Original Article

Patient Outcomes Are Not Improved by Platelet-Rich Plasma Injection Onto the Capsule at the Time of Closure During Hip Arthroscopy for Femoroacetabular Impingement Syndrome

S. Craig Morris, M.D., William T. Haselman, B.S., and Michael B. Banffy, M.D.

Purpose: To determine the effect of platelet-rich plasma (PRP) injection onto the capsule at time of closure on outcomes of patients undergoing hip arthroscopy for femoroacetabular impingement syndrome. **Methods:** Patients who underwent hip arthroscopy between January 2014 and December 2021 were retrospectively identified. The first cohort included patients who received PRP injection onto the capsule following capsular closure at the conclusion of the case. The second cohort did not receive PRP. Pain scores on a visual analog scale, Modified Harris Hip Scores, Single Assessment Numeric Evaluation (SANE), as well as Patient-Reported Outcomes Measurement Information System Physical Function scores were obtained preoperatively as well as at multiple time points postoperatively up to 2 years. **Results:** In total, 345 patients were included in the study, with 293 in the PRP cohort and 52 in the non-PRP cohort. There was no significance difference in age ($P = .69$), sex, or preoperative pain ($P = .92$) and patient-reported outcome scores between the 2 groups (modified Harris Hip Score, $P = .38$; Patient-Reported Outcomes Measurement Information System Physical Function, $P = .48$), except for preoperative SANE scores, which had a greater baseline in the PRP group ($P < .001$). Using both observed data as well as repeated measure analysis of variance model to estimate for missing data after baseline, we found there were no differences in visual analog scale pain scores nor patient-reported outcome scores at any time point. There was similarly no difference in change from baseline for SANE scores. There was no difference in rate of revision surgery between the 2 cohorts ($P = .66$). **Conclusions:** Based on the results of this study, intraoperative PRP injection onto the capsule at the time of capsular closure does not improve outcomes of patients undergoing hip arthroscopy for femoroacetabular impingement syndrome. **Level of Evidence:** Level III, retrospective comparative study.

Since it was described in 1931,[1] hip arthroscopy has been used to address various pathology and conditions around the hip joint. Indications for surgery include loose bodies, labral tears, degenerative disease, chondral injuries, femoroacetabular impingement (FAI), osteonecrosis, synovial disease, ruptured ligamentum teres, impinging osteophytes, instability, adhesive capsulitis, and joint sepsis.[2] Multiple studies have demonstrated the increasing use of hip arthroscopy over time,[3,4] with increased incidence seen in all age groups from adolescents (10-18 years old),[5] to adults (18-64 years old),[6] to the elderly population (65-74 years old).[7]

Biologics are increasingly being employed in the treatment of varying orthopaedic conditions, with platelet-rich plasma (PRP) being the most popular.[8,9] PRP has been shown to contain growth factors[10] that can improve the healing environment[11] and aid in tendon healing.[12] The potential benefits of PRP have led to its application and study in multiple pathologies, including but not limited to rotator cuff injury, lateral epicondylitis, patellar tendinopathy, Achilles tendinopathy, anterior cruciate ligament injury, hamstring tendinopathy, and muscle strains.[8,13] Another application of biologics with recent increase in use has been as an adjunct therapy in the arthroscopic treatment of FAI.[14] This has included injection of biologics intra-articularly preoperatively as part of nonoperative management as well as injection at the time of operative treatment. The

From Cedars-Sinai Kerlan-Jobe Institute, Los Angeles, California, U.S.A.

Received November 29, 2022; accepted September 28, 2023.

Address correspondence to William Haselman, Cedars-Sinai Kerlan-Jobe Institute, 6801 Park Terrace, Suite 140, Los Angeles, California 90045, U.S.A. E-mail: Tyler.haselman@gmail.com

2666-061X/22957

https://doi.org/10.1016/j.asmr.2023.100816

Table 1. Same Size per Group for the MCID Is Computed for Equal Sample Sizes in Both Groups and for 80% Power

	Sample Size (n) for 80% Power, Two-Sided Alpha = 0.05					Power for MCID, Alpha = 0.05	
Outcome	MCID	Largest Observed Mean Difference	Observed SD	No. per Group	Total No.	Base No.	12-Month No.
VAS	1.48	0.16	2.1	33	66	>99%	80%
mHSS	6.9	1.51	16.1	87	174	>99%	40%
PROMIS-10-PF	3.3	2.12	7.5	83	166	>99%	42%

NOTE. Power is computed for confirming the MCID for base sample of current study and n at 12 months follow up.

MCID, minimally clinically important difference; mHSS, modified Harris Hip Score; PROMIS-10-PF, Patient-Reported Outcomes Measurement Information System Physical Function; SD, standard deviation; VAS, visual analog scale.

preparation and injection of PRP during hip arthroscopy has been described previously.[15] Several studies have looked at the effect of intra-articular PRP injections at the time of arthroscopy,[16-18] with a recent systematic review[19] showing no significant improvement in pain or functional outcomes associated with PRP injections.

