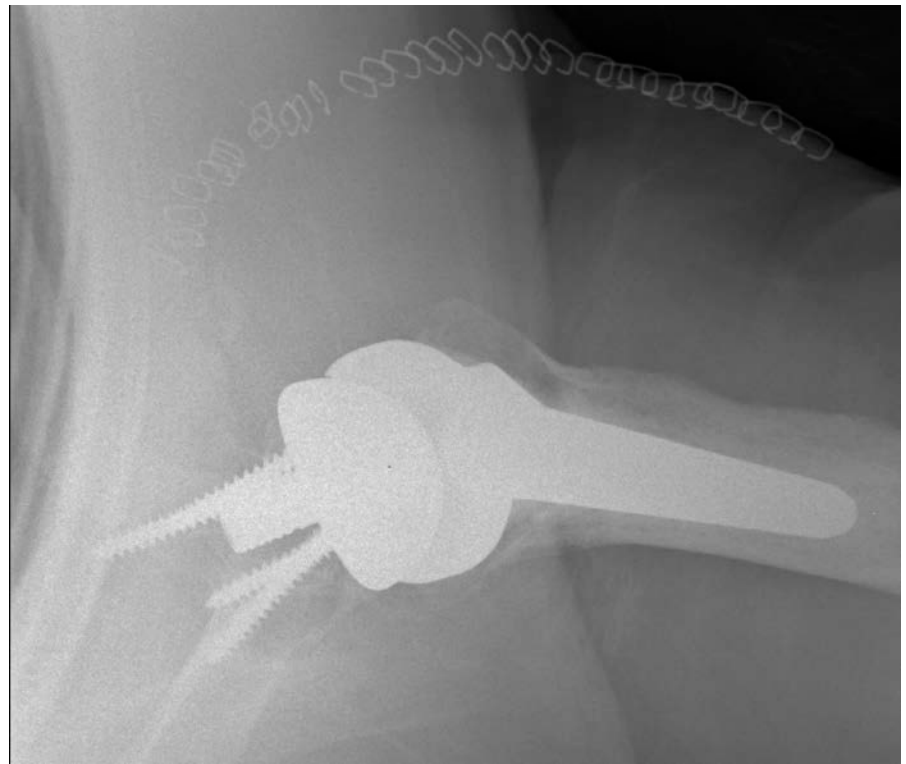
Philippe Favre, MSc*, Patrick S. Sussmann, MD, Christian Gerber, MD



71 YR OLD MALE



71 YR OLD MALE



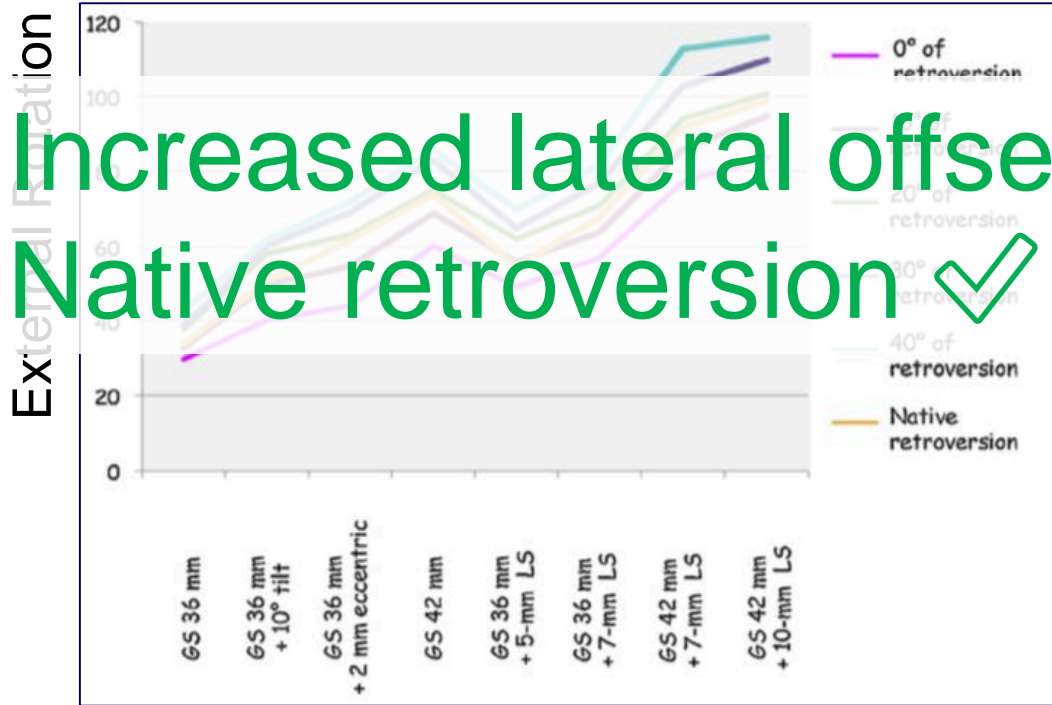
12 MONTHS POSTOP



Influence of glenoid component design and humeral component retroversion on internal and external rotation in reverse shoulder arthroplasty: A cadaver study

