Increased Lateral Tibial Slope Raises the Risk of Early ACL Graft Failure

Written by Nicola Parry

Joshua Christensen, MD, Mayo Clinic, Rochester, Minnesota, USA, presented data from a study that was conducted to determine the relationship between lateral tibial posterior slope (LTPS) and the probability of early graft failure in patients who have undergone anterior cruciate ligament (ACL) reconstruction. The results showed that regardless of graft type, increased LTPS is associated with an increased risk for early ACL graft failure, especially in women.

A growing number of reports suggest that LTPS is a risk factor for ACL injury [Wordeman SC et al. *Am J Sports Med* 2012]. However, the effect of LTPS on ACL graft failure is unknown. With this in mind, Dr. Christensen and colleagues conducted a case-control study in skeletally mature patients who experienced early graft failure following primary ACL reconstruction and underwent surgical revision between 1998 and 2009.

Exclusion criteria included clinical follow-up of < 4 years, graft failure occurring > 2 years from the time of the primary surgery, skeletal immaturity, deep infection, lack of availability of preoperative magnetic resonance imaging (MRI), and a history of previous proximal tibial trauma. Among 58 cases that were originally evaluated for inclusion, 35 cases (n = 21 for men) remained in which patients experienced early (within 2 years) failure of primary ACL reconstruction. These were matched to 35 control cases (n = 21 for men) involving patients who had undergone ACL reconstruction with a minimum of 4 years of clinical follow-up and no evidence of graft failure. Patients were matched by age, gender, date of primary surgery, and graft type (n = 14 for bone–patellar tendon–bone, n = 13 for hamstring autograft, and n = 8 for allograft in each group). Lateral tibial slope was determined on MRI imaging in blinded fashion.

In the graft failure group, all 35 cases failed within 2 years of primary ACL reconstruction, with a mean time to failure of 1 year (range, 0.6 to 1.4 years). In the matched control group, mean follow-up was 6.9 years (range, 4.0 to 13.9 years). Overall in the early ACL failure group, mean lateral tibial slope was significantly higher than that the control group (8.4° vs 6.5°; p = .012; odds ratio [OR], 1.6; 95% CI, 1.1 to 2.2), and the ORs increased to 2.4 (95% CI, 1.2 to 5.0) and 3.8 (95% CI, 1.3 to 11.3) with 4° and 6° increases in tibial slope, respectively.

This effect was also particularly pronounced in women, in which group mean lateral tibial slope was also significantly higher than in the control group (9.1° vs 5.9°; p = .007; OR, 2.2; 95% CI, 1.0 to 5.2). The ORs increased to 4.9 (95% CI, .9 to 26.7) and 10.9 (95% CI, .9 to 26.7) with 4° and 6° increases in tibial slope, respectively.

There was no significant association between graft type and primary ACL reconstruction failure.

Limitations of this study included its retrospective nature, as well as the need for dedicated software and the multiple steps required for measurement. However, because the data show that increased LTPS is associated with an increased risk for early ACL graft failure, Dr. Christensen concluded that orthopedic surgeons should consider measuring LTPS as part of their preoperative assessment of patients with ACL injury.

Concomitant Humeral Head and Glenoid Defects Increase Glenohumeral Translation

Written by Jill Shuman

Bone defects on the glenoid or humeral side are a primary reason for failure following instability surgery [Burkhart SS, De Beer JF. *Arthroscopy* 2000; Bollier MJ, Arciero R. *Sports Med Arthrosc* 2010]. The critical level for bone loss at the glenoid or humeral head as a risk factor following instability surgery is historically considered to be 20% to 25% and 25%, respectively. According to Robert Arciero, University of Connecticut Health Center, Farmington, Connecticut, USA, however, much of these data are derived from cadavers with isolated lesions, whereas in clinical practice, concomitant defects of the glenoid and humeral head occur in 89% to 100% of patients with instability.

Dr. Arciero shared data from a study that evaluated combined lesions of the shoulder from a cadaveric model that was based on an actual patient database. The purpose of the study was to assess the effects of concomitant glenoid (Bankart) lesions and humeral head (Hill–Sachs) lesions in a bipolar bone loss model.

The study was designed to determine (1) whether combined defects of the glenoid and humeral head had an additive negative effect on stability, and (2) whether the percentage of bone defects that predict instability is lower in the two lesions when they occur concomitantly. The working hypothesis was that combined humeral head and glenoid defects would increase glenohumeral translation and adversely affect soft tissue repair and that

lower percentages of bone loss would compromise soft tissue repair.

