INTRODUCTION: Despite the common nature of acute anterior glenohumeral dislocation, there is little information on the molecular factors which are important in healing (or failure to heal) of the glenoid labrum. The goal of this study was to utilize a novel animal model of acute anterior shoulder dislocation to determine the biomechanical stability of the rat glenohumeral joint after injury and the changes in stability over time as the injured labrum heals.

METHODS: We devised a novel animal model of anterior-inferior glenohumeral instability where we created a reproducible injury in the rat anterior inferior glenoid labrum. Using an IACUC approved protocol, injury to the anterior inferior labrum was surgically induced in 20 male Lewis rats. Rats were sacrificed at 14 or 28 days. The glenohumeral joint as well as the scapula and humerus were removed and dissected to isolate the joint capsule, humerus and scapula. For biomechanical stability testing, the humeri were mounted to the actuator of an EnduraTec ELF 3200 load frame (EnduraTec Systems, Minnetonka, MN) using custom pull-out fixtures. The tissue was preloaded to 0.2 N, and anterior to posterior laxity fatigue was performed for a total of 100 cycles at an amplitude of ± 5 N. Monotonic loading in anterior tension at a constant displacement rate of 0.1 mm/sec was completed upon the conclusion of fatigue testing until failure. Load and displacement data were acquired using WinTest collection software (EnduraTec Systems, Minnetonka, MN). Dynamic stiffness for anterior and posterior laxity, load to failure, stiffness and maximum load were recorded. The uninjured shoulder was used as a control. Statistical significance was determined using the student’s t test (p<0.05).

RESULTS: The injured shoulders demonstrated increased anterior displacement at both 2 and 4 weeks after injury compared to uninjured shoulders. The amount of displacement increased over time in injured shoulders whereas the amount of displacement did not significantly change in the control group.

DISCUSSION: In this animal model of acute anterior shoulder instability, increased anterior laxity was seen after anterior labral injury compared to uninjured control shoulders. Laxity increased by four weeks, suggesting impaired labral healing in these shoulders. Stiffness and maximum load to failure also decreased in injured compared to uninjured shoulders, further supporting an impaired healing response. These biomechanical data provides important information on the temporal changes which occur after anterior glenohumeral dislocation and anterior labral injury. When correlated with other molecular studies to assess gene expression in the injured labrum, these data will provide further understanding of the impaired healing response which occurs following acute anterior shoulder dislocation.

SIGNIFICANCE: There is currently no reliable animal model for glenohumeral instability, and little is known about the capacity for glenoid labral healing. The identification of factors important to glenoid labral healing may lead to the development of novel agents which may be used to augment glenoid labrum healing and ultimately improve both surgical and non-surgical treatment of this common shoulder injury.