

Introduction

- Prevalence of preoperative glenohumeral OA in anterior instability: 8.3-15 % [1, 2, 3]
- Severity of OA associated with the number of preoperative dislocations [1]

The neutral zone:

- range of joint motion with little or no resistance to motion [4]
- increases with injury, which in turn may result in instability [4]

Objective

Investigate the relationship between the neutral zone for external and internal rotation of the glenohumeral joint with the arm abducted and the number of anterior dislocations.

Hypothesis

Glenohumeral joint would become more unstable following multiple anterior glenohumeral dislocations due to capsular injuries.

Methods

- Eight fresh-frozen cadaveric shoulders (age range 48-66 years)
- All soft tissue except glenohumeral capsule removed
- Evaluate function of intact capsule at 60 degrees of glenohumeral abduction, +/- 1.1 Nm rotational torque was applied to the humerus, and the resulting joint kinematics were recorded
- Dislocation at 60° of abduction and 60° of ext. rotation of the glenohumeral joint to reach an anterior translation of [(1/2 max. AP width of the glenoid) + 10 mm] using 6-DOF robotic testing system
- Same torques were applied to shoulder and resulting kinematics were recorded following 1, 2, 3, 4, 5 and 10 dislocations.

Data analysis

- Torque-rotation curves – max. external to max. internal rotation [4][5]
- Neutral zone and “initial” stiffness calculated (Figure 1).