Capsular management during hip arthroscopy remains a topic of discussion, with increasing emphasis in recent years.[20-22] The hip capsule and its associated ligaments contribute to the stability of the hip joint. Both interportal and T-capsulotomy affect hip kinematics, with complete capsular repair having been shown to reverse those changes back toward native kinematics.[23-25] A recent systematic review of the biomechanical evidence concluded that the data support capsular closure after hip arthroscopy for femoroacetabular impingement or instability.[26] In reviewing clinical outcomes, growing evidence also supports capsular closure,[27] particularly in cases of borderline dysplasia, hip hypermobility, and instability.[28-30] Moreover, capsular closure has been shown to be associated with a lower risk of conversion to total hip arthroplasty.[31] In high-level athletes, complete capsular closure after hip arthroscopy is associated with faster return to play and a higher rate of return compared with that of nonclosure of the capsule.[32] Follow-up magnetic resonance imaging (MRI) studies have shown healing of the capsule with a contiguous appearance at 24 weeks postoperatively,[33] and that 92.5% of repaired hip capsules remain closed beyond 1 year follow up with thickening of the adjacent hip capsule.[34] Preoperative thickening of the anterior hip capsule has been shown to correlate with limitation in hip range of motion in FAI.[35] Although the intra-articular effects of PRP during hip arthroscopy have been studied, what is left to be discovered is the effect of PRP injection onto the capsule at the time of capsule closure during hip arthroscopy.

The purpose of this study is to determine the effect of PRP injection onto the capsule at time of closure on outcomes of patients undergoing hip arthroscopy for FAIS. We hypothesize that administration of PRP during capsular closure after hip arthroscopy will result in improve patient-reported outcome (PRO) scores at 6 months and 1-year postoperatively.

Table 2. Baseline Demographics and Patient-Reported Outcomes (PROs)

	PRP Group	Non-PRP Group	*P* Value
Number of Patients	557	180	—
Age, y	34.3	34.7	.6927
Sex			
Male	296	106	—
Female	261	74	—
Preoperative scores			
VAS score	4.46	4.45	.9183
mHSS	67.3	68.7	.3844
SANE	47.9	40.3	.0008
PROMIS-10-PF	46.1	45.4	.4834

mHSS, modified Harris Hip Score; PROMIS-10-PF, Patient-Reported Outcomes Measurement Information System Physical Function; PRP, platelet-rich plasma; SANE, and Single Assessment Numerical Evaluation Score; VAS, visual analog scale.

Methods

Study Design

The study received approval from the institutional review board. All patients who underwent hip arthroscopy during the study period from January 2014 to December 2021 were considered for this study. Inclusion criteria included patients undergoing hip arthroscopy for FAIS. Exclusion criteria included patients undergoing hip arthroscopy for other pathology, such as proximal hamstring pathology, abductor pathology. Exclusion criteria also included patients without PRO tools data. All patients signed informed consent when enrolled in the study group before undergoing surgery. Preoperative diagnoses included labral tears, FAI, chondral lesions, and intra-articular loose bodies. Indications for surgery were severe pain interfering with activities of daily living and failure of nonoperative treatment including anti-inflammatory medications and physical therapy. Physical examination findings preoperative were consistent with imaging findings and suspected preoperative diagnosis. The first cohort includes all patients before from January 2014 to February 9, 2021, who did receive intraoperative PRP

Table 3. Observed and Model-Based Mean Profiles for VAS Pain Scores

	Model-Based					Observed							% Diff
PRP	Month	Mean	SE	N	% Missing	Min	Q1	Median	Mean	Q3	Max	SD	in Means
No	0.0	4.46	0.18	119	33.9	0	2.52	4.49	4.46	6.27	9.97	2.45	0
No	0.5	2.98	0.18	120	33.3	0	1.09	2.84	2.91	4.10	8.13	2.03	2.3
No	1.0	2.61	0.19	112	37.8	0	0.96	2.15	2.52	3.63	9.25	1.94	3.6
No	3.0	2.16	0.21	88	51.1	0	0.67	1.71	2.09	2.84	9.68	2.10	3.2
No	6.0	1.93	0.24	58	67.8	0	0.10	0.95	1.84	2.26	10.00	2.43	4.5
No	12.0	1.88	0.39	19	89.4	0	0.07	0.51	1.54	1.82	8.06	2.18	18.2
Yes	0.0	4.43	0.10	400	29.0	0.01	2.99	4.48	4.45	6.03	9.88	2.12	-0.4
Yes	0.5	3.10	0.10	425	24.5	0	1.58	2.92	3.08	4.25	8.97	2.01	0.8
Yes	1.0	2.52	0.10	423	24.9	0	1.02	2.18	2.52	3.51	8.44	1.83	-0.1
Yes	3.0	2.32	0.10	381	32.3	0	0.90	1.99	2.36	3.50	9.95	2.04	-1.8
Yes	6.0	1.88	0.11	324	42.5	0	0.24	1.21	1.89	2.94	9.76	2.00	-0.4
Yes	12.0	1.81	0.11	315	44.0	0	0.09	0.97	1.78	2.53	9.89	2.16	1.7

NOTE. Comparison of model and observed means is shown. % Diff in means = ([model − observed]/model) * 100.

PRP, platelet-rich plasma; Max, maximum; Min, minimum; Q1, first quartile; Q3, third quartile; SD, standard deviation; SE, standard error; VAS, visual analog scale.

injection onto the capsule after capsular closure. The second cohort comprised all patients after February 9, 2021, who did not receive intra-operative PRP injection.

