

# Rates and Risk Factors for Multiple Periprosthetic Joint Infections in Patients with Multiple Arthroplasties

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**INTRODUCTION:** The rate for periprosthetic joint infection (PJI) exceeds 1% of all primary arthroplasties. Over 30% of patients with a primary total hip or knee arthroplasty end up with more than one arthroplasty. Given that patients with multiple arthroplasties incur the risk for PJI in each operated joint, we hypothesized that the rate in subsequent arthroplasty is high. Our objective was to determine the rates and risk factors for synchronous and metachronous PJI in subsequent prostheses in this population.

**METHODS:** Patients with multiple prostheses with more than one PJI were categorized as synchronous (i.e., presenting at the same time as the initial infection) or metachronous (i.e., presenting at a different time as the initial infection). Differences were assessed using a chi-square test for categorical variables and an t-test for continuous variables. Odds ratios (OR) and confidence intervals (CI) were calculated using logistic regression. P < 0.05 was considered statistically significant.

**RESULTS:** A total of 337 patients with a PJI in at least one joint were reviewed from 2003 to 2021. Demographics and risk factors were collected at a mean follow up of 2.9 ± 2.9 years (range: 0.0 – 17.2 years). Thirty-one (9%) patients developed a PJI in more than one joint. Patients with multiple PJI were significantly more likely to have a positive blood culture (48% vs. 16%, p < 0.001) and longer follow-up times than patients with single PJI (4.8 years vs. 2.7 years, p < 0.001). The odds of developing a second PJI in the contralateral limb (n = 27, 87%) were elevated by almost 7-fold (OR: 6.8, CI: 2.1-21.5, p = 0.001) when compared to a second PJI in the ipsilateral limb (n = 4, 13%, Figure 1). There was no difference for the odds of a synchronous (n = 13, 4%) versus metachronous (n = 18, 5%) presentation (OR: 0.72, CI: 0.30-1.72, p = 0.463, Table 1). Tobacco users were 75% more likely to have a metachronous presentation of their second PJI compared to patients without tobacco use (OR: 1.75, CI: 1.1-2.9, p = 0.041, Table 2).

**DISCUSSION AND CONCLUSION:** Almost 10% of patients with an initial PJI will develop a second PJI in a subsequent arthroplasty with the contralateral limb being at particular risk. Caution should be taken in patients with a history of tobacco use and prior PJI as the relative risk of a subsequent PJI is high. Given that many metachronous PJI patients presented years later with the same bacterial culture, the results point toward altered host immunity after PJI as a potential mechanism. Optimizing the management of patients with a prior PJI is essential to reducing morbidity and additional PJI-related healthcare spending in this high-risk group.

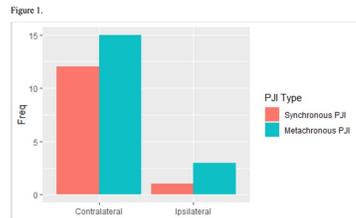


Table 1

Risk factors	Unadjusted			Adjusted		
	OR	95% CI	p-value	AOR	95% CI	p-value
Index surgery	Ref					
Primary	Ref					
Revision	0.97	0.91-1.03	0.540	0.98	0.92-1.05	0.660
Total joint replaced	Ref					
None	Ref					
One	0.95	0.88-1.01	0.075	0.95	0.88-1.01	0.047
Location of initial PJI						
Left knee	Ref					
Right knee	1.08	0.80-1.46	0.581	0.97	0.80-1.16	0.461
Left hip	0.94	0.86-1.03	0.200	1.06	0.85-1.32	0.603
Right hip	0.94	0.85-1.03	0.184	1.07	0.86-1.33	0.541
Sex						
Female	Ref					
Male	0.96	0.86-1.06	0.423	0.98	0.90-1.07	0.460
Race						
Non-White	0.99	0.92-1.07	0.775	0.97	0.89-1.06	0.515
White	Ref					
Ethnicity						
Hispanic/Latino or Unknown	1.01	0.92-1.12	0.869	1.02	0.91-1.15	0.719
Non-Hispanic/Non-Latino	Ref					
Age at time of first PJI	1.00	1.00-1.00	0.473	1.00	1.00-1.00	0.282
BMI	1.00	1.00-1.00	0.767	1.00	1.00-1.00	0.900
Charlson Comorbidity Index	0.99	0.97-1.01	0.401	0.99	0.97-1.01	0.236
ASA						
1&2	Ref					
3&4	1.05	0.99-1.12	0.108	1.05	0.98-1.12	0.183
Smoker						
No	Ref					
Current or former	1.01	0.92-1.12	0.750	1.02	0.92-1.12	0.748
Diabetes						
No	Ref					
Yes	1.03	0.88-1.11	0.585	1.01	0.84-1.09	0.758
Rheumatoid arthritis						
No	Ref					
Yes	1.02	0.85-1.18	0.717	1.01	0.85-1.18	0.745
Bacterio-positive blood culture						
No	Ref					
Yes	1.20	1.11-1.29	<0.001	1.20	1.11-1.30	<0.001
Follow-up time (years)	1.02	1.01-1.03	<0.001	1.02	1.01-1.03	<0.001
MSSA or MRSA in 1st PJI	1.11	1.03-1.19	0.004	1.09	1.02-1.18	0.011

