

Original Article

High Return to Play Rate and Diminished Career Longevity are Seen Following Arthroscopic Shoulder Labral Repair in Major League Baseball Players

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Purpose: To evaluate the impact of arthroscopic shoulder labral repair, not related to instability, on return to play (RTP), return to prior performance (RTPP), game utilization, and performance in Major League Baseball (MLB) pitchers and positional players. **Methods:** A retrospective review of all MLB athletes who underwent arthroscopic shoulder labrum repair from 2002 to 2020 was performed. Players with a history of instability events were excluded. A 2:1 control cohort of healthy MLB players were matched to the operative cohort by age, years of experience, position, height, and body mass index (BMI). Player demographics, game utilization, and performance metrics were collected for all players. **Results:** Twenty-six of 39 MLB pitchers (66%) and 18 of 25 (72%) positional players, who underwent arthroscopic shoulder labral repair RTP, with 46.2% of pitchers and 72% of positional players successfully RTP. At one season post-surgery, pitchers and positional players experienced a significant reduction in games played compared to their one season preinjury (44.7 ± 29.3 vs 109.5 ± 73.2 games; $P < .001$ and 75.7 ± 47.1 vs 98.0 ± 50.7 games; $P = .04$). When compared with matched controls at one season postinjury, pitchers had significantly fewer runs allowed per 9 innings (5.8 ± 2.0 vs 4.3 ± 1.4 ; $P = .0061$) and walk and hits per inning pitched (WHIP) (1.5 ± 0.3 vs 1.3 ± 0.2 ; $P = .0035$), while positional players had worse on-base percentage (0.3 ± 0.1 vs 0.3 ± 0.1 ; $P = .0116$). Both pitchers and positional players experienced significantly shorter career lengths after surgery ($P = .002$) when compared to controls. **Conclusion:** Following arthroscopic shoulder labral surgery, most MLB pitchers and positional players were able to RTP successfully but experienced shorter careers thereafter. These players also experienced declines in game utilization and performance one season after surgery but were able to return to baseline at 3 seasons after surgery.

Introduction

Shoulder labrum tears are a common, yet devastating injuries common among overhead throwing athletes. Due to the dynamic mobility of the shoulder and the extreme forces during the throwing motion,

the labrum is under high tension and prone to tearing with repeated stress. Baseball players are particularly at high risk for labral tears, with pitchers sustaining a higher documented risk of injury than position players.¹ First-line management typically consists of nonsurgical rehabilitation and has shown success in professional baseball players.² However, for some players with persistent symptoms, surgical management of the shoulder may be necessary. In an epidemiologic study of MLB player injuries, Chalmers et al. found that while shoulder injuries were common, a minority of these players underwent surgical management, with a 1.48% incidence of surgery; however, more than 60% of these shoulder surgeries addressed labral tears.³ Arthroscopic shoulder labral repair requires substantial recovery necessitating time away from sport with substantial financial implications to both player and team.^{4–6}

In Major League Baseball (MLB), previous literature reports mixed results in return to play (RTP) rates, as

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well as performance metrics after arthroscopic shoulder labral repair.^{3,7–10} For those MLB players who underwent shoulder labral repair, only 63% were found to RTP,³ which is considerably lower relative to other professional athletes with similar injuries in the NBA, NHL, and NFL.^{8,9,11–13} A retrospective review of MLB pitchers undergoing shoulder labral repair reported return to prior performance (RTPP) in 54.2% to 86.7% of MLB players who were able to RTP.¹⁴ As a result of the substantial demand and stress placed on the shoulder, rehabilitation from a shoulder surgery is often difficult, leading to variable return to play at an elite level.^{15,16}

With heterogeneous RTP and performance in the MLB, further investigation is necessary to elucidate the impact of isolated shoulder labral repair, not related to instability, on MLB players. The purpose of this study is to evaluate the impact of arthroscopic shoulder labral repair, not related to instability, on return to play (RTP), return to prior performance (RTPP), game utilization, and performance in Major League Baseball (MLB) pitchers and positional players. We hypothesize that most MLB players will successfully RTP; however, game utilization and performance will be worse acutely compared to a cohort of healthy MLB players.