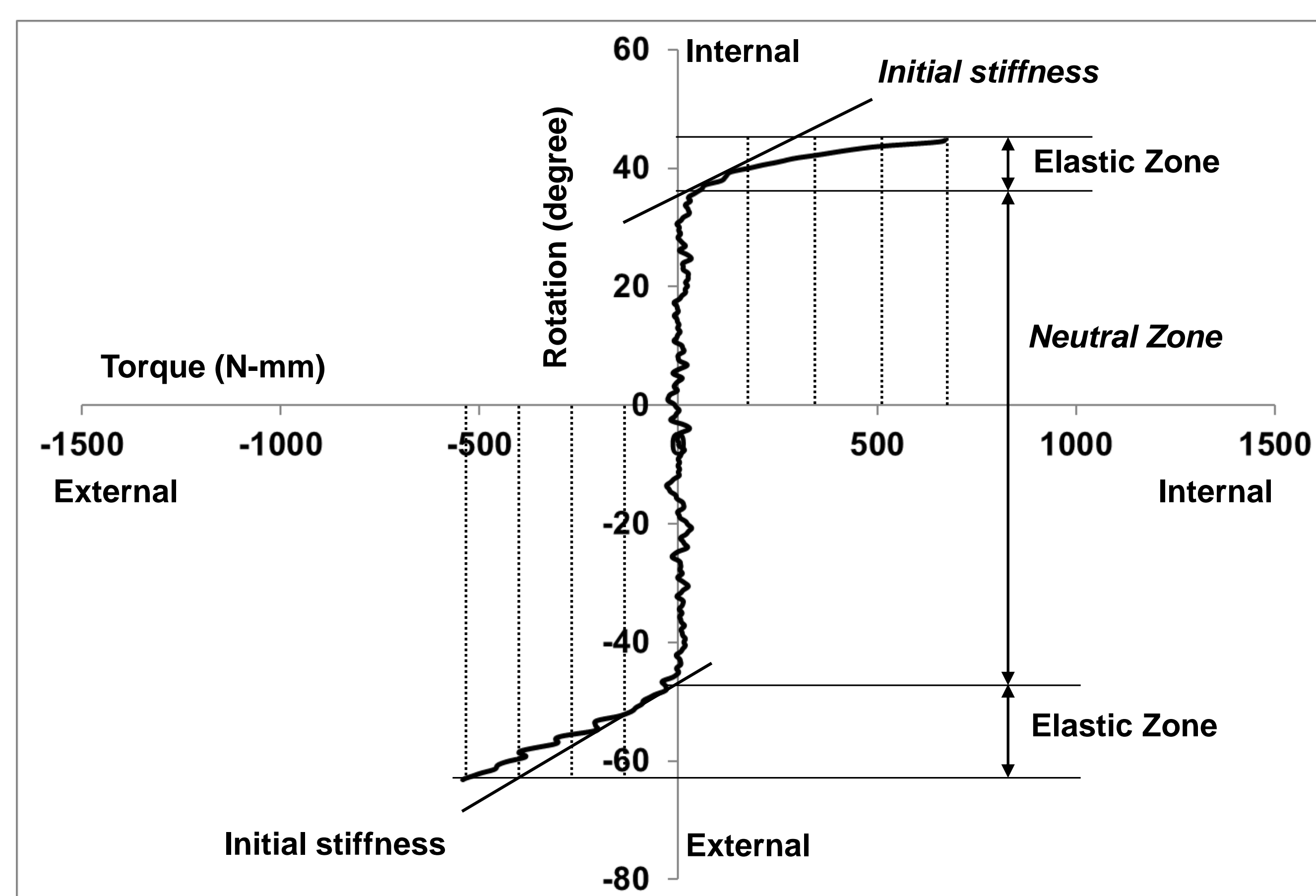


Figure 1. Torque-rotation curve of specimen 2 before dislocation (Intact state).

- *Neutral zone* defined as the range of motion (ROM) where the gradient of the torque-rotation curve was within ± 0.01 Nm/degree [6].
- *Initial stiffness* calculated as the mean gradient of the torque-rotation curve at the first quarter of elastic zone in external and internal rotation [4].

Statistical analysis

Repeated-measures analysis of variance (ANOVA) compared magnitude of neutral zone and initial stiffness in each direction of loading following each dislocation ($p < 0.05$).

Results

Neutral zone significantly increased by

- 6.5% 2nd dislocation to intact state, 5.8% 5th dislocation to 1st dislocation, and 5.0% 10th dislocation to 5th dislocation (Fig.2)

Initial stiffness in external rotation significantly increased by

- 46.6% 2nd dislocation to intact state, 35.6% 5th dislocation to 1st dislocation, and 43.3% 10th dislocation to 5th dislocation (Fig.3)

Initial stiffness in internal rotation significantly increased by

- 86.7% 5th dislocation to intact state and 52.9% 10th dislocation to 5th dislocation (Fig.3)