Surgical Technique

All surgical procedures were performed by the senior author (M.B.B.). Patients were placed in the supine position on a hip-distraction table and the operative extremity was prepped and draped in sterile fashion. An air arthrogram was created and approximately 1 cm of distraction obtained. An anterolateral portal was created, the camera was introduced into the joint, and a diagnostic arthroscopy was performed. A midanterior portal was created and interportal capsulotomy was performed with tagging sutures in the capsule. Additional portals were established as indicated by pathology and necessary interventions. Pincer lesions were treated with acetabuloplasty if needed, and labral repairs were treated with repair or reconstruction depending on the quality of the tissue and characteristics of the tear. Loose bodies were removed. Unstable chondral lesions were treated with debridement to a stable border. Traction was released at this time and work in the peripheral compartment including femoral osteoplasty of CAM lesions with fluoroscopic guidance was completed as indicated. At the conclusion of the case, the capsule was closed with multiple interrupted suture tape sutures. In the PRP cohort, following complete capsular closure a spinal needle was placed through a percutaneous approach so that the needle tip was juxtaposed to the capsular stitches. After fluid was removed from the hip and portal closure, a leukocyte-poor PRP solution that was prepared according to manufacturer' instructions (Stryker, Mahwah, NJ) was injected to bathe the capsule as the final step of the procedure. In the non-PRP cohort, following capsular closure all fluid was removed from the hip, the portals were closed, and sterile dressings applied. The patients were awoken from anesthesia and transferred to the recovery room. Post operative weight bearing restrictions and

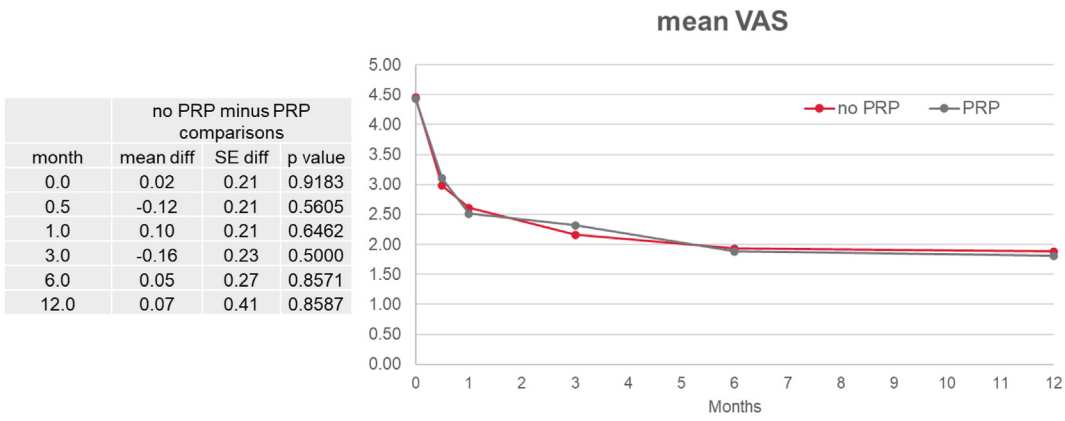


Fig 1. Comparison of PRP and no PRP cohorts for VAS scores. (PRP, platelet-rich plasma; VAS, visual analog scale.)

Table 4. Observed and Model-Based Mean Profiles for mHHS

	Model Based				Observed							% Diff
PRP	Month	Mean	SE	N	% Missing	Min	Q1	Median	Mean	Q3	Max	SD	in Means
No	0	68.6	1.53	119	33.9	14.3	59.4	70.4	68.7	81.4	100.0	17.5	−0.3
No	3	82.6	1.73	88	51.1	28.6	75.9	90.2	83.1	95.7	100.0	17.9	−0.6
No	6	85.3	2.04	58	67.8	41.8	79.2	92.4	86.6	96.8	100.0	14.3	−1.4
No	12	88.4	3.28	19	89.4	60.5	88.6	95.7	90.7	100.0	100.0	13.0	−2.6
Yes	0	67.0	0.83	398	29.3	12.1	56.1	68.2	67.3	81.1	100.0	18.5	−0.4
Yes	3	81.3	0.84	381	32.3	18.7	71.5	84.7	81.4	95.7	100.1	16.6	−0.2
Yes	6	85.5	0.90	324	42.5	23.1	79.2	92.4	85.6	96.8	100.1	16.2	−0.1
Yes	12	87.3	0.91	315	44.0	30.8	81.4	95.7	87.6	97.9	100.1	15.0	−0.4

NOTE. Comparison of model and observed means is shown. % Diff in means = ([model − observed]/model) * 100.

PRP, platelet-rich plasma; Max, maximum; Min, minimum; Q1, first quartile; Q3, third quartile; SD, standard deviation; SE, standard error; VAS, visual analog scale.

rehabilitation protocols were based on the pathology addressed and identified during the case. The 2 cohorts received the same weight-bearing and rehabilitation protocols for corresponding pathologies. Patients in both cohorts were routinely prescribed anti-inflammatory medication postoperatively to decrease heterotopic ossification.

Outcome Measures

Demographic data, including age and sex, were obtained from all patients. Pain scores on a visual analog scale (VAS) from 0 to 10, with 0 corresponding to no pain at all and 10 considered the worst possible pain, were obtained prospectively at the preoperative visit as well as at 2 weeks, 4 weeks, 3 months, 6 months, and 1 year postoperative. PRO tools included the modified Harris Hip Score (mHHS),[36] and Single Assessment Numerical Evaluation Score (SANE).[37] These PRO tools were obtained prospectively at the preoperative visit as well as at 3 months, 6 months, and 1-year postoperative. The physical function component of the Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF)[38] was prospectively obtained at the preoperative visit as well as at 6 months and 1-year postoperative.

Statistics

The *P* value for comparing the proportion of female patients between the 2 groups was computed using the Fisher exact test. The *P* value for comparing age at baseline was computed using the *t* test.