Methods

A retrospective review of all MLB athletes who underwent arthroscopic shoulder labrum repair in their throwing shoulder from 2002 to 2020 was performed. Individual player medical records were not available, therefore, consistent with previous literature, a public Internet search using www.baseballreference.com and www.MLB.com, along with various news, team, and official MLB websites was performed.^{10,17–20} These sources were used to cross-reference all players identified to ensure accuracy of the injury and date of the surgery. Game statistics were reviewed to confirm missing data following surgical management. Isolated labral tears were collected, and reports of instability events, such as shoulder dislocations or subluxations, were used as exclusion criteria. Players were also excluded if an acute injury occurred outside of participation in the MLB practice of game, the presence of a concomitant injury, if they had prior surgical management on the operative shoulder, or if the player suffered other injuries within 2 years before or after the index year because their data could not be attributed strictly to a history of arthroscopic labrum repair.

Operative players were matched with a control cohort of healthy MLB players, with a goal of 2:1, by age, years of playing experience, position played, height, and body mass index (BMI) to the players in the study cohort. Matching by age rather than years of experience took priority, as players in the MLB have varying experience

at the collegiate, minor league, or other developmental or overseas leagues. The index season for the healthy control group was set within 5 years of the injury season of the study group player. The index year represented the entire season in which the surgery occurred, including the postseason. The offseason was included in the index season if the surgery occurred during this time period, and no game play was missed.

Player demographics, game utilization, and performance metrics were collected for 3 seasons leading up to and directly after the index year. Demographics collected included the player's position, handedness, age at index year, height, weight, and BMI. Return to play was defined as returning for at least 1 game in the MLB; other professional leagues did not qualify. Game utilization statistics included games played, games started, and innings played. Performance metrics included runs allowed, hits allowed, home runs allowed, walks, and strikeouts all per 9 innings, as well as fielding percentage, walks and hits per inning pitched (WHIP), and earned run average (ERA) for pitchers. Performance metrics for positional players included batting average, on-base-percentage (OBS), on-base plus slugging percentage (OPS), and fielding percentage. Comparisons were made between the study group and healthy matched controls for game utilization and performance at 1 season postindex and 3 seasons postindex compared with 1 season preindex. The relative baseline percentage of all-game utilization and performance metrics were calculated by dividing post-index season 1 or 3 by baseline preindex season 1 statistics. These relative percentages were used to compare the short-term and long-term changes experienced between the study and control group. Consistent with previous study methodology, performance was also characterized by RTPP.^{1,21} This was defined as an ERA within 0.200 and WHIP within 0.500 from a previous 3-season preindex average for pitchers, and a batting average within 0.100 from a previous 3-season preindex average for positional players.

Statistical Analysis

All analyses were performed with SAS 9.4 (SAS Institute Inc., Cary, NC). Continuous data are reported as means \pm SD, while categorical data are reported as counts and column percentages. To evaluate continuous data, normality of data was determined using histograms, and variables were analyzed using two-sample *t*-tests for normally distributed variables and Wilcoxon rank sum tests for non-normally distributed variables. Categorical data were evaluated by performing 2-group univariate comparisons using the chi-square test for values greater than 5 and Fischer's exact tests for values less than 5. To compare pre- and post-data comparisons, paired *t*-tests were performed when

Table 1A. Demographic Characteristics of MLB Pitchers who Underwent Arthroscopic Shoulder Labral Repair Surgery Versus Healthy Matched Controls

	Response	Labrum (<i>n</i> = 26)	Control (<i>n</i> = 54)	<i>P</i> Value
RTP Rate		66%	100%	
Handedness	Left	7 (27%)	15 (28%)	
	Right	19 (73%)	39 (72%)	
	Both	0	0	
Age at surgery/index	Mean	28.2 ± 4.5	27.8 ± 4.4	.712
Height (inches)	Mean	74.3 ± 2.4	74.9 ± 2.0	.324
Weight (pounds)	Mean	202.9 ± 20.8	208.4 ± 17.9	.224
BMI	Mean	25.8 ± 2.2	26.2 ± 2.1	.479
Seasons after RTP	Mean	2.3 ± 2.6	5.8 ± 2.8	<.001

Bolded value indicates significant difference. Age is represented by years. Height is represented in inches; weight is represented in pounds. BMI represented in kg/m²; seasons represented in years. BMI, body mass index; RTP, return to play.

normally distributed, and differences were calculated as postsurgery minus presurgery. Pearson's correlation coefficient tests were used to calculate the association between time and RTP.