Using eight cadavers, the research team created 2-, 4-, and 6-mm glenoid bone lesions and an isolated 1.47-cm^3 Hill–Sachs lesion. A 3D printer was used to make a model of the proximal humerus with a 1.47-cm^3 bone lesion. The humerus lesion was then recreated in cadaveric specimens. Glenoid bone defects were created and made parallel at 2, 4, and 6 mm, which represented an 8% to 25% defect. These bone defects were tested on a test shoulder apparatus at 60° of glenohumeral abduction and 60° of external rotation, and with a 50 Newton compressive load as described by previous research [Itoi E et al. *J Bone Joint Surg Am* 2000; Yamamoto N et al. *Am J Sports Med* 2009]. The primary outcome was load to translation to 10 mm, loaded at a rate of 2 mm/second. Every specimen was tested intact with the humeral lesion, with subsequent bony lesions, and with Bankart repair (Table 1).

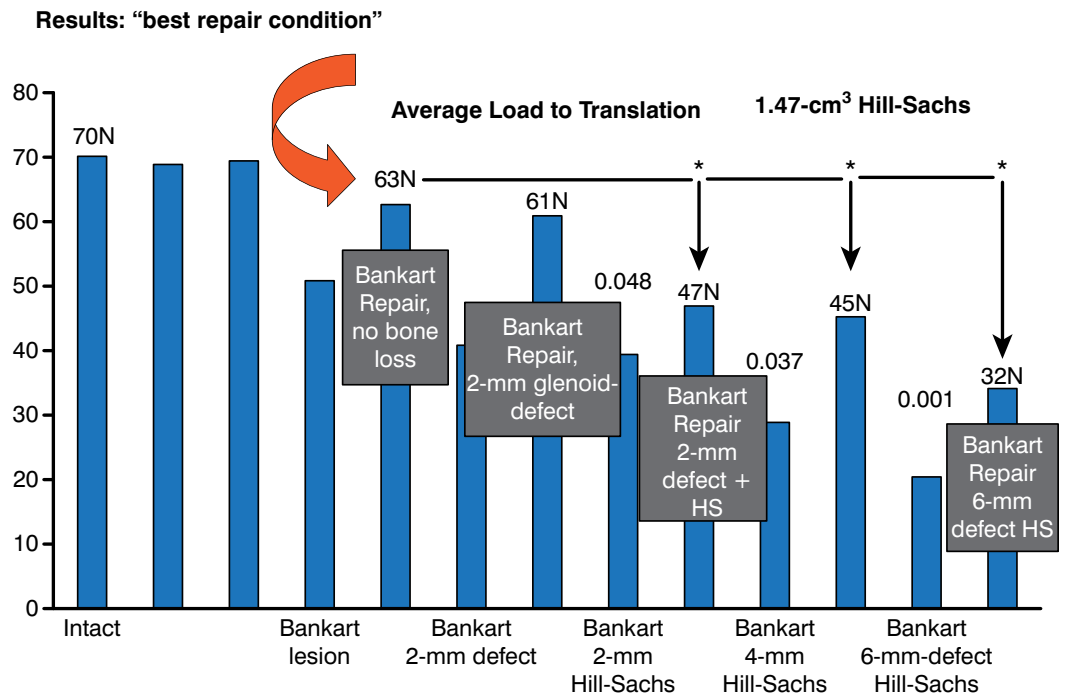
Dr. Arciero then reviewed the results. There was no significant difference in average load to translation when the two lesions were tested separately. When the two lesions were tested together with a 2-, 4-, or 6-mm glenoid defect, however, the average load-to-translation decreased significantly (Figure 1).

Table 1. Specimen Testing Sequence

Intact
Bankart lesion
Bankart repair
2-mm defect
Bankart repair
Hill–Sachs
Bankart repair
4-mm defect
Bankart repair
6-mm defect
Bankart repair

Dr. Arciero concluded that combined lesions have an additive and adverse effect on the amount of bone loss required to compromise soft tissue repair and that the critical point is lower than that of either defect evaluated in isolation. This may require surgeons to investigate alternative surgical procedures other than soft tissue repairs alone.

Figure 1. Cumulative Effects of Bone Defects on Load to Transmission



HS=Hill–Sachs.

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