A Prospective Randomized Clinical Trial to Assess the Effects of Tourniquet Use on Gait Parameters Following Primary Total Knee Arthroplasty

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INTRODUCTION:
The use of a pneumatic thigh-high tourniquet in Total Knee Arthroplasty (TKA) improves surgical field visualization, but its use has been linked to increased post-operative pain and decreased muscle strength. Resultant insufficient quadriceps strength can contribute to altered gait patterns and mechanics with potential for subsequent delayed rehabilitation. There are limited data available on the effects of tourniquet use on gait parameters following TKA. Therefore, this study was designed to determine the effects of tourniquet use on post-operative gait in patients undergoing primary TKA.
METHODS:
Patients undergoing primary TKA were enrolled in a prospective, randomized clinical trial and received either a pneumatic thigh-high tourniquet or no tourniquet during their procedure. Seventy-three of the enrolled patients completed the study. Two patients were excluded due to insufficient data leaving 71 patients for analysis (33 tourniquetless; 38 tourniquet). Patient demographics and surgical characteristics were collected and compared between the two groups. Spatiotemporal parameters of gait were measured using an instrumented pressure walkway. Gait measurements were performed preoperatively and then at six-weeks postoperatively. These were compared for all patients as well as between experimental groups. A p-value < 0.05 was considered statistically significant.
RESULTS:
Patient demographics were similar between groups. Mean tourniquet time was 67.4 ± 19.6 minutes. Mean intraoperative blood loss was higher in the tourniquetless group as compared to the tourniquet group (157.6 ± 87.6 mL versus 59.7 ± 28.1 mL) (p< 0.0001). Surgical time was higher in the tourniquet group (97.9 ± 19.0 minutes) as compared to the tourniquetless group (87 ± 17.4) (p=0.04). For all included patients, spatiotemporal gait parameters were similar between the pre and postoperative assessments with a mean stride length increase of 1.4 ± 18.0 cm (p =0.52), stride width increase of 0.31 ± 4.1 (p =0.52), and decreases in both ipsilateral single-leg support percentage and total double support percentage of 0.14 ± 4.2 (p=0.78) and 0.54 ± 4.0 (p=0.26), respectively. There were no statistically significant differences in the change in gait measures between the two groups.
DISCUSSION AND CONCLUSION:
Spatiotemporal gait parameters return to preoperative baseline levels in patients undergoing primary TKA regardless of tourniquet use by six-weeks postoperatively, with no identified differences in these gait parameters between patients who received a tourniquet or no tourniquet. Additional studies should give consideration to earlier evaluation of gait for tourniquet versus tourniquetless TKA.

Comparison of Patient and Surgical Characteristics

	TNT used in surgery? NT (N=33)	T (N=38)	Total (N=71)	P-value
Age				0.2968[1]
N	33	38	71	
Mean (SD)	66.91 (8.86)	63.79 (7.91)	64.77 (8.43)	
Median (Range)	66.00 (45.00, 86.00)	65.00 (50.00, 81.00)	65.00 (45.00, 86.00)	
IQR	64.00, 72.00	57.00, 67.00	58.00, 70.00	
BMI				0.0621[1]
N	33	38	71	
Mean (SD)	31.70 (5.99)	33.82 (6.08)	32.83 (6.15)	
Median (Range)	31.00 (22.00, 46.00)	35.00 (20.00, 46.00)	33.00 (20.00, 46.00)	
IQR	28.00, 34.00	28.25, 38.00	27.50, 38.00	
EBL (ml)				<.0001[1]
N	33	38	71	
Mean (SD)	157.58 (87.61)	59.74 (28.14)	105.21 (79.84)	
Median (Range)	150.00 (50.00, 600.00)	50.00 (50.00, 200.00)	50.00 (50.00, 600.00)	
IQR	100.00, 200.00	50.00, 50.00	50.00, 150.00	
Time in surgery (min)				0.0377[1]
N	26	25	51	
Mean (SD)	87.00 (17.38)	97.92 (19.04)	92.35 (18.65)	
Median (Range)	87.50 (49.00, 121.00)	91.00 (70.00, 154.00)	90.00 (49.00, 154.00)	
IQR	79.00, 98.00	89.00, 104.00	81.00, 103.00	
LOS (nights)				0.8389[1]
N	32	36	68	
Mean (SD)	1.03 (1.56)	0.97 (0.40)	1.00 (1.12)	
Median (Range)	1.00 (0.00, 9.00)	1.00 (0.00, 2.00)	1.00 (0.00, 9.00)	
IQR	0.00, 1.00	1.00, 1.00	1.00, 1.00	

[1]Unequal variance two sample t-test;
NT= No tourniquet, T= Tourniquet, BMI = Body Mass Index, EBL = Estimated Blood Loss, LOS = length of stay