Results

Demographics and Return to Sport

Twenty-six of 39 MLB pitchers (66%) and 18 of 25 (72%) positional players who underwent arthroscopic shoulder labral repair successfully RTP. These players were matched with 54 and 34 healthy pitchers and positional MLB players, respectively. When compared to controls, pitchers who underwent surgery demonstrated no significant difference in any demographic variable (Table 1A). However, pitchers who underwent surgery experienced a significant reduction in total seasons played after the index season (2.3 ± 2.6 vs 5.8 ± 2.8 seasons; *P* = .001). Positional players who underwent surgery similarly demonstrated no difference in demographic variables when compared to healthy matched controls (Table 1B). However, positional players also demonstrated a significant reduction in

seasons played after the index season (2.9 ± 2.5 vs 5.3 ± 2.3 seasons; *P* = .002).

Acute Player Game Utilization and Performance: One Year Pre/Post Index Player Comparisons

Overall, 66.7% (26/39) of pitchers were able to RTP in their first-year post-surgery. Of these, 30.8% (8/26) were able to RTP, leading to an overall RTP rate of 20.5% (8/39). Furthermore, in the first year of RTP, pitchers who underwent arthroscopic shoulder labral surgery experienced a significant reduction in games played (22.0 ± 21.3 vs 32.1 ± 21.0 games; *P* = 0.002), games started (6.1 ± 6.5 vs 15.0 ± 14.1 games; *P* = .0038), and innings pitched (44.7 ± 29.3 vs 109.5 ± 73.2 innings, *P* < .001). Pitchers also demonstrated an increase in runs allowed per 9 innings (5.8 ± 2.0 vs 4.3 ± 1.4 runs; *P* = .0061), hits allowed per 9 innings (9.6 ± 1.9 vs 8.4 ± 1.5 hits; *P* = .0075), home runs allowed per 9 innings (1.3 ± 0.6 vs 1.1 ± 0.5 home runs; *P* = .0496), walks per 9 innings (4.4 ± 1.8 vs 3.4 ± 1.3 walks; *P* = .047), and walks/hits per inning pitched (WHIP) (1.3 ± 0.2 vs 1.5 ± 0.3; *P* = .0035) in their first-year postsurgery. No significant differences were seen in strikeouts per 9 innings (7.3 ± 2.0 vs 7.1 ± 1.6

Table 1B. Demographic Characteristics of MLB Positional Players who Underwent Arthroscopic Shoulder Labral Repair Surgery Versus Healthy Matched Controls

	Response	Labrum (<i>n</i> = 18)	Control (<i>n</i> = 34)	<i>P</i> value
RTP rate		72%	100%	
Handedness	Left	0	9	
	Right	16 (89%)	18	
	Both	2 (11%)	7	
Age at surgery/index	Mean	28.8 ± 3.7	28.7 ± 3.5	0.928
Height (inches)	Mean	73.5 ± 2.2	73.0 ± 2.2	0.407
Weight (pounds)	Mean	213.6 ± 20.9	210.0 ± 18.0	0.515
BMI	Mean	27.8 ± 2.2	27.9 ± 1.8	0.887
Seasons after RTP	Mean	2.9 ± 2.5	5.3 ± 2.3	0.002

Bolded value indicates significant difference. Age is represented by years. Height is represented in inches; weight is represented in pounds; BMI is represented in kg/m²; seasons are represented in years. BMI, body mass index; RTP, return to play.

