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Biomechanical Consequences of Glenoid and Humeral Lateralization in RTSA

cadaveric measurements of center of rotation according to various lateralization options

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- **Conflicts of interest**

  - All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report

Introduction

- **Drawbacks of Medial Offset**

  Loss of shoulder contour; instability; scapular (adduction) notching; and limited active ER

Berglund et al, J Bone Joint Surg Am, 2018
Kennon et al, J Shoulder Elbow Surg, 2020

- The current RTSA designs have to find out the best adjustment of **Med vs. Lat offset** of COR by

  I. Glenoid side
  II. Humerus side

✓ **No consensus** regarding this issue

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Purpose

Lateralization in RTSA

- Cadaveric study
- Varying **glenoid / humeral component configurations**

1) to confirm the **effectiveness of lateralized RTSA**
2) to determine the **biomechanical consequences** between medialized and lateralized CORs

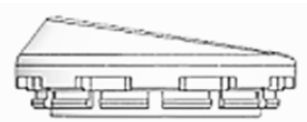
Methods

- Cadaveric biomechanical study
  - ✓ 8 fresh-frozen shoulder specimens

- Commercially-available lateralized RTSA designs
  - ✓ **Coralis® reverse total shoulder system**

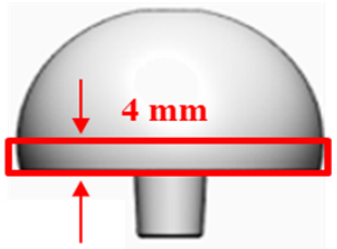
- **Implant option**
  - ✓ **Glenosphere (2) ×**
    Polyethylene insert (2) ×
    Tray offset (2) = 8

Standard

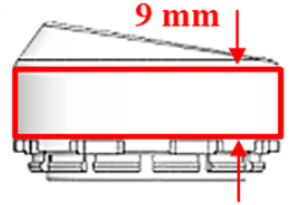


Standard

Standard



Lateralized Offset



Lateralized Humeral Insert

Eccentric Medial Offset

Measurements

1. Position of humerus (Microscribe)

- ✓ **Position of humerus** at 0º / 30º abd.

2. Impingement-free angles

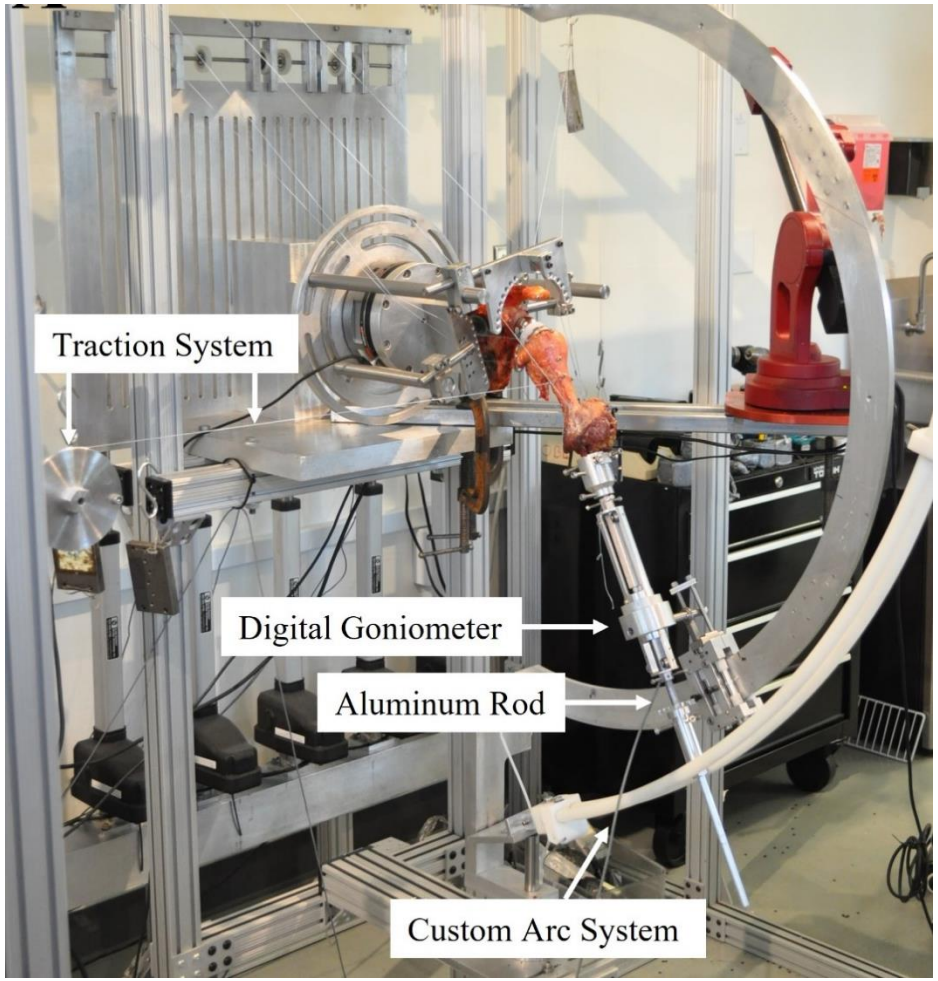
- ✓ **Add/Abd** at neutral rotation
- ✓ **IR/ER** at 0º / 30º abd.