Mean profiles over time between the PRP and non PRP groups were compared using a repeated-measure (mixed) analysis of variance model. This model uses the correlations between measurements on the same patients over time to try to estimate what the mean profile should be as if there was no missing data after baseline, assuming that the missing data is missing at random (MAR). This model is needed, since observations across time on the same patients are not independent. The normality of residual errors as required by the repeated measure model was assessed by examining normal quantile plots and the Shapiro−Wilks statistic (not reported). Since there was a difference in baseline SANE scores, the mean change from baseline was also assessed for the SANE scores.

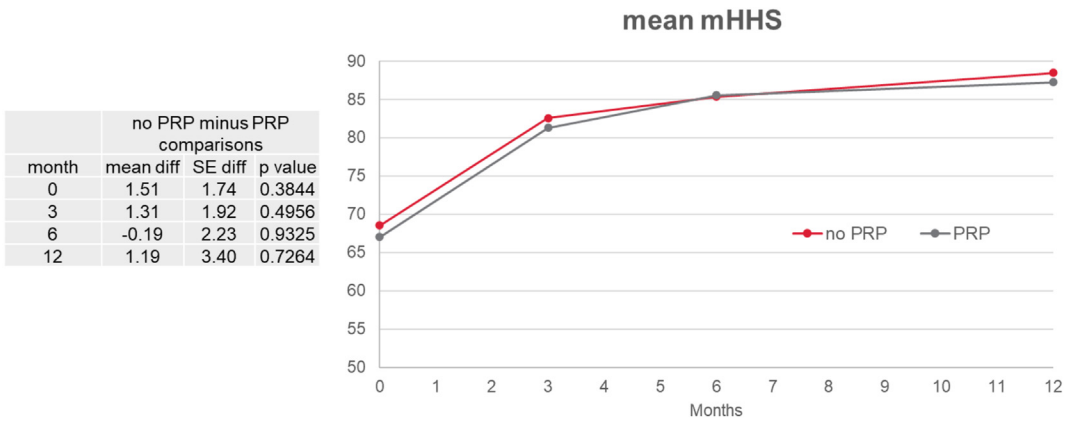


Fig 2. Comparison of PRP and no PRP cohorts for mHHS. (PRP, platelet-rich plasma; mHSS, modified Harris Hip Score.)

Table 5. Observed and Model-Based Mean Profiles for PROMIS-10-PF Scores

	Model Based				Observed							% Diff
PRP	Month	Mean	SE	N	% Missing	Min	Q1	Median	Mean	Q3	Max	SD	in Means
No	0	45.4	0.70	116	35.6	26.7	39.8	44.9	45.4	50.8	61.9	7.3	0
No	6	51.5	0.91	58	67.8	32.4	47.7	54.1	52.0	57.7	67.7	7.8	−1.0
No	12	55.0	1.41	19	89.4	42.3	54.1	57.7	56.5	59.8	67.7	6.7	−2.6
Yes	0	46.0	0.44	295	47.6	26.7	39.8	44.9	46.1	50.8	67.7	7.2	−0.2
Yes	6	52.2	0.47	234	58.4	32.4	47.7	54.1	52.0	57.7	67.7	8.2	−0.3
Yes	12	52.9	0.48	219	61.1	26.7	47.7	54.1	53.1	57.7	67.7	8.0	−0.4

NOTE. Comparison of model and observed means is shown. % Diff in means = ([model − observed]/model) * 100.

PROMIS-10-PF, Patient-Reported Outcomes Measurement Information System Physical Function; PRP, platelet-rich plasma; Max, maximum; Min, minimum; Q1, first quartile; Q3, third quartile; SD, standard deviation; SE, standard error; VAS, visual analog scale.

For the estimated mean profiles to be unbiased in the presence of missing data, the data must be MAR. Some support for MAR is provided if the missingness does not depend on any known covariates such as age, sex, or time. Thus, a mixed model logistic regression was used to determine whether missing VAS (yes or no) was dependent on age, sex, and/or time. Nonindependence in the same patient over time was accounted for by including a random patient effect (patient ID) in the model. The analysis of deviance table from this model is reported.

Revisions for each cohort were reported and the difference in rate of revision surgery was computed using the χ^2 test. Sample size per group for the minimal clinical important difference (MCID) was computed for equal sample sizes in both groups and for 80% power. The values for MCID for VAS pain score,[39] mHHS,[40] and PROMIS PF[41] had been defined previously for hip arthroscopy for FAI. Power analysis revealed minimum sample size per group necessary for 80% power to confirm MCID for VAS (33), mHHS (87), and PROMIS PF (83) (Table 1).

Results

In total, 743 patients underwent hip arthroscopy with the senior author during the time frame of the study and were enrolled. The PRP cohort contained 557 patients whereas the non-PRP cohort contained 180 patients. Patient demographics as well as preoperative scores are shown in Table 2. There were no significant differences between the 2 groups for age and sex; therefore, these are not confounding factors and no adjustments for age and sex are needed. Preoperative VAS pain, mHHS, and PROMIS PF were similar between groups. There was a difference in preoperative SANE scores, with greater baseline scores in the PRP group. There was no difference between the two cohorts at any time point in the mean profiles for VAS (Table 3, Fig 1), mHHS (Table 4, Fig 2), and PROMIS PF (Table 5, Fig 3). There was no difference at any time point between the 2 cohorts in mean change from baseline profiles for SANE scores (Table 6, Fig 4). The missing data were identified to not depend on age or sex but did depend on follow-up time with more data missing over time (Table 7). Five patients in the PRP cohort subsequently required revision surgery for the following reasons: capsular dehiscence, failed labral repair; residual cam, recurrent labral tear; recurrent labral tear, residual cam, subspine impingement, adhesions; failed labral repair, loose foreign body; and recurrent labral tear, subspine impingement, adhesions. One patient in the non-PRP cohort required revision surgery for failed labral repair, residual cam, and