Table 2A. Pitcher Game Utilization and Performance One Year Before and After Labral Surgery

	Time Point	Labrum (n = 26)	Control (n = 54)
Mean GP	Pre	32.1 ± 21.0	37.7 ± 19.4
	Post	22.0 ± 21.3	38.7 ± 18.1
	P value	.002	.682
Mean games started	Pre	15.0 ± 14.1	17.3 ± 14.1
	Post	6.1 ± 6.5	18.0 ± 14.7
	P value	.004	.552
Mean innings played	Pre	109.5 ± 73.2	130.6 ± 67.3
	Post	44.7 ± 29.3	135.9 ± 73.2
	P value	.000	.410
Mean runs allowed per 9 innings	Pre	4.3 ± 1.4	4.8 ± 3.2
	Post	5.8 ± 2.0	4.4 ± 1.2
	P value	.006	.325
Mean hits allowed per 9 innings	Pre	8.4 ± 1.5	8.6 ± 2.9
	Post	9.6 ± 1.9	8.9 ± 1.6
	P value	.008	.501
Mean home runs allowed per 9 innings	Pre	1.1 ± 0.5	1.2 ± 1.0
	Post	1.3 ± 0.6	1.0 ± 0.6
	P value	.0496	.3772
Mean walks per 9 innings	Pre	3.4 ± 1.3	3.1 ± 1.2
	Post	4.4 ± 1.8	3.3 ± 1.3
	P value	.049	.451
Mean strikeouts per 9 innings	Pre	7.1 ± 1.6	7.0 ± 1.8
	Post	7.3 ± 2.0	7.1 ± 1.8
	P value	.378	.643
Mean fielding percentage	Pre	0.9 ± 0.3	1.0 ± 0.0
	Post	0.9 ± 0.3	1.0 ± 0.1
	P value	.357	.824
Mean WHIP	Pre	1.3 ± 0.2	1.3 ± 0.3
	Post	1.5 ± 0.3	1.36
	P value	.004	.791
Mean ERA	Pre	4.0 ± 1.3	4.1 ± 2.5
	Post	4.9 ± 2.4	4.0 ± 1.3
	P value	.062	.895

Continuous variables are presented using adjusted means ± SD. Significant *P* values (<.05) are indicated in bold. *P* values compare pre vs post index values within the same group. ERA, earned run average; GP, games played; WHIP, walk/hits per inning pitched.

strikeouts; *P* = .378), fielding percentage (0.9 ± 0.3 vs 0.9 ± 0.3; *P* = .357), nor earned run average (ERA) (4.9 ± 2.4 vs 4.0 ± 1.3; *P* = .062) (Table 2A).

Positional players were able to RTP at a rate of 72% (18/25) one season after surgery. Of those that RTP, 38.9% (7/18) were able to return to prior performance, leading to an overall RTP rate of 28% (7/25). In the first season of RTP, positional players experienced decreases in games played (75.7 ± 47.1 vs 98.0 ± 50.7 games; *P* = .0399), innings played (528.6 ± 429.9 vs 778.9 ± 431.6 innings; *P* = 0.0263), on-base-

Table 2B. Positional Player Game Utilization and Performance 1 Year Before and After Labral Surgery

	Time Point	Labrum (n = 18)	Control (n = 34)
Mean GP	Pre	98.0 ± 50.7	101.1 ± 41.2
	Post	75.7 ± 47.1	101.1 ± 33.6
	P value	.040	.996
Mean games started	Pre	82.2 ± 55.7	81.7 ± 42.4
	Post	60.9 ± 49.9	82.7 ± 37.8
	P value	.057	.852
Mean innings played	Pre	778.9 ± 431.6	708.8 ± 373.5
	Post	528.6 ± 429.9	701.8 ± 317.0
	P value	.026	.895
Mean Batting Average	Pre	0.3 ± 0.1	0.2 ± 0.0
	Post	0.2 ± 0.1	0.3 ± 0.0
	P value	.070	.439
Mean On Base Percentage	Pre	0.3 ± 0.1	0.3 ± 0.0
	Post	0.3 ± 0.1	0.3 ± 0.1
	P value	.012	.256
Mean Fielding Percentage	Pre	1.0 ± 0.0	1.0 ± 0.0
	Post	0.9 ± 0.3	1.0 ± 0.0
	P value	.401	.096
Mean OPS	Pre	0.7 ± 0.2	0.7 ± 0.1
	Post	0.6 ± 0.2	0.7 ± 0.1
	P value	.028	.998

Continuous variables are presented using adjusted means ± SD. Significant *P* values (<.05) are indicated in bold. *P* values compare pre vs post index values within the same group. GP, games played; OPS, on-base-plus-slugging-percentage.

percentage (0.3 ± 0.1 vs 0.3 ± 0.1; *P* = 0.0116), and OPS (0.6 ± 0.2 vs 0.7 ± 0.2; *P* = .0281). There were no significant differences found in the operative group 1 year before and after surgery in games started, although approach significance, (60.9 ± 49.9 vs 82.2 ± 55.7 games; *P* = .057), batting average (0.2 ± 0.1 vs 0.3 ± 0.1; *P* = .07), and fielding percentage (0.9 ± 0.3 vs 1.0 ± 0.0; *P* = .401) (Table 2B).

