

Risk factors for periprosthetic fractures following primary total joint arthroplasty

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Disclosures: Janna van den Kieboom (N); Venkatsaiakhil Tirumala (N); Ruben Oganessian (N); Paul Walker (N); John Drago (N); KA (N); Alina Syros (N); Saimrunali Dadigala (N); Travis Dang (N); Andriana Velmahos (N); Christian Klemm (N); Young-Min Kwon (5- Stryker;5- Zimmer Biomet; 5- Depuy;5- Corentec; 5- Smith&Nephew)

INTRODUCTION: As the number of primary total joint arthroplasty (TJA) in the United States continues to increase, the need for revision surgery for periprosthetic fracture (PF) subsequently rises. Periprosthetic fracture is a challenging complication for both patient and surgeon, and it is additionally associated with poor clinical outcomes and high mortality. No study has been conducted presently stratifying the patient factors and outcomes associated with periprosthetic fracture after primary total hip arthroplasty (THA) and total knee arthroplasty (TKA). The aim of this study is therefore to estimate 1) the risk factors and 2) the outcomes for periprosthetic fracture after primary THA and TKA.

METHODS: This retrospective cohort study was performed on a cohort of 4192 consecutive patients that underwent revision total joint arthroplasty (TJA). To determine the characteristics and risk factors of patients sustaining periprosthetic fracture after TJA, patient demographics including type of primary TJA and risk factors were recorded alongside clinical outcomes such as readmission and re-revision rates. Significant differences between the cohorts were established using Pearson Chi-Square Test for dichotomous variables and Student's t-test for continuous variables.

RESULTS: This study included 2488 patients who underwent revision THA (301 for peri-prosthetic fracture and 2187 for other reasons) and 1703 patients who underwent revision TKA (67 for peri-prosthetic fracture and 1636 for other reasons). Patient factors that significantly increased the risk of periprosthetic fracture after THA were ASA 3 and 4 ($p<0.001$), advanced age (>75) ($p<0.001$), a lower BMI (<0.001), and a history of cardiovascular disease (CVD) ($p<0.001$), renal disease ($p=0.032$), and hematological disease ($p=0.014$; Table 1). Patient factors that significantly increased the risk of periprosthetic fracture after TKA were female gender ($p=0.007$), advanced age (>70) ($p<0.001$), alcohol use ($p<0.001$), and a history of CVD ($p=0.044$), malignancy ($p=0.002$), systemic inflammatory disease ($p<0.001$), and hematological disease ($p<0.001$). Peri-prosthetic fracture of the hip was significantly more present than peri-prosthetic fracture of the knee ($p<0.001$). Patients with peri-prosthetic fracture after both THA and TKA showed a significantly longer length of stay (LOS) ($p<0.001$), but only patients with peri-prosthetic fracture after TKA showed a higher mortality rate ($p<0.001$). No significant differences were seen at 30, 60, and 90 day readmission.

DISCUSSION: The findings of this study suggest ASA score, age, BMI, CVD, renal disease, and hematological disease to be risk factors for peri-prosthetic fracture after THA. For peri-prosthetic fracture after TKA, female gender, age, alcohol use, CVD, malignancy, systemic inflammatory disease and hematological disease were found to risk factors, with the hip presenting more peri-prosthetic fracture than the knee. LOS was found to be significantly longer in all peri-prosthetic fracture patients, whereas mortality was higher only in patients with peri-prosthetic fracture after TKA. The risk factors and outcomes presented in this study have the potential to assist surgeons in the work-up and treatment of patients presenting with peri-prosthetic fracture after both THA and TKA striving for better patient outcomes.

SIGNIFICANCE/CLINICAL RELEVANCE: The findings of this study suggest ASA score, age, BMI, CVD, renal disease, and hematological disease to be risk factors for peri-prosthetic fracture after THA.

Table 1: Patient cohort characteristics and outcomes

Characteristic	Control THA (N=287)	PF THA (N=301)	p-value	Control TKA (N=1636)	PF TKA (N=67)	p-value
Female/male	1117/1070	168/135	0.154	898/738	48/19	0.006
Right/left	1138/1049	155/148	0.774	824/812	34/33	0.951
Age (years)	65.3 \pm 13.7	75.3 \pm 12.0	<0.001	65.3 \pm 11.3	72.7 \pm 13.8	<0.001
BMI (kg/m ²)	29.8 \pm 7.3	28.4 \pm 6.8	0.001	32.6 \pm 7.5	31.2 \pm 6.2	0.244
Cardiovascular disease	1060 (48.5%)	202 (66.6%)	<0.001	870 (53.2%)	44 (65.7%)	0.044
Diabetes Mellitus	203 (9.2%)	31 (10.2%)	0.595	235 (14.4%)	13 (19.4%)	0.251
Renal disease	121 (5.5%)	22 (7.3%)	0.226	105 (6.4%)	6 (9.0%)	0.410
Malignancy	146 (6.7%)	24 (7.9%)	0.421	105 (6.4%)	5 (7.5%)	0.002
Depression	191 (8.7%)	29 (9.6%)	0.630	171 (10.5%)	8 (11.9%)	0.697
Liver disease	68 (3.1%)	8 (2.6%)	0.656	51 (3.1%)	1 (1.5%)	0.449
Sleep apnea	80 (3.6%)	15 (5.0%)	0.271	96 (5.9%)	4 (6.0%)	0.972
Endocrine disease	258 (11.8%)	39 (12.9%)	0.589	183 (11.2%)	9 (13.4%)	0.569
Respiratory disease	245 (11.2%)	38 (12.5%)	0.491	210 (12.8%)	9 (13.4%)	0.886
Systemic inflammatory	130 (5.9%)	23 (7.6%)	0.263	98 (6.0%)	11 (16.4%)	<0.001
Hematological disease	153 (7.0%)	33 (10.9%)	0.016	118 (7.2%)	13 (19.4%)	<0.001
Smoking	160 (7.3%)	21 (6.9%)	0.809	106 (6.5%)	0 (0.0%)	0.099
Alcohol	682 (31.2%)	93 (30.7%)	<0.001	433 (26.5%)	14 (20.9%)	<0.001
Drugs	32 (1.5%)	7 (2.3%)	0.266	17 (1.0%)	0 (0.0%)	0.251
Follow-up Time	50.3 \pm 54.6	35.9 \pm 46.5	<0.001	46.2 \pm 49.1	55.0 \pm 74.7	0.260
30 day readmission	266 (12.2%)	49 (16.3%)	0.044	162 (9.9%)	10 (14.9%)	0.181
60 day readmission	328 (15.0%)	57 (18.9%)	0.076	232 (14.2%)	12 (17.9%)	0.393
90 day readmission	387 (17.7%)	68 (22.6%)	0.040	273 (16.7%)	12 (17.9%)	0.793
Re-revision	343 (15.7%)	40 (13.3%)	0.280	284 (17.4%)	11 (16.4%)	0.842
Death rate	189 (8.6%)	31 (10.3%)	0.185	125 (7.6%)	14 (20.9%)	<0.001
Length of Stay (days)	4.99 \pm 4.80	7.0 \pm 4.5	<0.001	4.5 \pm 4.7	8.1 \pm 6.2	<0.001