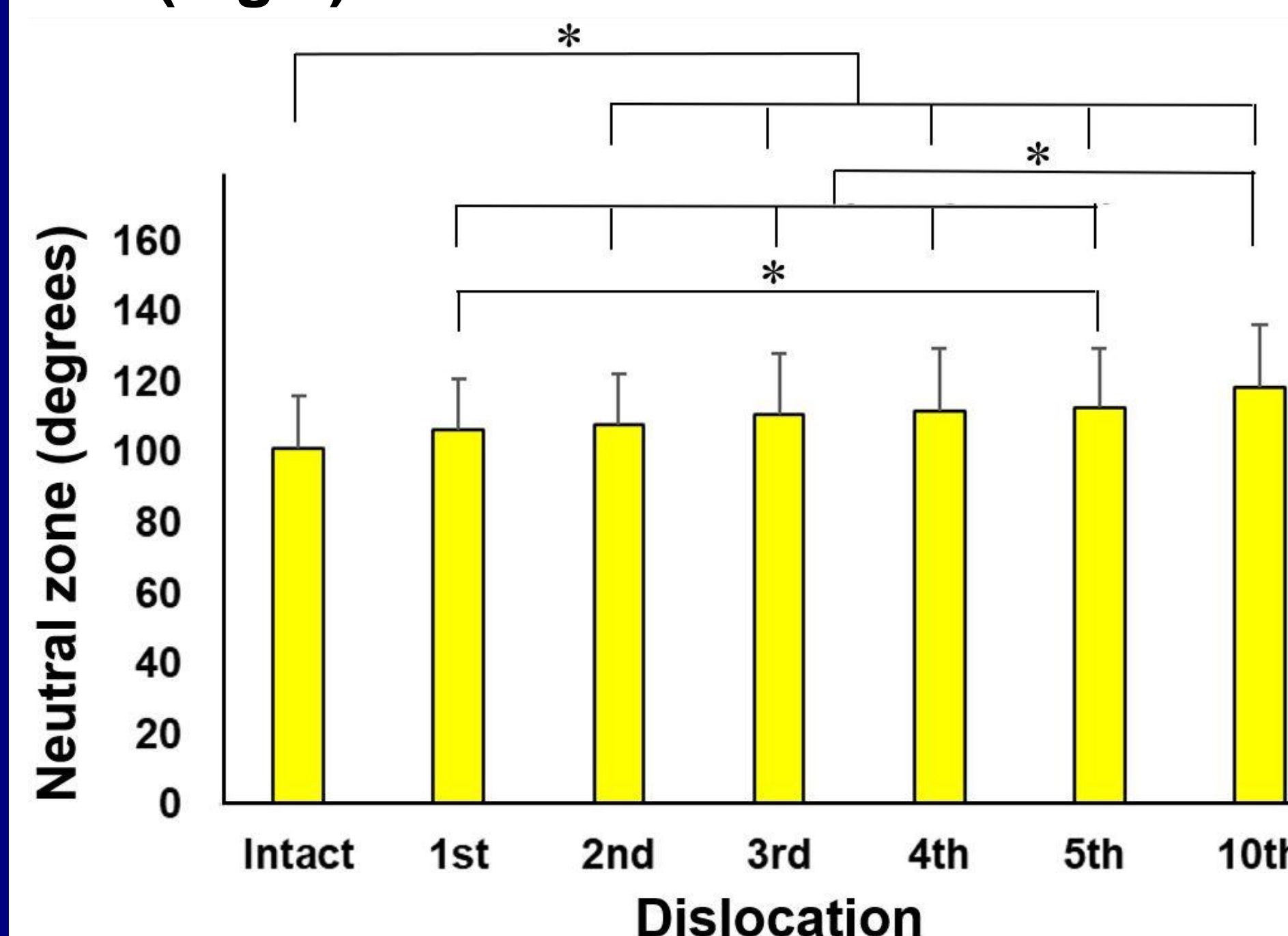


Figure 2. Neutral zone before and after each dislocation. (mean \pm S.D.)
*: $p < 0.05$