J. Berhouet*, P. Garaud, L. Favard

1. Increased lateral offset ✓
2. Native retroversion ✓

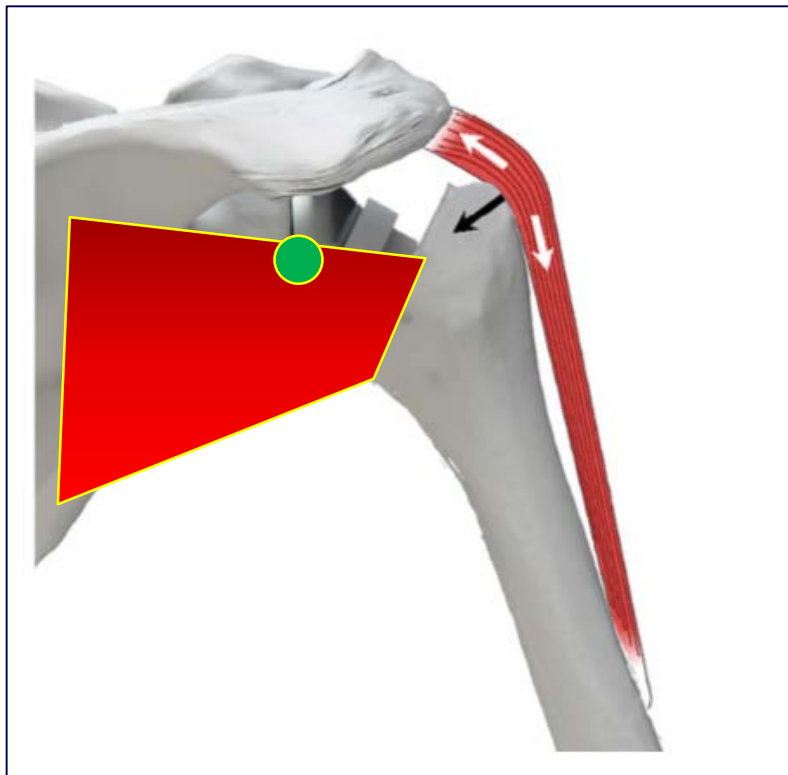


Grammont design

PATIENT FACTORS

- Subscap repair?
- Infra and Teres minor deficient?

WHAT ABOUT SUBSCAPULARIS?



The rotator cuff muscles are antagonists after reverse total shoulder arthroplasty

Joshua W. Giles, PhD^{1,2}, G. Daniel G. Langohr, PhD³, James A. Johnson, PhD⁴,
George S. Athwal, MD, FRCSC^{5,*}

DOES SUBSCAP REPAIR MATTER?

The influence of subscapularis tendon reattachment on range of motion in reversed shoulder arthroplasty: a clinical study

No Significant Difference

Jason D. Vourazeris, MD^{a,*}, Thomas W. Wright, MD^b, Aimee M. Struk, MEd, ATC^c,
Joseph J. King, MD^b, Kevin W. Farmer, MD^b