Long-Term Player Game Utilization and Performance: One Year Pre/Three Years Post Index Player Comparisons

Three-years after surgery, pitchers had RTP at a rate of 66.7% (26/39). Of those returning, 69.2% (18/26) had RTPP, leading to an RTPP of 46.2% (18/39). At 3 years after RTP, pitchers who underwent arthroscopic shoulder labral surgery no longer experienced a significant difference in games played (29.9 ± 21.4 vs 32.1 ± 21.0 games; *P* = .926), games started (11.0 ± 13.7 vs 15.0 ± 14.1 games; *P* = .536), innings pitched (81.9 ± 66.2 vs 109.5 ± 73.2 innings; *P* = .3873), runs allowed per 9 innings (5.0 ± 2.3 vs 4.3 ± 1.4 runs; *P* = .303), hits allowed per 9 innings (9.5 ± 2.6 vs 8.4 ± 1.5 hits; *P* = .079), home runs allowed per 9 innings (1.1 ± 0.7

Table 3A. Pitcher Game Utilization and Performance 1 Year Before and 3 Years After Labral Surgery

	Time Point	Labrum (<i>n</i> = 26)	Control (<i>n</i> = 54)
Mean GP	Pre	32.1 ± 21.0	37.7 ± 19.4
	Post	29.9 ± 21.4	36.5 ± 18.5
	<i>P</i> value	.926	.924
Mean games started	Pre	15.0 ± 14.1	17.3 ± 14.1
	Post	11.0 ± 13.7	17.0 ± 14.4
	<i>P</i> value	.536	.875
Mean innings played	Pre	109.5 ± 73.2	130.6 ± 67.3
	Post	81.9 ± 66.2	125.4 ± 76.3
	<i>P</i> value	.387	.665
Mean runs allowed per 9 innings	Pre	4.3 ± 1.4	4.8 ± 3.2
	Post	5.0 ± 2.3	4.7 ± 1.9
	<i>P</i> value	.303	.622
Mean hits allowed per 9 innings	Pre	8.4 ± 1.5	8.6 ± 2.9
	Post	9.5 ± 2.6	8.9 ± 2.1
	<i>P</i> value	.079	.791
Mean home runs allowed per 9 innings	Pre	1.1 ± 0.5	1.2 ± 1.0
	Post	1.1 ± 0.7	1.0 ± 0.4
	<i>P</i> value	.943	.329
Mean walks per 9 innings	Pre	3.4 ± 1.3	3.1 ± 1.2
	Post	3.0 ± 3.2	3.0 ± 1.4
	<i>P</i> value	.1999	.9124
Mean strikeouts per 9 innings	Pre	7.1 ± 1.6	7.0 ± 1.8
	Post	7.7 ± 1.5	7.1 ± 1.9
	<i>P</i> value	.325	.687
Mean fielding percentage	Pre	0.9 ± 0.3	1.0 ± 0.0
	Post	0.9 ± 0.3	0.9 ± 0.1
	<i>P</i> value	.833	.003
Mean WHIP	Pre	1.3 ± 0.2	1.3 ± 0.3
	Post	1.4 ± 0.4	1.3 ± 0.2
	<i>P</i> value	.268	.756
Mean ERA	Pre	4.0 ± 1.3	4.1 ± 2.5
	Post	4.6 ± 2.1	4.2 ± 1.7
	<i>P</i> value	.387	.979

Continuous variables are presented using adjusted mean ± SD. Significant *P* values (<.05) are indicated in bold. *P* values compare pre vs post index values within the same group. GP, games played; ERA, earned run average; WHIP, walk/hits per inning pitched.

