Tight Native Lateral Flexion Gap is a Major Intraoperative Predictor of Manipulation Under Anesthesia: A Cross-sectional Study

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Introduction: Arthrofibrosis is a common source of dissatisfaction after total knee arthroplasty (TKA) and frequently necessitates manipulation under anesthesia (MUA). While preoperative contributing factors are well documented, potential intraoperative predictors remain understudied. This study aimed to evaluate the association between such variables and the risk of MUA following TKA.

Methods: This retrospective study included all primary TKAs performed with the BalanceBot robotic system between September 2021 and March 2025. Exclusion criteria were revision TKA, conversion arthroplasty, unicompartmental arthroplasty, use of other robotic systems, or missing intraoperative gap data. Demographics, preoperative, and intraoperative variables were compared between patients who did and did not require MUA.

Results: Among 542 patients (331 women, 61.1%), 51 (9.4%) underwent MUA at a mean of 70.4 ± 26.9 days postoperatively (Table 1). Compared with the non-MUA group, patients requiring MUA were younger (67.0 vs. 70.0 years, P=0.012), more frequently women (76.5 vs 59.5%, P=0.018), and non-obese (70.6 vs 55.0% P=0.032), and had reduced early postoperative range of motion (ROM) (57.7±22.7 vs 77.0±18.6°, P<0.001). Anemia (19.6 vs. 7.9%, P= 0.006), vitamin D deficiency (23.5 vs. 11.6, P= 0.015), and back pain (15.7 vs. 8.6%, P=0.043) were more frequently observed in the MUA group. Intraoperatively, the MUA group had significantly tighter native lateral gaps at 90 and 45° flexion, as well as a greater postero-lateral femoral resection (Figure 1). Regression analysis identified younger age (OR=0.93; 95% CI: 0.87-0.99; P=0.034), women (OR=3.58; 95% CI: 1.09-11.78; P=0.036), non-obesity (OR=0.19; 95% CI: 0.07-0.56; P=0.003), reduced early ROM (OR = 0.96; 95% CI: 0.94-0.99; P=0.002), and tighter lateral gap at 90° flexion (OR = 0.79; 95% CI: 0.64-0.98; P=0.029) as independent predictors of MUA (Table 2).

Discussion: Tighter native lateral flexion gaps, younger age, being a woman, lower BMI, and limited early postoperative ROM independently predict the need for MUA after TKA. These findings underscore the importance of intraoperative gap assessment, particularly in the lateral compartment, as a potential target to reduce postoperative stiffness.

Significance/Clinical Relevance: In patients with a tight native lateral gap, surgeons may need to perform additional lateral compartment resection to reduce the risk of arthrofibrosis and MUA. Moreover, patients with identified risk factors for MUA require more attentive postoperative physical therapy to help restore functional range of motion.

Table 2. Binomial Logistic Regression using the Enter Method

variable	SE	Wald	OR	95% CI	P
Age (years)	0.054	4.513	0.93	0.87-0.99	0.034
Obesity (BMI ≥30)	0.548	9.108	0.19	0.07-0.56	0.003
Women	0.606	4.386	3.58	1.09-11.78	0.036
Early Postop ROM*	0.012	9.256	0.96	0.9-0.98	0.002
Back Pain	0.608	1.666	2.24	0.6-0.48	0.199
Anemia	1.054	1.054	0.34	0.04-3.69	0.905
Vitamin D Deficiency	0.623	1.381	2.08	0.62-7.07	0.238
Native Lateral Flexion Gap at 90°	0.106	4.731	0.79	0.6-0.98	0.029
Native Medial Flexion Gap at 90°	0.129	0.361	0.91	0.71-1.17	0.453
Aspirin	0.689	3.239	0.29	0.08-1.12	0.072
Steroid Injection	0.744	0.169	1.36	0.32-5.84	0.681
WOMAC Stiffness	0.157	0.436	1.08	0.83-1.47	0.565
Constant	2.868	5.377	545.38		0.019

ROM= Range of Motion, WOMAC= The Western Ontario and McMaster Universities Arthritis Index, Postop ROM= Preoperative Range of Motion, BMI= Body Mass Index, OR= Odds Ratio, SE= Standard Error, CI= Confidence Interval.