3. Active ROM

- ✓ **ER capability** with 0%, 50%, 100% loads
- ✓ **Abd capability** with 0%, 50%, 100% loads

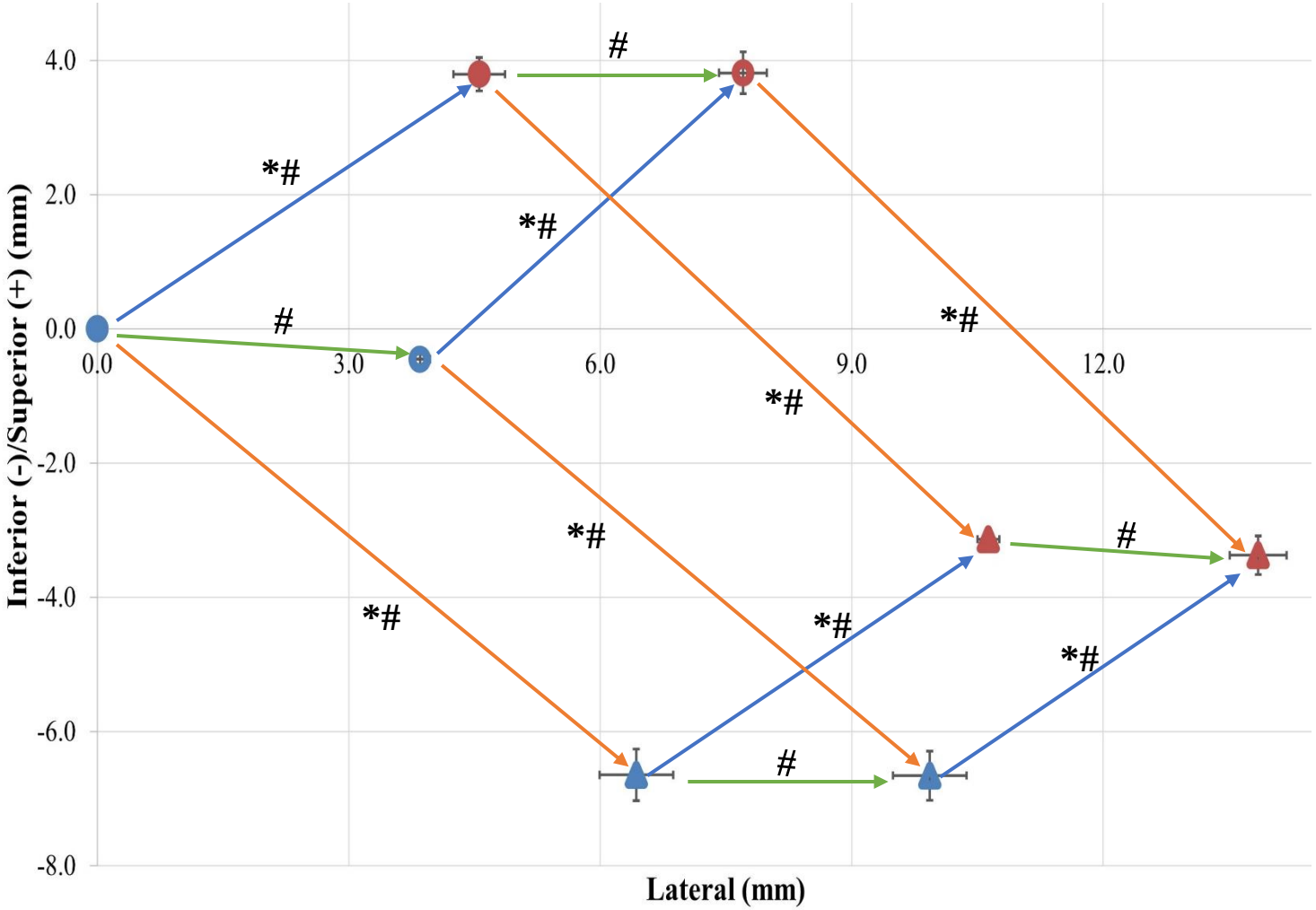
4. Stability

- ✓ **Anterior dislocation