

# Synovial Fluid Aspiration in the Clinic Versus Operating Room Setting: Is There Concordance in Synovial Fluid Analysis and Culture Results?

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## INTRODUCTION:

Synovial fluid aspiration prior to revision shoulder arthroplasty is performed by some surgeons when prosthetic joint infection (PJI) is suspected. Previous studies have suggested that clinic aspiration culture results can be predictive of tissue culture results at the time of revision arthroplasty. However, these samples are taken sometimes weeks to months prior to revision, and there have been no studies testing the concordance of synovial fluid obtained in the clinic and synovial fluid obtained at the time of revision surgery. Our objective was to answer two clinically-relevant questions:

- 1) Are synovial fluid cell count and differential similar in clinic and operating room fluid samples?
- 2) How concordant are culture results in terms of positivity and bacterial species when comparing clinic and operating room samples?

## METHODS:

Data was prospectively collected from consecutive revision shoulder arthroplasty cases in the American Shoulder and Elbow Surgeons (ASES) Revision Shoulder Arthroplasty and PJI Multicenter Research Group. The decision to perform a clinic aspiration prior to revision shoulder arthroplasty was left to the discretion of the surgeon in his or her workup for shoulder PJI. Intraoperative sampling including synovial fluid aspiration prior to arthrotomy was standardized among surgeons in the group. WBC counts and differentials were analyzed only if both were available for clinic and OR samples. Concordance of culture results was analyzed, and sensitivity, specificity, positive predictive value, and negative predictive value were calculated.

## RESULTS:

A total of 183 patients with both clinic and OR aspirates were included in the final analysis.

**Synovial WBC count:** Clinic and OR aspirates had similar WBC counts ( $p=0.670$ ) (Table 1).

**Synovial neutrophil percentage:** Synovial neutrophil percentage was significantly higher in OR aspirates compared to clinic aspirates (51% vs 61%,  $p=0.008$ ).

**Culture results:** The concordance rate with tissue culture results was similar between clinic and OR samples (76.0% vs. 73.8%,  $p=0.506$ ). The sensitivity and specificity were higher in the OR samples (sensitivity 0.607, specificity 0.915) compared to the clinic samples (sensitivity 0.462, specificity 0.870).

**Microbiology:** The number of positive aspirate cultures was significantly higher in the clinic aspirate compared to the OR aspirate (22.4% vs. 15.3%,  $p=0.032$ ) (Table 2). Of note, the proportion of samples positive for *Cutibacterium* and coagulase negative *Staphylococcus* were higher in clinic aspirates compared to the OR aspirates.

**DISCUSSION AND CONCLUSION:** This study demonstrates important differences when comparing clinic and OR synovial aspirates. Synovial neutrophil percentages were typically lower in the clinic samples, and there was a higher proportion of positive aspirates in the clinic cultures including those positive for *Cutibacterium* and coagulase-negative *Staphylococcus*. This raises the question of whether clinic aspirations have a higher risk of skin contamination during aspiration.

Table 1: Concordance of operating room versus clinic aspirate laboratory and deep culture results

Variable	Clinic Aspirate Samples Mean [IQR]; count (%)	OR Aspirate Samples Mean [IQR]; count (%)	Sample Size (Total N = 183)	P-value
WBC count	635 [74, 2363]	527 [95, 1734]	115	0.670
WBC count >3000	26 (22.6%)	24 (20.9%)	115	0.908
Neutrophil count	88 [8, 906]	136 [12, 854]	107	0.541
Neutrophil percentage	51 [14, 74]	61 [24, 88]	109	<b>0.008</b>
Neutrophil percentage >80%	24 (22.0%)	40 (36.7%)	109	<b>&lt;0.001</b>
Lymphocyte percentage	25 [9, 45]	24 [7, 49]	104	0.843
Monocyte percentage	11 [5, 22]	7 [3, 14]	97	<b>0.005</b>
Eosinophil percentage	1 [0, 2]	0 [0, 1]	68	<b>0.004</b>
Basophil percentage	0 [0, 1]	0 [0, 0]	49	<b>&lt;0.001</b>
<b>Culture results</b>				
Concordant with positive tissue culture results (≥2) (percent of total)	139 of 183 (76.0%)	135 of 183 (73.8%)		0.506
True positive (percent of total positive)	24 of 41 (58.5%)	17 of 28 (60.7%)		0.127
False positive (percent of total positive)	17 of 41 (41.5%)	11 of 28 (39.3%)		0.158
True negative (percent of total negative)	114 of 142 (80.3%)	119 of 155 (76.8%)		0.198
False negative (percent of total negative)	28 of 142 (19.7%)	36 of 155 (23.2%)		0.088
Sensitivity	0.462	0.607		
Specificity	0.870	0.915		
Positive predictive value	0.585	0.607		
Negative predictive value	0.803	0.768		

Table 2: Bacterial species isolated from clinic and operating room aspirates

Culture Result	Clinic Aspirate Samples Count (%)	OR Aspirate Samples Count (%)	P-value
Negative aspirate culture	142 (77.6%)	155 (84.7%)	
Positive aspirate culture	41 (22.4%)	28 (15.3%)	<b>0.032</b>
<i>Cutibacterium</i>	28 (15.3%)	18 (9.8%)	0.060
Coagulase-negative <i>Staphylococcus</i>	8 (4.4%)	3 (1.6%)	0.059
Other bacteria	6 (3.3%)	10 (5.5%)	0.407
MSSA	1 (0.5%)	3 (1.6%)	
Corynebacterium sp.	1 (0.5%)	1 (0.5%)	
Enterococcus sp.	1 (0.5%)	1 (0.5%)	
Streptococcus sp.	1 (0.5%)	2 (1.1%)	
Finogoldia sp.	1 (0.5%)	0 (0.0%)	
Lactobacillus sp.	1 (0.5%)	0 (0.0%)	
Micrococcus sp.	0 (0.0%)	1 (0.5%)	
Penicillium sp.	0 (0.0%)	1 (0.5%)	
Serratia sp.	0 (0.0%)	1 (0.5%)	

sp., species; MSSA, methicillin-sensitive *Staphylococcus aureus*