Comparison of Patient and Surgical Characteristics

	TNT used in surgery? NT (N=33)	T (N=38)	Total (N=71)	P-value
Gender, n (%)				0.8247[1]
F	19 (57.6%)	19 (50.0%)	38 (53.5%)	
M	14 (42.4%)	19 (50.0%)	33 (46.5%)	
TKA side, n (%)				0.8140[1]
R	17 (51.5%)	21 (55.3%)	38 (53.5%)	
L	16 (48.5%)	17 (44.7%)	33 (46.5%)	
Anesthesia Type, n (%)				1.0000[1]
S + P	30 (90.9%)	32 (84.2%)	62 (87.3%)	
S + P + G	0 (0.0%)	1 (2.6%)	1 (1.4%)	
P + G	3 (9.1%)	3 (7.9%)	6 (8.5%)	
G	0 (0.0%)	1 (2.6%)	1 (1.4%)	
G + S	0 (0.0%)	1 (2.6%)	1 (1.4%)	

[1]Fisher Exact p-value
NT = No tourniquet, T = tourniquet, TKA = Total Knee Arthroplasty, S = Spinal Anesthesia, P = Peripheral Block, G = General Anesthesia

Comparison of Change in Gait Measures by Group

	TNT used in surgery? NT (N=33)	T (N=38)	Total (N=71)	P-value
Pre-Post Step Length (cm)				0.8797
N	33	38	71	
Mean (SD)	0.02 (2.10)	-0.00 (3.20)	0.01 (2.70)	
Median (Range)	0.00 (-3.32, 3.18)	0.00 (-7.01, 5.46)	0.00 (-7.01, 5.46)	
IQR	-0.84, 0.69	-0.93, 0.07	-0.03, 0.69	
Pre-Post Stance Time (sec)				0.3199
N	33	38	71	
Mean (SD)	0.00 (0.05)	-0.03 (0.09)	-0.01 (0.07)	
Median (Range)	0.00 (-0.14, 0.10)	-0.01 (-0.32, 0.16)	-0.01 (-0.38, 0.16)	
IQR	-0.02, 0.05	-0.03, 0.02	-0.03, 0.04	
Pre-Post Swing Time (sec)				0.4604
N	33	38	71	
Mean (SD)	0.02 (0.15)	0.07 (0.41)	0.04 (0.31)	
Median (Range)	0.00 (-0.23, 0.52)	0.01 (-0.08, 2.30)	0.01 (-0.98, 2.30)	
IQR	-0.07, 0.07	-0.05, 0.10	-0.06, 0.07	
Pre-Post Stride Length (cm)				0.9182
N	33	38	71	
Mean (SD)	1.84 (20.55)	1.17 (15.07)	1.39 (17.97)	
Median (Range)	3.66 (-66.25, 36.64)	1.62 (-30.25, 50.79)	2.42 (-66.25, 50.79)	
IQR	-9.21, 9.96	-7.63, 10.35	-9.16, 10.35	
Pre-Post Stride Width (cm)				0.3519
N	33	38	71	
Mean (SD)	-0.34 (4.27)	0.74 (4.02)	0.31 (4.10)	
Median (Range)	0.23 (-9.22, 10.19)	0.63 (-7.93, 10.90)	0.37 (-9.22, 10.90)	
IQR	-1.46, 1.76	-2.02, 3.22	-1.96, 3.00	
Pre-Post Velocity (cm/sec)				0.8121[1]
N	33	38	71	
Mean (SD)	-1.36 (31.41)	0.14 (19.24)	-0.56 (25.40)	
Median (Range)	3.42 (-115.72, 57.92)	4.77 (-48.18, 47.73)	4.01 (-115.72, 57.92)	
IQR	-10.60, 8.97	-10.22, 12.66	-10.60, 10.70	
Pre-Post Single Leg Support %				0.8017[1]
N	33	38	71	
Mean (SD)	-0.21 (3.54)	-0.08 (4.75)	-0.14 (4.20)	
Median (Range)	0.09 (-11.58, 7.11)	0.78 (-23.78, 4.70)	0.59 (-23.78, 7.11)	
IQR	-1.63, 1.30	-1.97, 2.61	-1.57, 1.99	
Pre-Post Total Double Support %				0.7072[1]
N	33	38	71	
Mean (SD)	-0.54 (3.97)	-0.72 (3.98)	-0.64 (4.04)	
Median (Range)	-0.80 (-12.76, 12.48)	-0.58 (-7.17, 11.42)	-0.66 (-12.76, 12.48)	
IQR	-2.16, 1.09	-2.89, 0.34	-2.36, 1.41	

[1]Two sample t-test;

Correlation of Tourniquet Time and Change in Gait Measures

R=Pearson Correlation Coefficients	
Gait Variable	**Tourniquet Time (min)**
Step Length (cm) Pre-Post Step Length	R=0.0646 p=0.7081 n=36
Stance Time (sec) Pre-Post Stance Time	R=-0.2133 p=0.2116 n=36
Swing Time (sec) Pre-Post Swing Time	R=0.1797 p=0.2945 n=36
Stride Length (cm) Pre-Post Stride Length	R=0.0497 p=0.7734 n=36
Stride Width (cm) Pre-Post Stride Width	R=-0.2035 p=0.2350 n=36
Velocity (cm/sec) Pre-Post Velocity	R=0.0691 p=0.6884 n=36
Single Support % Pre-Post Single Support	R=0.0163 p=0.9244 n=36
Total Double Support % Pre-Post Total Double Support	R=-0.0479 p=0.7813 n=36