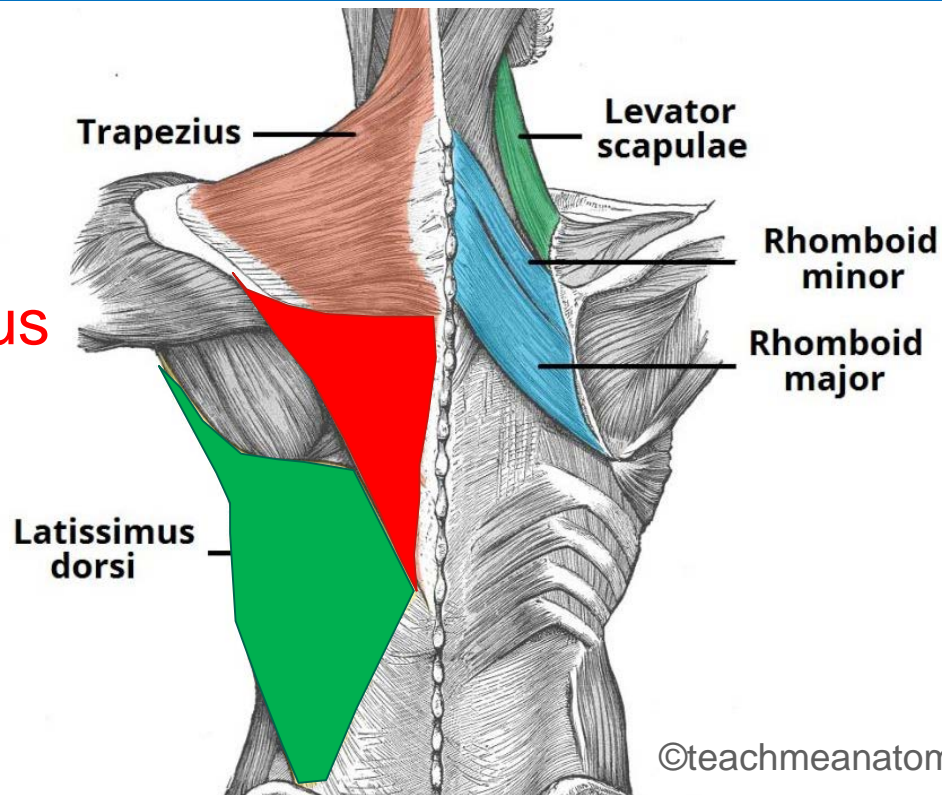
Comparison of reverse total shoulder arthroplasty

aER better in no repair group!

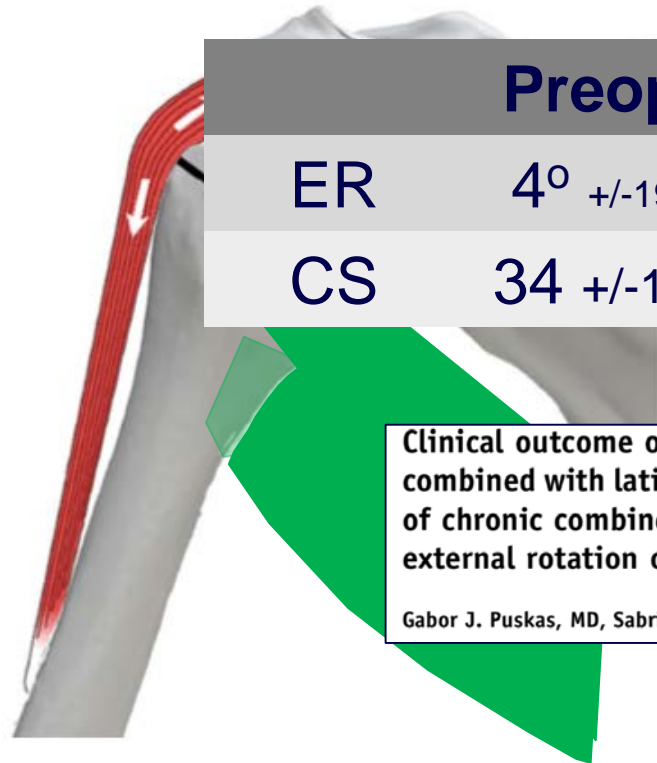
Richard J. Friedman, MD, FRCSC^{a,*}, Pierre-Henri Flurin, MD^b, Thomas W. Wright, MD^b,
Joseph D. Zuckerman, MD^d, Christopher P. Roche, MSE, MBA^e