vs 1.1 ± 0.5 home runs; *P* = 0.9434), walks per 9 innings (3.0 ± 3.2 vs 3.4 ± 1.3 walks; *P* = .1999), or WHIP (1.4 ± 0.4 vs 1.3 ± 0.2; *P* = .2681) (Table 3A). Positional players were able to RTP at a rate of 72% (18/25) 3 years after surgery. Of those still playing, 100% (18/18) were able to RTP. No significant difference was found for positional players in games played (85.8 ± 57.5 vs. 98.0 ± 50.7 games; *P* = .184),

Table 3B. Positional Player Game Utilization and Performance 1 Year Before and 3 Years After Labral Surgery

	Time Point	Labrum (<i>n</i> = 18)	Control (<i>n</i> = 34)
Mean GP	Pre	98.0 ± 50.7	101.1 ± 41.2
	Post	85.8 ± 57.5	92.6 ± 43.6
	<i>P</i> value	.184	.127
Mean games started	Pre	82.2 ± 55.7	81.7 ± 42.4
	Post	76.6 ± 58.1	75.1 ± 46.4
	<i>P</i> value	.211	.154
Mean innings played	Pre	528.6 ± 429.9	701.8 ± 317.0
	Post	602.7 ± 538.3	614.6 ± 404.9
	<i>P</i> value	.175	.053
Mean batting average	Pre	.3 ± 0.1	.2 ± 0.0
	Post	0.2 ± 0.0	0.2 ± 0.1
	<i>P</i> value	.119	.246
Mean on-base percentage	Pre	0.3 ± 0.1	0.3 ± 0.0
	Post	0.3 ± 0.0	0.3 ± 0.1
	<i>P</i> value	.019	.327
Mean fielding percentage	Pre	1.0 ± 0.0	1.0 ± 0.0
	Post	1.0 ± 0.0	1.0 ± 0.0
	<i>P</i> value	.087	.126
Mean OPS	Pre	0.7 ± 0.2	0.7 ± 0.1
	Post	0.7 ± 0.2	0.7 ± 0.2
	<i>P</i> value	.052	.332

Continuous variables are presented using adjusted means ± SD. Significant *P* values (<.05) are indicated in bold. *P* values compare pre versus post index values within the same group
GP, games played; OPS, on-base-plus-slugging-percentage.

innings played (602.7 ± 538.3 vs 528.6 ± 429.9 innings; *P* = .1746), or on-base-plus-slugging percentage (0.7 ± 0.2 vs 0.7 ± 0.2; *P* = .0523). The difference in on-base-percentage did persist after 3 years (0.3 ± 0.0 vs 0.3 ± 0.1; *P* = .0194). There were no significant changes 3 years after surgery in games started (76.6 ± 58.1 vs 82.2 ± 55.7 games; *P* = .2109), batting average (0.2 ± 0.0 vs 0.3 ± 0.1; *P* = 0.119), or fielding percentage (1.0 ± 0.0 vs 1.0 ± 0.0; *P* = 0.0872) (Table 3B).

Relative Game Utilization and Performance: Percentage of Baseline Comparison (Operative Cohort vs Controls)

In the first year of RTP, pitchers who underwent arthroscopic shoulder labral surgery experienced a significant decrease in games played (50% ± 40% vs 150% ± 180%; *P* < .001), innings pitched (40% ± 30% vs 150% ± 190%; *P* < .001), an increase in runs allowed per 9 innings (150% ± 60% vs 110% ± 40%; *P* = .001), and WHIP (120% ± 20% vs 100% ± 20%; *P* = .027) when compared to controls (Fig 1A). At 3 seasons postindex, pitchers demonstrated a decrease in walks (50% ± 50% vs 110% ± 40%; *P* = .013), but no longer demonstrated a difference in any other statistical metric when

