

The Effect of Implant Constraint and Ligament Repair on Compartment Balancing after Medial Collateral Ligament Injury During Total Knee Arthroplasty

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INTRODUCTION:

Intraoperative midsubstance injury to the medial collateral ligament (MCL) is a devastating complication of total knee arthroplasty (TKA). No single definitive treatment method has been shown to yield optimal stability. The purpose of this cadaveric study was to compare the impact of primary MCL repair, increasing prosthetic constraint, and a combination of both techniques on medial tibiofemoral compartment gapping after iatrogenic MCL injury.

METHODS:

We performed 16 cadaveric robotic-assisted TKA and recorded gap measurements at 10, 30, 60, and 90 degrees of flexion with a posterior stabilized (PS) prosthesis as the control group. The primary experimental groups were: G1) no MCL repair and PS, G2) no MCL repair with varus-valgus constrained inserts (VVC), G3) MCL repair with PS, G4) MCL repair and VVC. The average balance with the 3 different approaches of interest (G2, G3, and G4) were compared to the control group for rate of deficit (RD) and compared to G1 for rate of improvement (RI) in gap balance. Simple statistics were used to calculate average medial balance for the groups and ANOVA modeling was used to determine average changes in RD and RI with a $p < 0.05$ considered significant.

RESULTS:

The RD was highest for G1 at 621.13% (i.e., ~6x increase in medial gapping vs. control), followed by G2 at 93.02%, G3 at 65.66%, and 20.01% for G4 ($p < 0.001$) (Table 1). RI for G4 was highest at 83.08% (i.e., 83% improvement from G1), followed by G3 at 76.62%, and G2 at 72.95% ($p < 0.001$) (Figure 1).

DISCUSSION AND CONCLUSION:

This cadaveric study demonstrates that primary MCL repair combined with VVC most closely approximated gap measurements of TKA prior to MCL injury, and provided the highest rate of improvement, followed by MCL repair with PS, and then VVC without MCL repair. To our knowledge, this study is the first to quantify the impact of the three most common treatments for intraoperative midsubstance MCL injury on gap balancing.

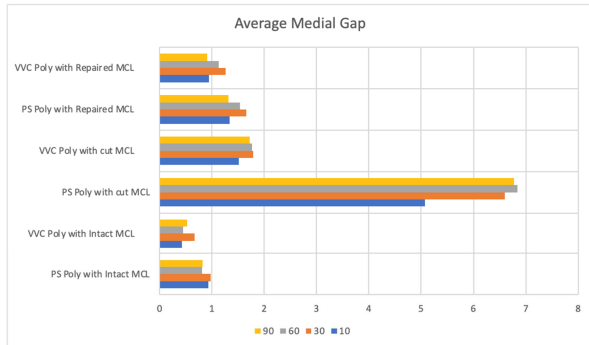


Figure 1: Mean medial tibiofemoral gap measurements (mm) for each experimental group

Flexion	PS Poly with Intact MCL (mm)	CI Poly with Intact MCL (mm)	PS Poly with cut MCL (mm)	CI Poly with cut MCL (mm)	PS Poly with Repaired MCL (mm)	CI Poly with Repaired MCL (mm)	P-value
10	0.93	0.43	5.07	1.51	1.34	0.94	
30	0.98	0.67	6.59	1.79	1.66	1.26	
60	0.81	0.44	6.84	1.76	1.54	1.13	
90	0.82	0.53	6.77	1.72	1.31	0.91	
Average	0.89	0.52	6.32	1.7	1.46	1.06	<0.001

Table 1: ANOVA comparing average medial tibiofemoral compartment gap measurements (mm) for each experimental group