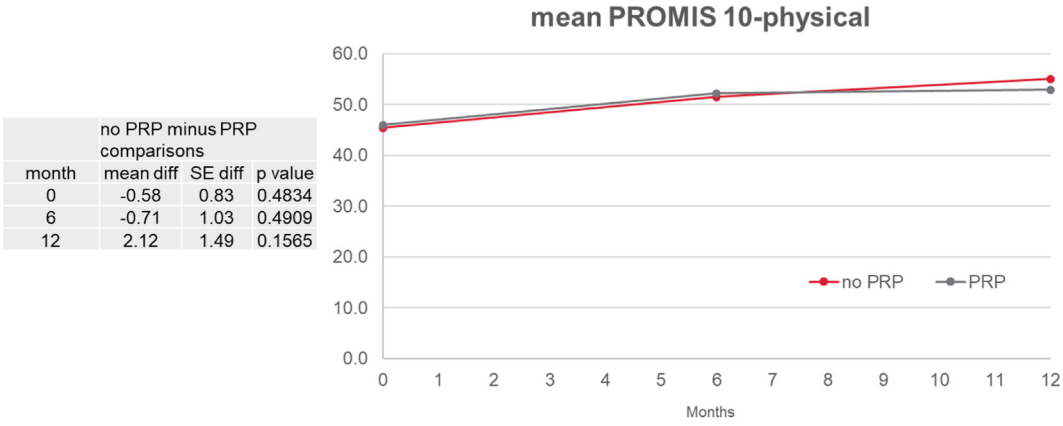


Fig 3. Comparison of PRP and no PRP cohorts for PROMIS PF scores. (PRP, platelet-rich plasma; PROMIS-10-PF, Patient-Reported Outcomes Measurement Information System Physical Function.)

Table 6. Observed and Model-Based Mean Change From Baseline Profiles for SANE Scores

	Model Based				Observed							% Diff
PRP	Month	Mean	SE	N	% Missing	Min	Q1	Median	Mean	Q3	Max	SD	in Means
No	3	22.2	3.04	75	58.3	−40.0	2.0	21.0	22.0	40.5	85.0	29.2	−0.9
No	6	32.1	3.42	52	71.1	−63.0	21.3	34.0	33.0	52.3	89.0	27.8	−2.7
No	12	30.9	4.82	19	89.4	−42.0	18.5	30.0	31.1	52.5	79.0	29.5	−0.7
Yes	3	18.9	1.58	270	52.0	−68.0	1.0	20.0	19.2	39.0	89.0	25.8	−1.7
Yes	6	28.6	1.65	237	57.9	−90.0	15.0	31.0	30.0	48.0	95.0	27.0	−4.6
Yes	12	33.6	1.67	226	59.9	−20.0	18.0	32.0	34.7	50.0	90.0	24.1	−3.1

NOTE. Comparison of model and observed means is shown. % Diff in means = ([model − observed]/model) * 100.

PRP, platelet-rich plasma; Max, maximum; Min, minimum; Q1, first quartile; Q3, third quartile; SANE, and Single Assessment Numerical Evaluation Score; SD, standard deviation; SE, standard error; VAS, visual analog scale.

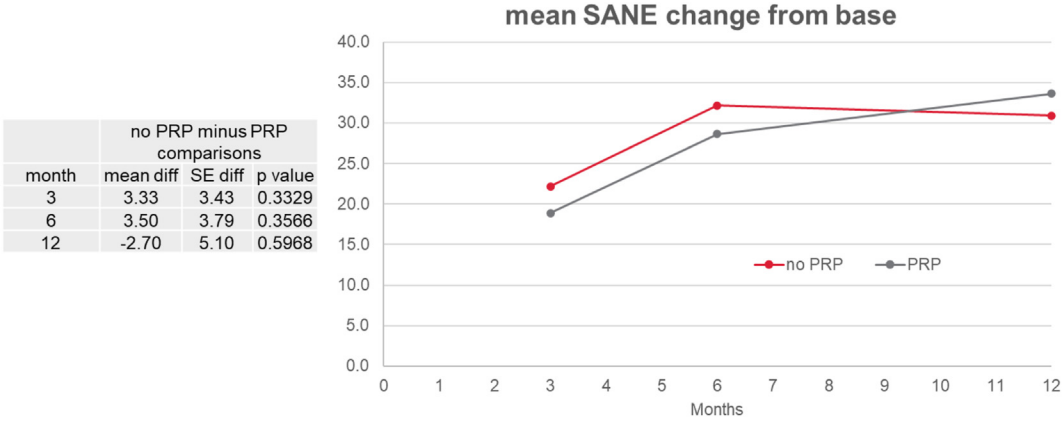
adhesions. There was no difference in the rate of revision surgery (*P*-value .6643). No patients in this study went on to total hip arthroplasty during the study period.

Discussion

The data from this study suggest that there is no difference in outcomes with PRP injection onto the capsule after capsular closure during hip arthroscopy, despite PRP having been shown to have beneficial effects in other applications within orthopaedics.[8] The lack of effect of the PRP in these patients may have been the result of many factors, including anti-inflammatory medications taken during the post-operative period as part of multimodal pain control, dilution of the PRP within residual arthroscopic irrigation fluid, or no true effect of capsular healing by the PRP.

