

# PATIENTS WITH ROTATOR CUFF TEARS UTILIZE TRUNK COMPENSATION TO REDUCE GLENOHUMERAL ELEVATION POST-EXERCISE THERAPY WHEN REACHING BEHIND THE BACK

Luke T. Mattar<sup>1</sup>, Camille C. Johnson<sup>2</sup>, Tom H. Gale<sup>2</sup>, Adam J. Popchak<sup>3</sup>, James J. Irrgang<sup>3,2</sup>, William J. Anderst<sup>2</sup>, Volker Musahl<sup>2,1</sup>, Richard E. Debski<sup>1,2</sup>

<sup>1</sup> Department of Bioengineering, <sup>2</sup> Department of Orthopaedic Surgery, & <sup>3</sup> Department of Physical Therapy University of Pittsburgh

## Introduction

Subjects with rotator cuff tears have been shown to compensate with trunk motion during provocative tasks [1]. Clinically, these subjects often experience pain when reaching behind the back making personal hygiene or dressing difficult. Studies have shown an average of 15.9° of glenohumeral elevation is required to reach behind the back in healthy subjects, encompassing the upper range of shoulder abduction where the supraspinatus is the main antagonist. Thus, rotator cuff tear subjects may compensate with trunk motion to reduce glenohumeral elevation and in turn pain.

## Objectives

Determine changes in trunk motion, maximum reach, and glenohumeral elevation and the relationship between trunk motion and glenohumeral elevation during a behind the back task following a 12-week structured exercise therapy program.

## Methods

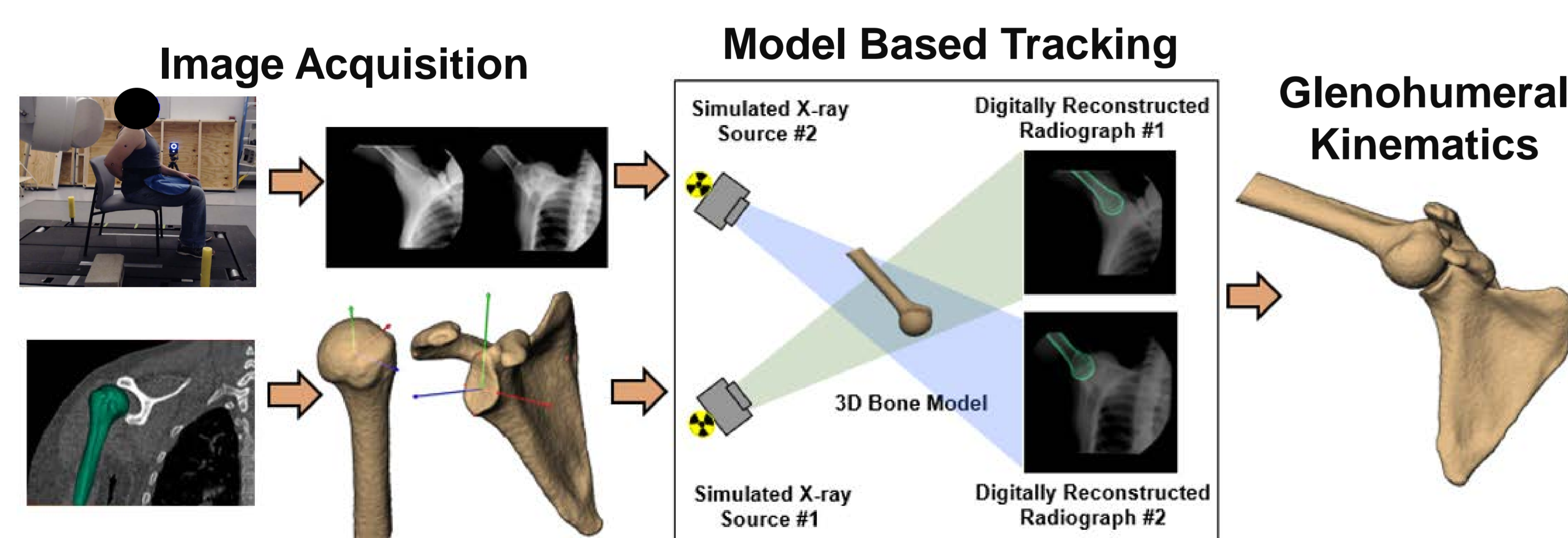
- 20 subjects (ages 45-70) recruited after providing IRB-approved written informed consent
  - Symptomatic rotator cuff tear isolated to supraspinatus