forces** with 0%, 50%, 100% loads



Result 1

Position of the humerus



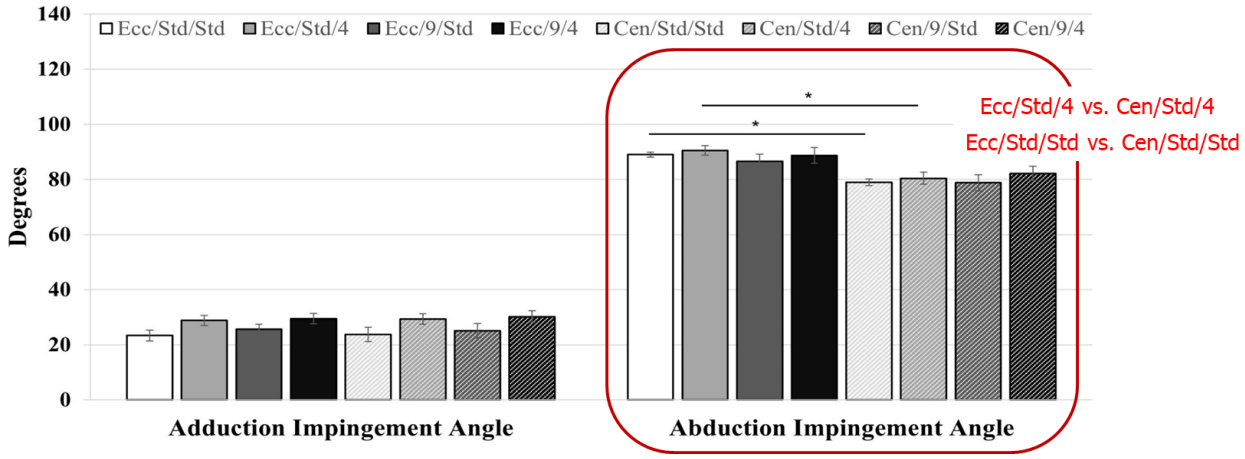
- **0 mm → +4 mm glenosphere**
  : 3 mm more **lateralization**
  without distalization