Mannava et al.[15] detailed their institutional protocol for the preparation and administration of PRP during hip arthroscopy. After capsular closure the hip is lavaged with arthroscopic fluid and drained. A cannula is then placed intracapsular and 10 to 15 mL of PRP is injected onto the osteoplasty site. These authors also report that they do inject 4 mL of diluted PRP and 0.5 mL of platelet-rich plasma releasate into the repaired hip joint capsule in the peripheral compartment through the arthroscopic cannula with traction removed from the joint. The authors do not report on outcomes in this technique paper.

The intra-articular effects of PRP at the time of hip arthroscopy has been studied previously. LaFrance et al.[18] randomized 20 patients to 5 cc of PRP and 15 patients to an equal volume of 0.9% normal saline. At 1 week postoperative, there was no difference in the 2 groups in thigh circumference; however, more patients in the placebo group demonstrated lateral thigh bruising. There was no significant difference in outcome scores between the 2groups up to 1-year postoperatively. Redmond et al.[17] published a prospective comparative study of 271 patients. The study group received intra-articular PRP whereas the control group received 0.25% bupivacaine. The study group had slightly lower mHHS and slightly greater pain scores than the control group 2 years after surgery. There was no difference in conversion to total hip arthroplasty or revision surgery. Rafols et al.[16] randomized patients to intra-articular PRP or no PRP at the end of hip arthroscopy. They obtained mHHS and VAS pain scores, and also obtained MRI studies 6 months



	no PRP minus PRP comparisons		
month	mean diff	SE diff	p value
3	3.33	3.43	0.3329
6	3.50	3.79	0.3566
12	-2.70	5.10	0.5968

Fig 4. Comparison of PRP and no PRP cohorts for mean change from baseline SANE scores. (PRP, platelet-rich plasma; SANE, and Single Assessment Numerical Evaluation Score.)

Table 7. Missing Data Assessment Showing Missing Data Does Not Depend on Age or Sex but Does Depend on Time With Increasing Missing Data Over Time

Age vs VAS missing							
VAS Missing	N obs	Min	Q1	Median	Mean	Q3	Max	SD
0-not missing	2813	12.0	25.0	33.0	34.5	42.0	79.0	12.9
1-missing	1572	12.0	22.0	33.0	34.1	43.0	76.0	13.3
Total	4380							

Gender vs VAS missing				
VAS missing	F	M	Total	% Female
0-not missing	1307	1497	2804	46.6%
1-missing	703	915	1618	43.4%
Total	2010	2412	4422	45.5%

Months follow up vs VAS missing							
VAS missing	0	0.5	1	3	6	12	Total
0-not missing	525	557	543	476	390	342	2833
1-missing	218	186	200	267	353	401	1625
Total	743	743	743	743	743	743	4458
% missing	29.3%	25.0%	26.9%	35.9%	47.5%	54.0%	36.5%

after surgery. They showed lower pain scores in the PRP group 48 hours after surgery but no difference in mHHS. MRI data showed greater rates of effusions at 6 months in the no PRP group but no difference regarding labral integration. The authors did not report data regarding healing of the capsule repair nor capsular thickness on MRI 6 months' postoperative. Ali et al.[19] performed a systematic review analyzing a total of 363 hips with 141 randomized to intra-articular PRP injection at the time of hip arthroscopy. The review was limited by differing PRP systems and preparations across studies, but the authors concluded that intra-articular PRP did not lead to significantly improved postoperative pain or functional outcomes when compared with control groups. Concern has been raised previously by DeLong et al.[42] that many different protocols for preparation of PRP limits the ability to compare outcomes from different studies.

Limitations

Our study has numerous limitations. We had a high percentage of lost to follow-up or missing data, increasing the potential for type II error. Second, this was not a prospective, randomized clinical trial and as such is subject to some of the limitations inherent in retrospective studies of prospectively obtained data. Although there were no identified demographic differences between the 2 cohorts, randomization would have improved the confidence that confounding variables are not impacting the outcome measures. Third, we used VAS pain scores and PRO scores as outcome measures. Especially as we were interested in the effect on capsular closure, postoperative follow-up imaging, ideally MRI, to evaluate the integrity of the capsular closure as well as thickening of adjacent capsular tissue would have provided valuable information on the effect of PRP. The cost associated with obtaining these MRI studies was prohibitive from inclusion in this study. Fourth, the patients in this study represented a broad range of pathology. Although this heterogeneity would lend to the broad application of the effects of PRP for all hip arthroscopic interventions, this heterogeneity in the patient populations has the potential to add confounding variables. Radiographic measurements were not included in the study, which would add value to potentially identify confounding factors between the groups such as hip dysplasia, which are particularly important when considering capsule management. Conclusions need to be tempered based on the unknown effect of that missing data. Fifth, the follow-up was limited to 1 year postoperative and the missing data assessment revealed increasing data with increasing time from surgery. This is a major limitation of this current study and an inherent problem with survey-based research. Since the missing VAS data (and missing data for other outcomes) depend on time and are therefore not missing at random, we do not know if the mean profiles are biased and the interpretation of the model-based analyses is impacted. However, previous imaging studies have shown healing of the capsule with a contiguous appearance at 24 weeks' postoperatively[33]; therefore, the effect of PRP on capsular closure would be expected to be identified in this early postoperative period. Moreover, our power analysis revealed a minimum sample size of 33 per group for 80% power to identify MCID in VAS scores, and the smaller cohort (non PRP) had 58 subjects responding at the 6-month postoperative mark so our

study was appropriately powered to identify a difference at that time point. Nonetheless, improved subject response rates and longer-term follow-up is necessary to identify long-term impact of PRP in this patient population. Our study was limited to one preparation protocol for PRP according to the manufacturer's instructions, and although this eliminates potential confounding factors, this also limits the ability to apply the results to other preparation protocols and PRP concentrations. Moreover, the platelet concentration and other characteristics of the PRP after preparation were not analyzed in the study. Finally, given the linear time line of the study and since all surgeries were performed by the senior author another potentially confounding variable is improved surgical ability and refined patient selection secondary to increased repetitions in the operating room and more time in practice.