### Exercise Therapy Protocol

- 12-week structured program
  - Focuses: Range of motion and strengthening of rotator cuff/scapular muscles
  - Subject progression based upon pain, range of motion, and strength

### Dynamic Stereoradiography [2] and Vicon Motion Capture

- Subjects performed a behind the back task beginning with hand placed on thigh, reached as far behind back
- Vicon used to track anatomical markers to quantify trunk motion and reach



### Subject Specific Bone Models

Figure 1: Overview of image acquisition and procedures for kinematic analysis

### Pre- vs. Post-Exercise Therapy

- Comparisons made using pre- and post-exercise therapy trials containing the maximum reach in medial-lateral (ML) direction
- Outcome Parameters
  - Maximum anterior-posterior and lateral trunk lean, maximum trunk rotation (degrees, Vicon)
  - Maximum reach behind the back in ML direction, normalized to sternum marker and lower arm length (Vicon)
  - Glenohumeral elevation at maximum reach (degrees, Dynamic Stereoradiography)

### Statistics

- Paired t-test or circular statistics on outcome parameters pre- vs. post-exercise therapy
- Pearson's or Spearman's correlations to determine relationships between changes in trunk motion and glenohumeral elevation post-exercise therapy
  - Significance was set at  $p < 0.05$

## Results

Table 1: Maximum Trunk Motion, Glenohumeral Kinematics, and Maximum Reach Pre and Post 12-Week Exercise Therapy Program (Mean  $\pm$  SD)

Outcome Measure	Pre	Post	p
Anterior (-)/Posterior (+) Lean	-4.2 $\pm$ 4.2°	-5.1 $\pm$ 4.3°	>0.05
Lateral Lean (Towards Unaffected -, Affected +)	-4.4 $\pm$ 3.2°	-4.2 $\pm$ 3.1°	>0.05
Trunk Rotation (Unaffected forward -, Affected Forward +)	0.7 $\pm$ 4.7°	2.1 $\pm$ 3.7°	>0.05
Maximum Reach	-0.4 $\pm$ 0.3	-0.4 $\pm$ 0.6	>0.05
Glenohumeral Elevation	8.0 $\pm$ 9.4°	6.6 $\pm$ 8.1°	>0.05

- No differences in trunk motion, maximum reach, or glenohumeral elevation post-exercise therapy
  - Increased trunk rotation towards affected side  $\rightarrow$  decreased glenohumeral elevation at maximum reach (Figure 2)
  - $p < 0.05$ ,  $R^2 = 0.27$ ,  $R = -0.52$

