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Synovial Fluid Biomarkers Reflect Pre- and Postoperative Clinical Features in Rotator Cuff Tears, Independent of Tear Size

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Introduction and Background

Synovitis is a major contributor to pain and dysfunction in rotator cuff tears (RCTs), yet it remains unclear whether routine synovial fluid (SF) parameters reflect clinical features independent of tear size and patient age.

Material and Method

This prospective cohort study aimed to evaluate the associations between routine SF parameters and clinical features before and after rotator cuff repair. Preoperative glenohumeral SF was aspirated from 109 patients undergoing arthroscopic repair, and interleukin-6, total protein levels, and differential white blood cell counts were analyzed. Clinical features, including pain, active range of motion, strength, Constant score, and American Shoulder and Elbow Surgeons (ASES) score, were assessed preoperatively and at 3 and 6 months postoperatively

Results

Associations between SF parameters and clinical features were examined after adjusting for tear size and age. Higher interleukin-6 and total protein levels were associated with greater preoperative pain and lower range of motion and Constant score, and these relationships persisted at 3 and 6 months. A higher neutrophil percentage was negatively correlated with preoperative range of motion, strength, and Constant score; with range of motion, strength, Constant score, and ASES score at 3 months; and with ASES score at 6 months. Routine SF parameters, including interleukin-6, total protein, and neutrophil percentage, were associated with poorer preoperative clinical features and remained related to early postoperative outcomes.

Conclusions

These findings suggest that routine SF parameters are linked to the clinical features of RCT, independent of cuff tear size and patient age, and may serve as practical biomarkers for predicting both preoperative and postoperative outcomes.

Figure & Table 1.

Figure 1 Study flow diagram

Assessed for eligibility (n=122)
Patients with RCT who had arthroscopic rotator cuff repair between March 2016 and May 2020.

Excluded (n=13)

Prior shoulder surgery (n=6)

Inflammatory arthritis including rheumatoid arthritis (n=2)

Septic arthritis (n=1)

Insufficient test results (n=4)

Study included patients (n=109)
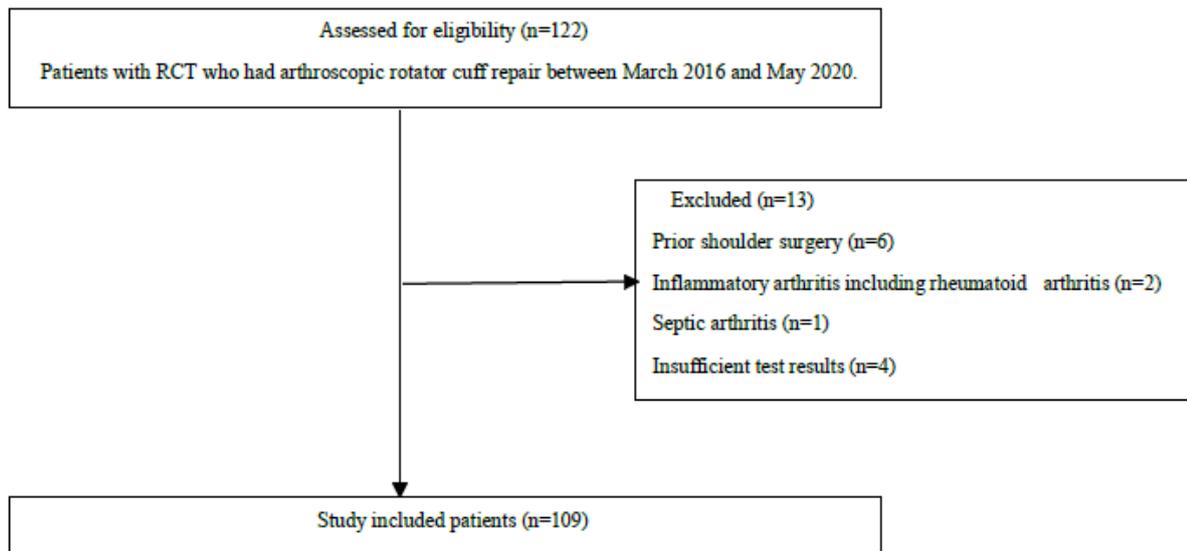
Figure & Table 2.

Table 1 Patient demographic characteristics

Characteristics	Value
Sex, n (%)	
Male: Female	55:54 (50.5%:49.5%)
Age, y	62.7 ± 6.7
Cuff tear size, n (%)	
Small: Medium: Large: Massive	3:23:37:46 (2.8%:21.1%:33.9%:42.2%)
Synovial fluid parameter	
IL-6, pg/mL	284.5 ± 705.7
Total Protein, mg/dL	3632.8 ± 1253.9
Neutrophil, %	22.7 ± 24.9
Monocyte, %	36.3 ± 22.2
Lymphocyte, %	39.2 ± 19.1

Abbreviations: IL, interleukin.