Conclusions

Based on the results of this study, intraoperative PRP injection onto the capsule after capsular closure does not improve outcomes of patients undergoing hip arthroscopy for FAIS.

Disclosure

The authors report the following potential conflicts of interest or sources of funding: M.B.B. reports consulting fees from Stryker, Smith & Nephew, and Vericel and other financial or nonfinancial interests from Stryker, Smith & Nephew, and Vericel. All other authors (S.C.M., W.T.H.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

References

1. Burman MS. Arthroscopy or the direct visualization of joints: An experimental cadaver study. 1931. *Clin Orthop Relat Res* 2001;(390):5-9.
2. Byrd JW. Hip arthroscopy. *J Am Acad Orthop Surg* 2006;14:433-444.
3. Colvin AC, Harrast J, Harner C. Trends in hip arthroscopy. *J Bone Joint Surg Am* 2012;94:e23.
4. Montgomery SR, Ngo SS, Hobson T, et al. Trends and demographics in hip arthroscopy in the United States. *Arthroscopy* 2013;29:661-665.
5. Hassan MM, Hussain ZB, Rahman OF, Kocher MS. Trends in adolescent hip arthroscopy from the PHIS database 2008-2018. *J Pediatr Orthop* 2021;41:e26-e29.
6. Maradit Kremers H, Schilz SR, Van Houten HK, et al. Trends in utilization and outcomes of hip arthroscopy in the United States between 2005 and 2013. *J Arthroplasty* 2017;32:750-755.
7. Malik AT, Jain N, Scharschmidt TJ, Glassman AH, Khan SN. Primary hip arthroscopy and conversion to total hip arthroplasty: Trends and survival analysis in the Medicare population. *Hip Int* 2022;32:239-245.
8. Hsu WK, Mishra A, Rodeo SR, et al. Platelet-rich plasma in orthopaedic applications: Evidence-based recommendations for treatment. *J Am Acad Orthop Surg* 2013;21:739-748.
9. Noback PC, Donnelley CA, Yeatts NC, et al. Utilization of orthobiologics by sports medicine physicians: A survey-based study. *J Am Acad Orthop Surg Glob Res Rev* 2021;5:e20.00185.
10. Boswell SG, Cole BJ, Sundman EA, Karas V, Fortier LA. Platelet-rich plasma: A milieu of bioactive factors. *Arthroscopy* 2012;28:429-439.
11. Lopez-Vidriero E, Goulding KA, Simon DA, Sanchez M, Johnson DH. The use of platelet-rich plasma in arthroscopy and sports medicine: optimizing the healing environment. *Arthroscopy* 2010;26:269-278.
12. Baksh N, Hannon CP, Murawski CD, Smyth NA, Kennedy JG. Platelet-rich plasma in tendon models: A systematic review of basic science literature. *Arthroscopy* 2013;29:596-607.
13. Chen X, Jones IA, Park C, Vangsness CT Jr. The efficacy of platelet-rich plasma on tendon and ligament healing: A systematic review and meta-analysis with bias assessment. *Am J Sports Med* 2018;46:2020-2032.
14. Robinson PG, Murray IR, Maempel J, Rankin CS, Hamilton D, Gaston P. Use of biologics as an adjunct therapy to arthroscopic surgery for the treatment of femoroacetabular impingement: A systematic review. *Orthop J Sports Med* 2019;7:2325967119890673.
15. Mannava S, Chahla J, Geeslin AG, et al. Platelet-rich plasma augmentation for hip arthroscopy. *Arthrosc Tech* 2017;6:e763-e768.
16. Rafols C, Monckeberg JE, Numair J, Botello J, Rosales J. Platelet-rich plasma augmentation of arthroscopic hip surgery for femoroacetabular impingement: A prospective study with 24-month follow-up. *Arthroscopy* 2015;31:1886-1892.
17. Redmond JM, Gupta A, Stake CE, Hammarstedt JE, Finch NA, Domb BG. Clinical results of hip arthroscopy for labral tears: A comparison between intraoperative platelet-rich plasma and bupivacaine injection. *Arthroscopy* 2015;31:445-453.
18. LaFrance R, Kenney R, Giordano B, Mohr K, Cabrera J, Snibbe J. The effect of platelet enriched plasma on clinical outcomes in patients with femoroacetabular impingement following arthroscopic labral repair and femoral neck osteoplasty. *J Hip Preserv Surg* 2015;2:158-163.
19. Ali M, Benjamin B, Jain N, Malviya A. Does platelet-rich plasma augmentation following hip arthroscopy improve outcomes: A systematic review. *Hip Pelvis* 2020;32:70-77.
20. Freeman KL, Nho SJ, Suppauksorn S, Chahla J, Larson CM. Capsular management techniques and hip arthroscopy. *Sports Med Arthrosc Rev* 2021;29:22-27.
21. Nho SJ, Beck EC, Kunze KN, Okoroha K, Suppauksorn S. Contemporary management of the hip capsule during arthroscopic hip preservation surgery. *Curr Rev Musculoskelet Med* 2019;12:260-270.
22. Harris JD. Capsular management in hip arthroscopy. *Clin Sports Med* 2016;35:373-389.