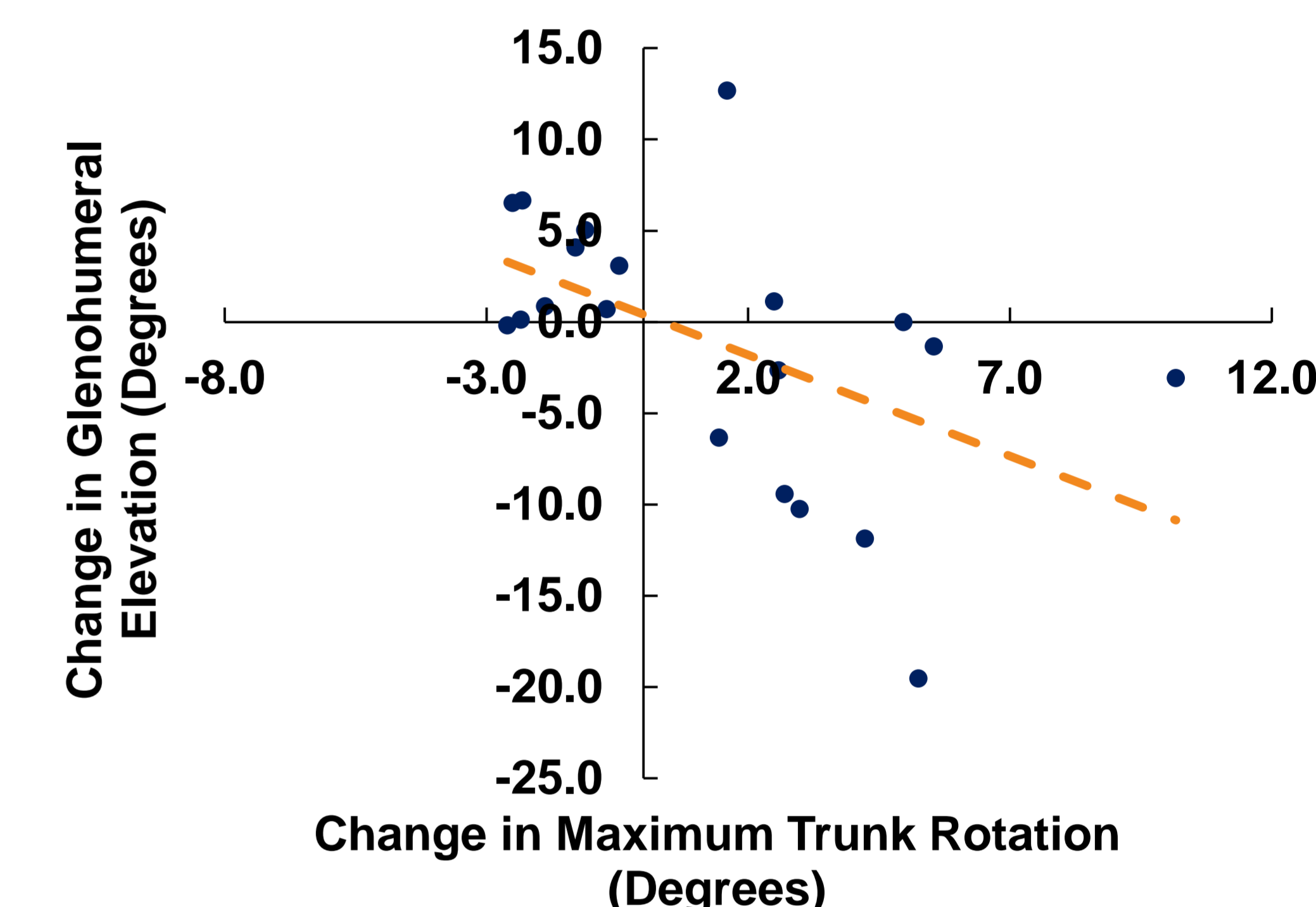


Figure 2: Relationship Between Changes in Trunk Rotation and Changes in Glenohumeral Elevation

## Discussion

- No changes in maximum reach in ML direction  $\rightarrow$  exercise therapy may not affect reaching behind the back
- Relationship between changes in maximum trunk rotation and glenohumeral elevation at maximum reach  $\rightarrow$  indicative of changes in motion strategy
  - Positioning affected side more forward  $\rightarrow$  increase clearance with lateral torso minimizing glenohumeral elevation required
  - Glenohumeral elevation measured in healthy subjects at maximum reach behind the back was 15.9° [3], 240% higher than current cohort

### Future Directions

- Relationship between tear size and patient reported outcomes with trunk compensation will be evaluated  $\rightarrow$  determine if motion strategy decreases discomfort reaching behind the back
- Evaluate changes in maximum reach in superior-inferior direction post-exercise therapy

### Significance

- Identifying motion strategies utilized by patients with rotator cuff tears may help identify functional improvements
- Compensation via trunk rotation may aid in development of a predictive model to determine the effects of exercise therapy on glenohumeral elevation during a behind the back task

### Acknowledgements

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### References

- [1] Lefevre-Colau et al. *Ann Phys Rehabil Med* 2018
- [2] Bey M et al. *J Biomech Eng* 2006
- [3] Kolz et al. *ORS* 2018