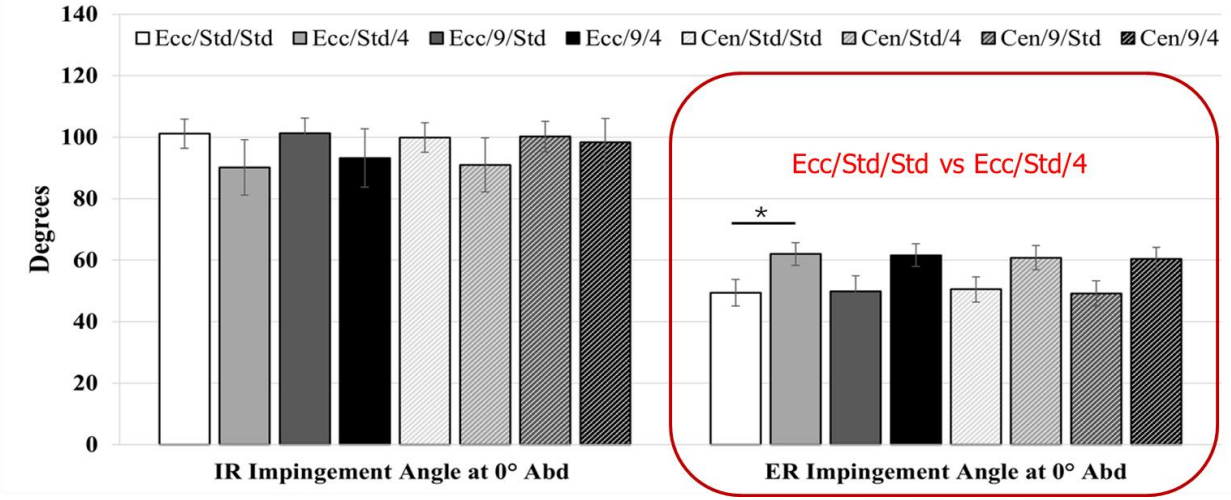
- **0 mm → +9 mm humeral insert**
  : 6 mm more **lateralization**
  7 mm more **distalization**

- **+6 mm eccentric → centric tray**
  : 4 mm more **lateralization**
  4 mm more **proximalization**

Result 2

Impingement-free passive ROM: Add/Abd, IR/ER





- **No significant difference** of adduction angles between implant configurations.
- **No significant difference** of IR angles between implant configurations.
- **Abduction** angle **significantly increased** in **eccentric tray** configurations when compared with the centric tray group.
- **ER** angle **significantly increased** in **thicker glenosphere** configuration when compared with the standard group.

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Result 2

Correlation: shifting of humeral position & passive ROM

Passive ROM	Superior Shifting		Lateral Shifting	
	r	*P*	r	*P*
Add angle	0.006	0.960	0.288	***0.022***
Abd angle	- 0.383	***0.002***	- 0.414	***0.001***
IR angle at 0° Abd	- 0.099	0.440	- 0.039	0.761
ER angle at 0° Abd	0.049	0.701	0.249	***0.049***

- **Add and ER angle** show **positive correlation** with **humeral lateralization.**
- **Abd angle** has a **negative correlation** with **humeral position.**