TENDON TRANSFERS

1. Elongated Lower Trapezius
2. Latissimus Dorsi



LATISSIMUS DORSI TRANSFER



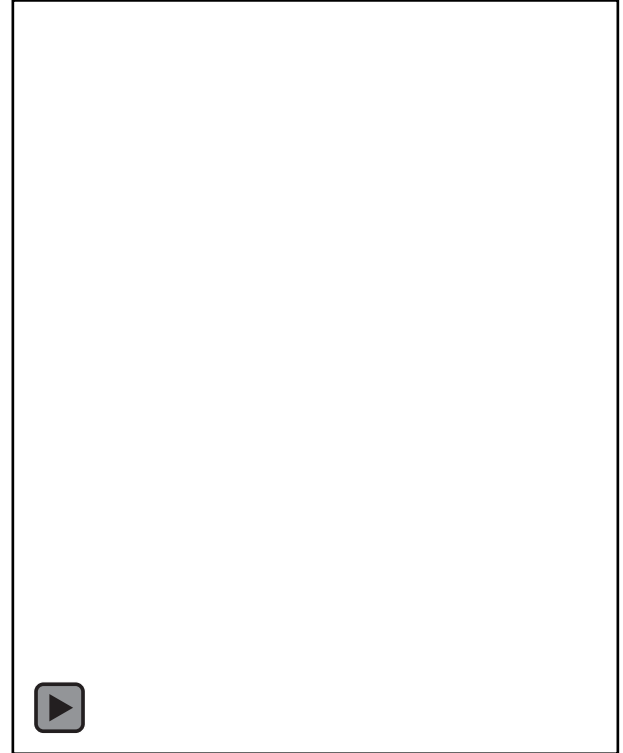
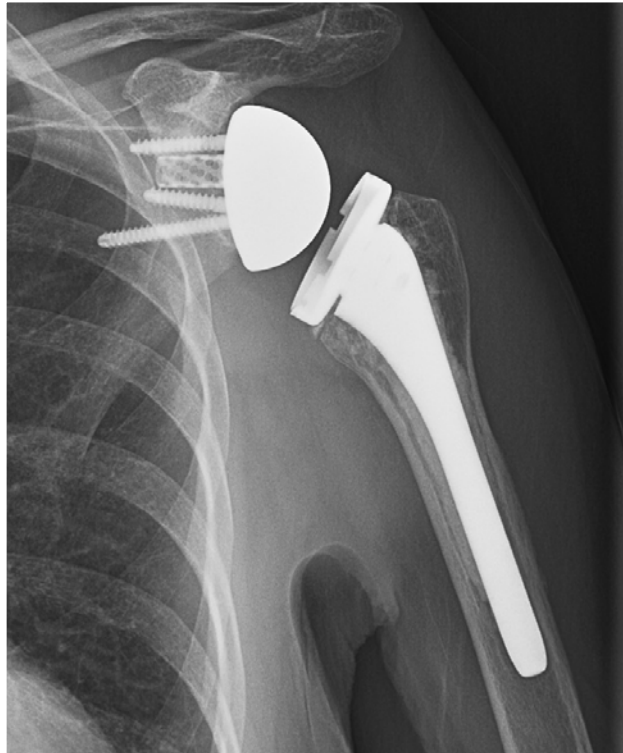
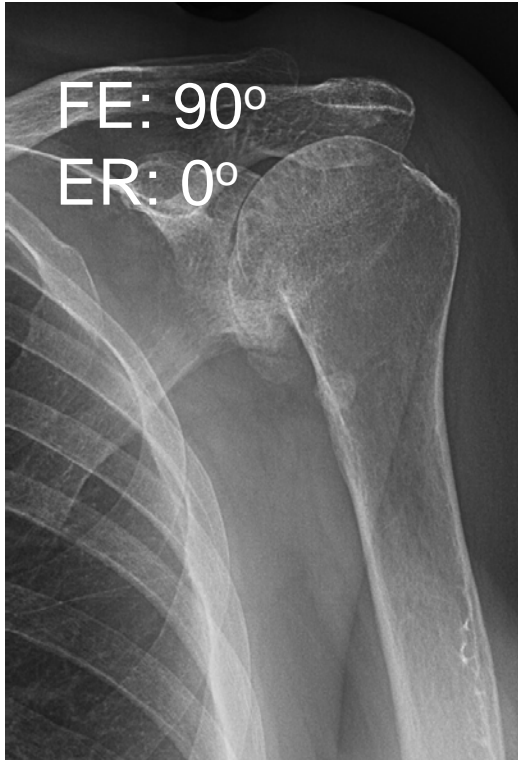
	Preop	2 Yrs	Final
ER	4° +/-19	27° +/-21	27° +/-20
CS	34 +/-14	69 +/-14	66 +/-14

Clinical outcome of reverse total shoulder arthroplasty combined with latissimus dorsi transfer for the treatment of chronic combined pseudoparesis of elevation and external rotation of the shoulder

Gabor J. Puskas, MD, Sabrina Catanzaro, RRN, Christian Gerber, MD, FRCSEd(hon)*

JSES 2015

ONE YEAR POST rTSA



SUMMARY

1. Restore RC tension – lateralize
2. Optimize ER moment arms – lateralize
3. Avoid humeral component anteversion
4. Latissimus transfer for ER lag
5. Subscapularis repair?

THANK YOU



THANK YOU

