Introduction
Anterior shoulder dislocations can result in non-recoverable strain of the glenohumeral capsule, increasing the chances of recurrent shoulder instability. Optical tracking can be used to determine non-recoverable strain, which indicates injury, by recording the position of markers adhered to the capsule before and after a dislocation. This method has not been assessed following a severe anterior shoulder dislocation.

Objective
Assess ability to determine non-recoverable strain via optical tracking in the glenohumeral capsule following a severe anterior shoulder dislocation
1) Tissue pathomorphology 2) Intra-observer repeatability 3) Inter-observer repeatability

Materials & Methods
• 2 fresh-frozen shoulders, dissected of all tissue except glenohumeral capsule
• 7x11 Grid of strain markers adhered to inferior glenohumeral ligament
• 6 DOF Robotic testing system (FRS2010, Chino, Japan) performed 3 severe dislocations by applying force to anteriorly translate humerus across entire width of glenoid (Figure 1)
• 3D position of strain markers recorded by motion tracking system (Spica technology corporation, HI) before and after dislocation in reference configuration
• Max principal strain calculated on humeral side of anterior band using ABAQUS (Simulia, Providence RI)
• Tissue pathomorphology observed

Repeatability
• Average non-recoverable strain of nine elements on humeral side of anterior band of glenohumeral capsule (Figure 2)
• Intra-observer repeatability: Tracked 3 times, 1 day apart
• Inter-observer repeatability: Tracked 3 times each by two observers

Results
Tissue Pathomorphology
• Specimen 1: capsular tearing- strain analysis not possible (Figure 3)
• Specimen 2: no capsular tearing, marker visibility affected by new folds in tissue- strain analysis possible

Repeatability
• Good intra- and inter-observer repeatability
• Inter-observer repeatability slightly better

Table 1. Intra- and inter-observer repeatability

<table>
<thead>
<tr>
<th></th>
<th>STD (% Strain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer 1</td>
<td>0.2%</td>
</tr>
<tr>
<td>Observer 2</td>
<td>0.2%</td>
</tr>
<tr>
<td>Inter-Observer</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Discussion
• Capsule plication- common procedure to reduce recurrent shoulder instability after a dislocation
➢ Quantify non-recoverable strain → improve accuracy of capsular plication
• Capsular tearing
➢ Humeral head tore through capsule, with tear starting near anterior portal
➢ Non-recoverable strain analysis not possible
• Better repeatability than previous studies [3]
• Strain averaged across region instead of measuring each element
• All tracking done from one recording- effect of entire experimental procedure not assessed

Future directions
• Study surgical repair of capsule tear

Significance
• Optical tracking has good repeatability for determining non-recoverable strain, but limited by tissue pathomorphology caused by severe dislocation