OR = odds ratio, CI = confidence interval, AOR = adjusted odds ratio, BMI = body mass index, ASA = American Society of Anesthesiologists, MSSA = methicillin-sensitive staphylococcus aureus, MRSA = methicillin-resistant staphylococcus aureus.

Table 2

Risk factors	Synchronous PJI	Metachronous PJI	Fisher or chi-square p-value
	N (%) or M (SD)	N (%) or M (SD)	
Index surgery			1.00
Primary	6 (46.2%)	8 (44.7%)	
Revision	7 (53.8%)	10 (55.3%)	
Total joint replaced			0.432
None	10 (76.9%)	11 (61.1%)	
One	3 (23.1%)	6 (32.6%)	
Number of joints with PJI			
≥ 2	6 (46.2%)	6 (32.6%)	
1	7 (53.8%)	10 (55.3%)	
Location of initial PJI			0.151
Left knee	3 (23.1%)	4 (22.2%)	
Right knee	2 (15.4%)	7 (38.1%)	
Left hip	3 (23.1%)	2 (11.1%)	
Right hip	1 (7.7%)	5 (27.8%)	
Sex			0.294
Female	6 (46.2%)	12 (66.7%)	
Male	7 (53.8%)	6 (32.6%)	
Race			0.076
Asian	0 (0.0%)	0 (0.0%)	
Black	0 (0.0%)	0 (0.0%)	
Native American	0 (0.0%)	0 (0.0%)	
Other	1 (7.7%)	0 (0.0%)	
Pacific Islander	0 (0.0%)	0 (0.0%)	
Unknown	0 (0.0%)	0 (0.0%)	
White	10 (76.9%)	11 (61.1%)	
Ethnicity			1.00
Hispanic/Latino	3 (23.1%)	2 (11.1%)	
Non-Hispanic/Non-Latino	11 (84.6%)	16 (88.9%)	
Unknown	0 (0.0%)	0 (0.0%)	
Age at time of first PJI	68.1 (8.96)	67.09 (8.50)	0.350
BMI	28.29 (7.20)	33.07 (9.54)	0.145
Charlson Comorbidity	3.08 (1.50)	2.72 (1.33)	0.825
ASA			1.00
1&2	3 (23.1%)	3 (15.8%)	
3&4	10 (76.9%)	13 (71.7%)	
Smoker			0.130
Current or former	13 (100.0%)	14 (77.8%)	
No	0 (0.0%)	4 (22.2%)	
Diabetes			0.669
No	9 (69.2%)	14 (77.8%)	
Yes	4 (30.8%)	4 (22.2%)	
Recurrent arthritis			0.343
No	12 (92.3%)	13 (72.2%)	
Yes	1 (7.7%)	5 (27.8%)	
Bacterio-positive blood			0.285
No	3 (23.1%)	11 (61.1%)	
Yes	4 (30.8%)	7 (38.9%)	
Follow-up time (years)	3.48 (1.39)	3.74 (2.36)	0.057

PJI = periprosthetic joint infection, N = total, SD = standard deviation, BMI = body mass index, ASA = American Society of Anesthesiologists.