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Result 3

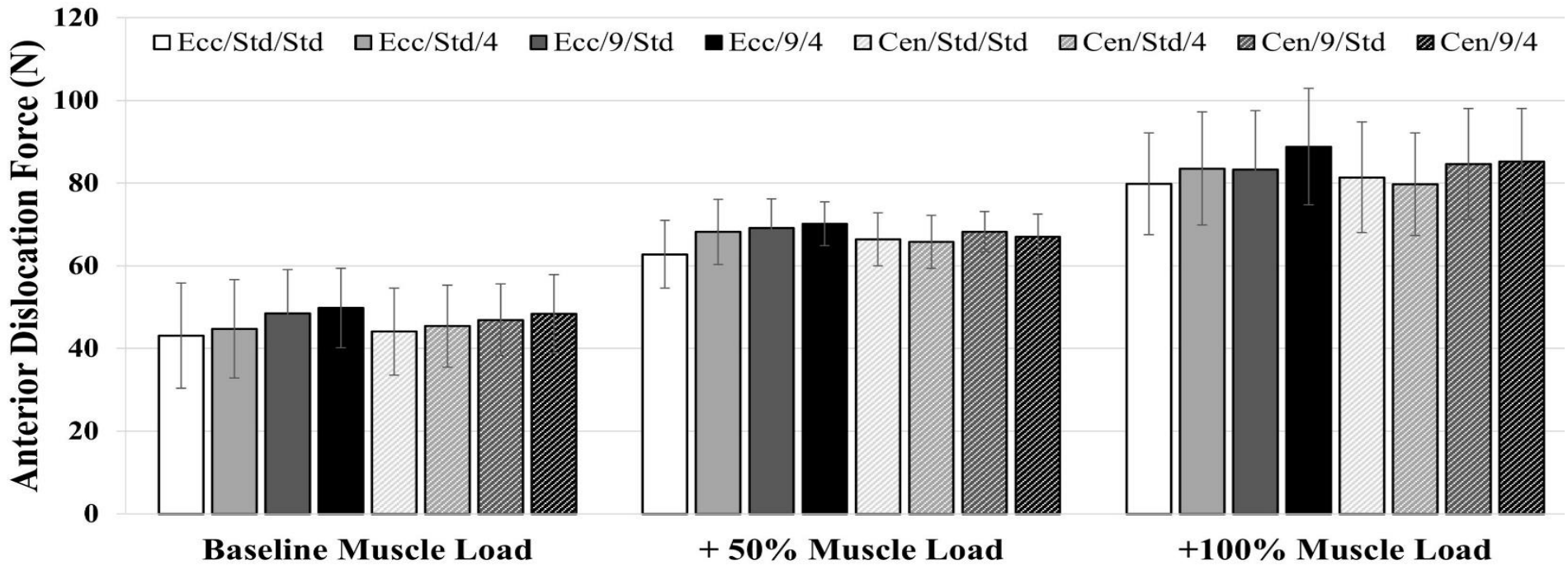
Active ROM: ER and Abd capability

Correlation: shifting of humeral position & active ER

- When increasing **teres minor** muscle load, ER capability was **not significantly different** between implant configurations under baseline and increased muscle load.
- When increasing **middle deltoid** muscle load, Abd capability was **not significantly different** between implant configurations under baseline and increased muscle load.
- **Active ER capability** has a **positive correlation** with **lateralization**.

Result 4

Stability: anterior dislocation forces



- **No significant difference** in anterior dislocation forces btw. implant configurations in this lateral RTSA implant of the current cadaveric test.

Conclusion

- **Lateralization** contributes to
  1) reducing **adduction scapular notching**
  2) increasing **active ER**

- **Glenoid lateralization**

✓ **Proper selection** of lateralization option would enhance the outcome of RTSA.

Disadvantages of reversing pseudoparalysis d/t absence of distalization

- **Humerus lateralization**
  1) **Thicker insert:** increase deltoid tension by **lateral & distal shift** (pts. with pseudoparalysis with lateral design implant)
  2) **Centric tray:** prevent over-lengthening by **'less-distal' & lateral shift**
  3) **Eccentric (medial) tray:** prevent abduction notching by **'less-lateral' & distal shift**

References

Lateralization in RTSA

- ✓ *Oh et al. JSES 2014*
- ✓ *Wong et al. JSES 2016*
- ✓ *Ernstbrunner et al. JBJS 2017*
- ✓ *Nolte et al. JSES 2021*
- ✓ *Langohr et al. JSES 2015*
- ✓ *Li et al. JSES 2013*
- ✓ *Tashjian et al. JSES 2015*
- ✓ *Gutiérrez et al JBJS 2008*
- ✓ *Barrett Payne KSSTA 2016*

Thank you very much for your attention!!