INTRODUCTION: Patellofemoral disorders are among the most common knee problems. The spectrum of disorders range from anterior knee pain to frank patellar dislocation. Patellofemoral pain, or anterior knee pain, is more common in females than in males. Factors believed to contribute to anterior knee pain include genu varum, increased Q-angle, increased femoral anteversion, and increased foot pronation, all of which are more common in females. Treatment of patellofemoral pain begins with quadriceps muscle strengthening with special emphasis on selective vastus medialis (VM) strengthening. For the patients who fail conservative treatment, the next step may be surgical intervention, possibly including lateral retinacular release. Clinically, the results of lateral release are variable, with success rates reported up to 80%. Huberti and Hayes’ biomechanical study showed that lateral release does not result in decreased patellofemoral contact pressures. However, their study did not evaluate differences in contact pressures with respect to gender. The objective of this study, therefore, was to determine if there are gender related effects of lateral retinacular release and tibial rotation on patellofemoral joint forces, contact areas, and contact pressures.

MATERIALS AND METHODS: Twelve fresh frozen cadaveric specimens, six male and six female, were dissected free of all skin and soft tissue leaving only the extensor mechanism, the iliotibial band (ITB), the joint capsule, and retinaculum intact. The individual components of the quadriceps mechanism (VM, RF/VI, VL) and the ITB were separated and clamped individually. Each knee was then mounted on a custom knee testing jig with 6 degrees of freedom at the femur and 5 degrees of freedom at the tibia. (Figure 1) The femur and the tibia were fixed rigidly onto the testing jig. Anatomically based multiaxial loading of the quadriceps mechanism (VM 67N, RF/VI 111N, VL 98N) and the ITB (27N) was used to simulate physiologic loading of the PFJ. (3) Fuji Pre-Scale pressure sensitive film was used to quantify patellofemoral contact pressures and areas. A six degree of freedom load cell mounted on the jig along the axis of the femur was used to directly measure the PFJ forces. Data was collected at 0, 30, 60, and 90 degrees of knee flexion with the tibia in neutral position, 15 degrees external rotation, and 15 degrees internal rotation both before and after lateral retinacular release. To determine if there were gender differences in the patellofemoral contact areas, pressures, and joint forces, statistical analysis was performed using a one-way analysis of variance (ANOVA) with a significance level of 0.05.

RESULTS: The patellofemoral joint forces measured directly by the load cell were normalized by taking the difference between the tibial rotation and neutral for both the intact and following lateral retinacular release at each knee flexion angle. Gender differences were seen for change in resultant patellofemoral joint forces in response to lateral retinacular release and tibial rotation at 60 degrees (28N increase in Females(F) vs. 79N increase in Males(M) (p<0.05)) and 90 degrees (24N increase in F vs. 44N increase in M (p<0.05) of knee flexion angle and internal rotation (Figure 2). There were no gender differences at all knee flexion angles in response to lateral release and tibial rotation at 60 degrees (17% decrease in F vs. 2% decrease in M (p<0.05)) and 90 degrees (19% decrease in F vs. 3% increase in M (p<0.05)) of knee flexion angle. There were no gender differences for external tibial rotation at knee flexion angles of 60 and 90 degrees in response to lateral release for the patellofemoral joint forces. At neutral, only at 90 degrees of knee flexion showed gender differences in patellofemoral contact pressures in response to lateral retinacular release (26% decrease in F vs. 6% increase in M (p<0.05)). At 30 degrees of knee flexion angle, patellofemoral joint contact pressures showed gender differences in response to lateral release only in external rotation of the tibia (p<0.05). Specifically, female knees showed a decrease in contact pressures of 22% and the male knees showed an increase of contact pressure of 27%. There were no differences between gender at 0 degree of knee flexion.

DISCUSSION: The results from this study suggest that that the patellofemoral joint in female knees may be more effective in redistribution of joint forces with increased soft tissue load sharing following lateral retinacular release. In male knees, at 60 and 90 degrees of knee flexion, the lateral retinacular release resulted in significant increase in resultant patellofemoral joint forces while having essentially no change in the patellofemoral joint contact pressures. The results of patellofemoral joint contact pressures in male knees support previous findings by Huberti et al (2) and Barnett et al (1). This suggests that the effects of structural alterations due to the lateral retinacular release in male knees are predominantly absorbed by the change in patellofemoral joint forces. In female knees, at 60 and 90 degrees of knee flexion, the lateral retinacular release resulted in increase in resultant patellofemoral joint forces but less than in males while having significant decreases in patellofemoral joint contact pressures. Therefore, the results from this study suggest that in female knees, the effects of structural alterations due to the lateral retinacular release may be absorbed by both the patellofemoral joint contact pressures and the joint forces. Patients with anterior knee pain often have symptoms with prolonged knee flexion as well as extremes of knee flexion under loading conditions. The decrease in contact pressure seen in the female knees at 30, 60 and 90 degrees of flexion after lateral retinacular release may represent relative unloading of the joint and redistribution of joint forces with increased soft tissue load sharing. Thus, in females, a decrease in contact pressures following lateral release may result in decreased anterior knee pain at higher knee flexion angles.