23. Baha P, Burkhart TA, Getgood A, Degen RM. Complete capsular repair restores native kinematics after interportal and t-capsulotomy. *Am J Sports Med* 2019;47:1451-1458.
24. Philippon MJ, Trindade CAC, Goldsmith MT, Rasmussen MT, Saroki AJ, Løken S, LaPrade RF. Biomechanical assessment of hip capsular repair and reconstruction procedures using a 6 degrees of freedom robotic system. *Am J Sports Med* 2017;45:1745-1754.
25. Abrams GD, Hart MA, Takami K, et al. Biomechanical evaluation of capsulotomy, capsulectomy, and capsular repair on hip rotation. *Arthroscopy* 2015;31:1511-1517.
26. Jimenez AE, Owens JS, Shapira J, Saks BR, Ankem HK, Sabetian PW, Lall AC, Domb BG. Hip capsular management in patients with femoroacetabular impingement or microinstability: A systematic review of biomechanical studies. *Arthroscopy* 2021;37:2642-2654.
27. Owens JS, Jimenez AE, Shapira J, et al. Capsular repair may improve outcomes in patients undergoing hip arthroscopy for femoroacetabular impingement: A systematic review of comparative outcome studies. *Arthroscopy* 2021;37:2975-2990.
28. Ortiz-Declet V, Mu B, Chen AW, et al. Should the capsule be repaired or plicated after hip arthroscopy for labral tears associated with femoroacetabular impingement or instability? A systematic review. *Arthroscopy* 2018;34:303-318.
29. Westermann RW, Bessette MC, Lynch TS, Rosneck J. Does closure of the capsule impact outcomes in hip arthroscopy? A systematic review of comparative studies. *Iowa Orthop J* 2018;38:93-99.
30. Nepple JJ, Smith MV. Biomechanics of the hip capsule and capsule management strategies in hip arthroscopy. *Sports Med Arthrosc Rev* 2015;23:164-168.
31. Riff AJ, Kunze KN, Movassaghi K, et al. Systematic review of hip arthroscopy for femoroacetabular impingement: The importance of labral repair and capsular closure. *Arthroscopy* 2019;35:646-656.e3.
32. Hassebrock JD, Makovicka JL, Chhabra A, et al. Hip arthroscopy in the high-level athlete: Does capsular closure make a difference? *Am J Sports Med* 2020;48:2465-2470.
33. Strickland CD, Kraeutler MJ, Brick MJ, et al. MRI evaluation of repaired versus unrepaired interportal capsulotomy in simultaneous bilateral hip arthroscopy: A double-blind, randomized controlled trial. *J Bone Joint Surg Am* 2018;100:91-98.
34. Weber AE, Kuhns BD, Cvetanovich GL, et al. Does the hip capsule remain closed after hip arthroscopy with routine capsular closure for femoroacetabular impingement? A magnetic resonance imaging analysis in symptomatic postoperative patients. *Arthroscopy* 2017;33:108-115.
35. Zhang K, de Sa D, Yu H, Choudur HN, Simunovic N, Ayeni OR. Hip capsular thickness correlates with range of motion limitations in femoroacetabular impingement. *Knee Surg Sports Traumatol Arthrosc* 2018;26:3178-3187.
36. Byrd JW, Jones KS. Prospective analysis of hip arthroscopy with 2-year follow-up. *Arthroscopy* 2000;16:578-587.
37. Lau BC, Scribani M, Lassiter T, Wittstein J. Correlation of Single Assessment Numerical Evaluation Score for Sport and Activities of Daily Living to Modified Harris Hip Score and Hip Outcome Score in patients undergoing arthroscopic hip surgery. *Am J Sports Med* 2019;47:2646-2650.
38. Kollmorgen RC, Hutyra CA, Green C, Lewis B, Olson SA, Mather RC 3rd. Relationship between PROMIS computer adaptive tests and legacy hip measures among patients presenting to a tertiary care hip preservation center. *Am J Sports Med* 2019;47:876-884.
39. Beck EC, Nwachukwu BU, Kunze KN, Chahla J, Nho SJ. How can we define clinically important improvement in pain scores after hip arthroscopy for femoroacetabular impingement syndrome? Minimum 2-year follow-up study. *Am J Sports Med* 2019;47:3133-3140.
40. Nwachukwu BU, Beck EC, Kunze KN, Chahla J, Rasio J, Nho SJ. Defining the clinically meaningful outcomes for arthroscopic treatment of femoroacetabular impingement syndrome at minimum 5-year follow-up. *Am J Sports Med* 2020;48:901-907.
41. Bodendorfer BM, DeFroda SF, Clapp IM, Newhouse A, Nwachukwu BU, Nho SJ. Defining clinically significant improvement on the patient-reported outcomes measurement information system test at 1-year follow-up for patients undergoing hip arthroscopy for the treatment of femoroacetabular impingement syndrome. *Am J Sports Med* 2021;49:2457-2465.
42. DeLong JM, Russell RP, Mazzocca AD. Platelet-rich plasma: The PAW classification system. *Arthroscopy* 2012;28:998-1009.