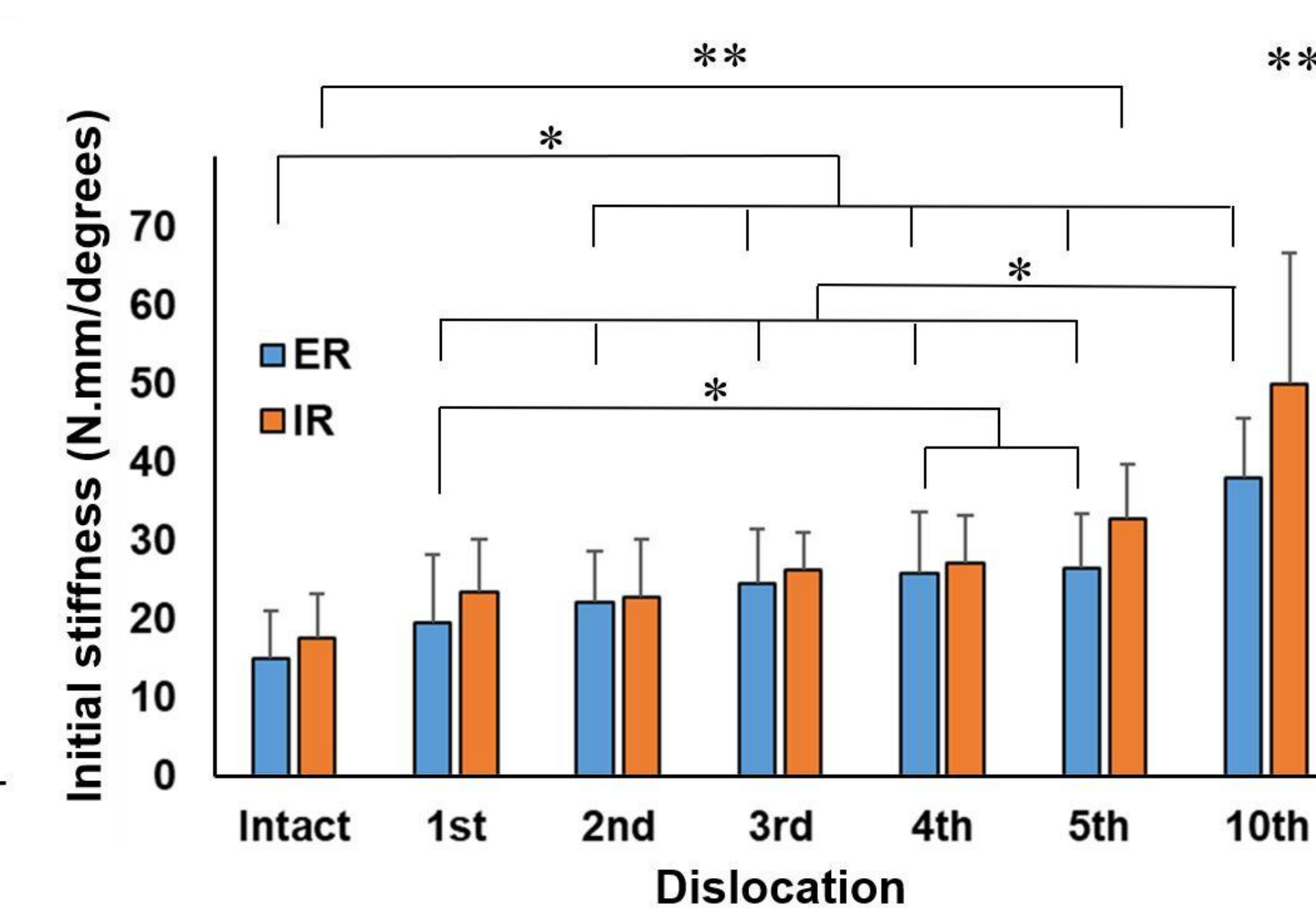


Figure 3. Initial stiffness for external rotation (ER) and internal rotation (IR). (mean \pm S.D.) *: $p < 0.05$ for ER, **: $p < 0.05$ for IR.

Discussion

- Size of neutral zone increased following 2nd, 5th, and 10th dislocations
- Initial stiffness in ext. rotation increased following 2nd, 5th, and 10th dislocations
- Initial stiffness in int. rotation increased following 5th and 10th dislocations
- ✓ Increase of initial stiffness in ER indicate anterior capsular damage
- ✓ Increase of initial stiffness in IR indicate posterior capsular damage
- Glenohumeral joint became more unstable following 2nd, 5th, and 10th dislocations
- Anterior capsule appears to be injured first and then the posterior capsule based on initial stiffness data
- ⇒ Findings consistent with previous clinical studies - severity of glenohumeral OA associated with number of preoperative dislocations [1].

Future Direction

- Determine capsular plication procedure to restore the neutral zone and initial stiffness to level of intact joint

Significance

- Glenohumeral joint became more unstable following a 2nd anterior dislocation due to capsular injuries first to anterior capsule, then posterior capsule.
- Surgical repair should be considered following a 2nd dislocation to avoid further damage.

Acknowledgements

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References

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