Data are presented as mean ± standard deviation (range) unless otherwise indicated

Table 2 Clinical features before and after arthroscopic cuff repair

Clinical features	Preoperative	3 months Postoperative	6 months Postoperative
VAS	4.7 ± 2.0	3.1 ± 1.6*	2.2 ± 1.3*
ROM			
FF	106.5 ± 46.5	115.5 ± 34.5	129.0 ± 30.0*
ABD	90.0 ± 49.5	99.0 ± 42.0*	121.5 ± 36.0*
ER	51.0 ± 20.3	39.8 ± 18.8*	51.0 ± 20.3*
IR (range)	T12 (L1 – T11)	T12 (L1 – T11)	T10 (T12 – T10)
ABD strength (kg)	5.2 ± 3.2	6.5 ± 4.0*	8.2 ± 4.6*
Constant score	57.0 ± 17.3	64.2 ± 14.0*	74.2 ± 13.7*
ASES score	50.5 ± 17.8	62.5 ± 16.2*	71.3 ± 15.0*

Abbreviations: VAS, visual analog scale; ROM, range of motion; FF, forward flexion; ABD, abduction; ER, external rotation at side; IR, internal rotation; Constant, Constant–Murley; ASES, American Shoulder and Elbow Surgeons.

Values are presented as mean ± standard deviation.

*Statistically significant ($p < 0.05$) compared to preoperative data.

Table 3 Relationship between preoperative clinical features and synovial fluid parameters.

Clinical features	IL-6 (pg/mL)		Total Protein (mg/dL)		Neutrophil (%)		Monocyte (%)		Lymphocyte (%)	
	r	p	r	p	r	p	r	p	r	p
VAS	-0.036	0.758	0.412	<0.001*	-0.009	0.922	0.047	0.627	-0.074	0.442
ROM										
FF	-0.429	< 0.001*	-0.402	< 0.001*	-0.246	0.010*	0.155	0.108	0.171	0.075
ABD	-0.356	0.002*	-0.343	< 0.001*	-0.202	0.035*	0.173	0.072	0.095	0.328
ER	-0.250	0.031*	-0.227	0.017*	-0.153	0.113	0.047	0.626	0.146	0.131
IR	-0.091	0.436	-0.327	< 0.001*	-0.071	0.464	0.173	0.072	-0.074	0.444
ABD strength (kg)	-0.101	0.401	-0.189	0.051	-0.269	0.005*	0.171	0.079	0.159	0.102
Constant score	-0.264	< 0.023*	-0.372	< 0.001*	-0.196	0.041*	0.151	0.118	0.110	0.254
ASES score	-0.058	0.623	-0.304	< 0.001*	-0.131	0.174	0.042	0.666	0.147	0.126

Abbreviations: IL, interleukin; VAS, visual analog scale; ROM, range of motion; FF, forward flexion; ABD, abduction; ER, external rotation at side; IR, internal rotation; Constant, Constant–Murley; ASES, American Shoulder and Elbow Surgeons.

*Statistically significant ($p < 0.05$).

Table 4 Relationship between postoperative clinical features (3 and 6 months) and synovial fluid parameters.

	IL-6 (pg/mL)		Total Protein (mg/dL)		Neutrophil (%)		Monocyte (%)		Lymphocyte (%)	
	r	p	r	p	r	p	r	p	r	p
3 months postoperatively										
VAS	0.113	0.420	0.111	0.319	0.031	0.795	-0.025	0.831	-0.018	0.875
ROM										
FF	-0.361	0.008*	-0.237	0.043*	-0.249	0.034*	0.317	0.007*	-0.014	0.902
ABD	-0.308	0.024*	-0.120	0.310	-0.168	0.154	0.272	0.042*	-0.063	0.592
ER	-0.366	0.007*	-0.313	0.007*	-0.375	0.001*	0.334	0.010*	0.104	0.382
IR	-0.187	0.178	-0.228	0.052	-0.115	0.331	0.142	0.229	-0.010	0.934
ABD strength (kg)	-0.394	0.003*	-0.381	0 < 0.001*	-0.351	0.002*	0.152	0.198	0.254	0.030*
Constant score	-0.467	< 0.001*	-0.358	0.002*	-0.375	0.001*	0.292	0.012*	0.145	0.222
ASES score	-0.174	0.210	-0.152	0.198	-0.248	0.034*	0.181	0.126	0.112	0.344
6 months postoperatively										
VAS	-0.084	0.584	0.201	0.107	-0.017	0.895	-0.038	0.763	0.028	0.823
ROM										
FF	-0.152	0.322	-0.355	0.004*	-0.091	0.471	0.075	0.552	0.063	0.617
ABD	-0.188	0.222	-0.404	< 0.001*	-0.158	0.208	0.084	0.504	0.152	0.225
ER	-0.190	0.217	-0.334	0.007*	-0.056	0.656	-0.071	0.573	0.172	0.170
IR	-0.316	0.036*	-0.415	< 0.001*	-0.011	0.928	-0.027	0.828	0.094	0.456
ABD strength (kg)	-0.500	< 0.001*	-0.289	0.019*	-0.039	0.756	0.160	0.202	-0.110	0.381
Constant score	-0.370	0.005*	-0.379	0.002*	-0.156	0.214	0.125	0.320	0.091	0.469
ASES score	-0.116	0.454	-0.140	0.264	-0.269	0.030*	0.134	0.287	0.190	0.130

Abbreviations: IL, interleukin; VAS, visual analog scale; ROM, range of motion; FF, forward flexion; ABD, abduction; ER, external rotation at side; IR, internal rotation; Constant, Constant–Murley score; ASES, American Shoulder and Elbow Surgeons.

*Statistically significant ($p < 0.05$).