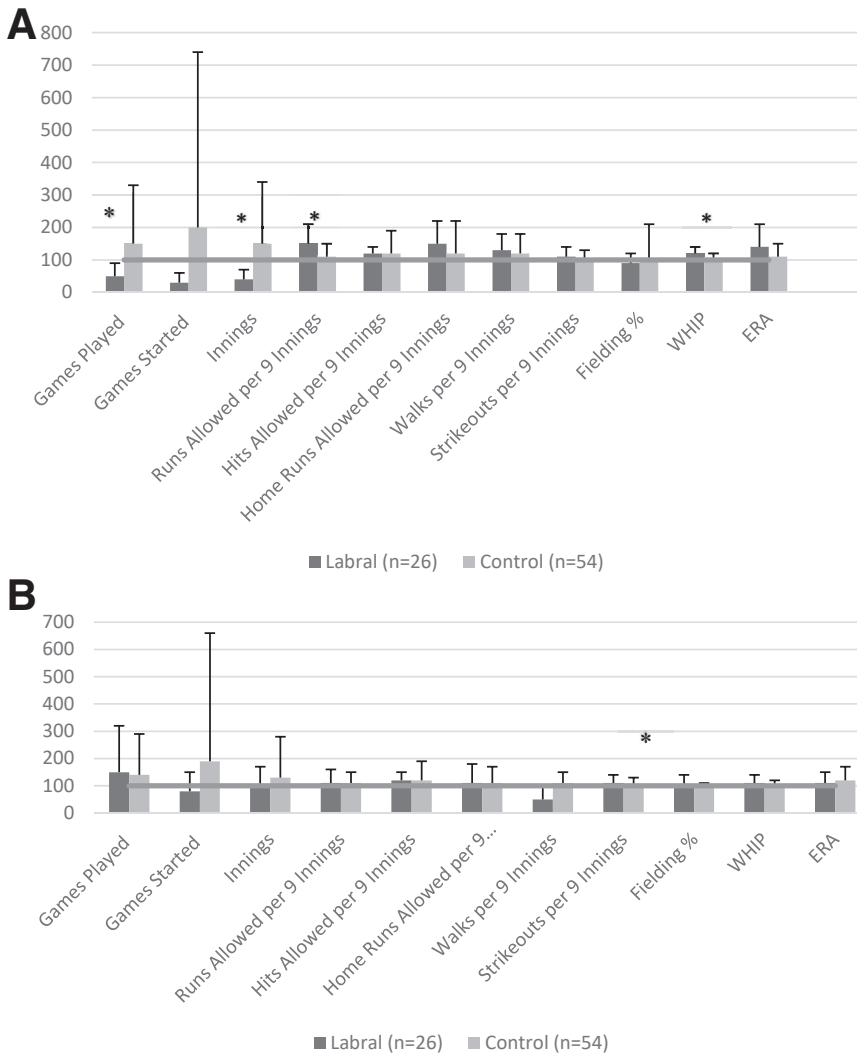


Figure 1. Relative Percentage of Game Utilization and Performance (A) One Season and (B) Three Seasons Following RTP from Arthroscopic Shoulder Labral Surgery for MLB Pitchers Pre-index baseline is represented by the horizontal line (100% across all variables.A)

compared to the change experienced by matched controls (Fig 1B).

In the first year of RTP, positional players who underwent arthroscopic shoulder labral surgery experienced a significant decrease in on-base-percentage ($80\% \pm 30$ vs $110\% \pm 40$; $P = .017$) and OPS ($80\% \pm 30$ vs $100\% \pm 20$; $P = .019$) when compared to healthy matched controls (Fig 2A). The difference in on-base-percentage persisted at 3-years post-index ($90\% \pm 20$ vs $100\% \pm 20$; $P = .017$) (Fig 2B). However, no further statistically significant differences were found for positional players who underwent surgery at 3 seasons.

Discussion

The present study reveals that after isolated arthroscopic shoulder labral repair, 2/3rds of MLB players successfully return to play, with almost 3/4ths of positional players returning compared to pitchers. Both pitchers and positional players experienced a decline in

game utilization and performance one season after surgery. These players were able to return closer to baseline performance 3 seasons after injury compared to controls; however, both pitchers and positional players experienced significant decreases in career longevity with fewer seasons played after injury compared to controls. These findings suggest that shoulder labral surgery significantly impacts MLB players' game utilization and performance in the acute setting after shoulder labral repair. MLB players who were able to return to sport were ultimately able to resume usual productivity in the long term, but experienced reduced overall career lengths.

Considerable variability exists in the literature on reporting on return-to-play rates following arthroscopic shoulder labral repair among professional baseball players, ranging from 40% to 69% for pitchers and 48 to 85% for positional players.^{9,14,22-24} Fedoriw et al. identified 68 major and minor league professional

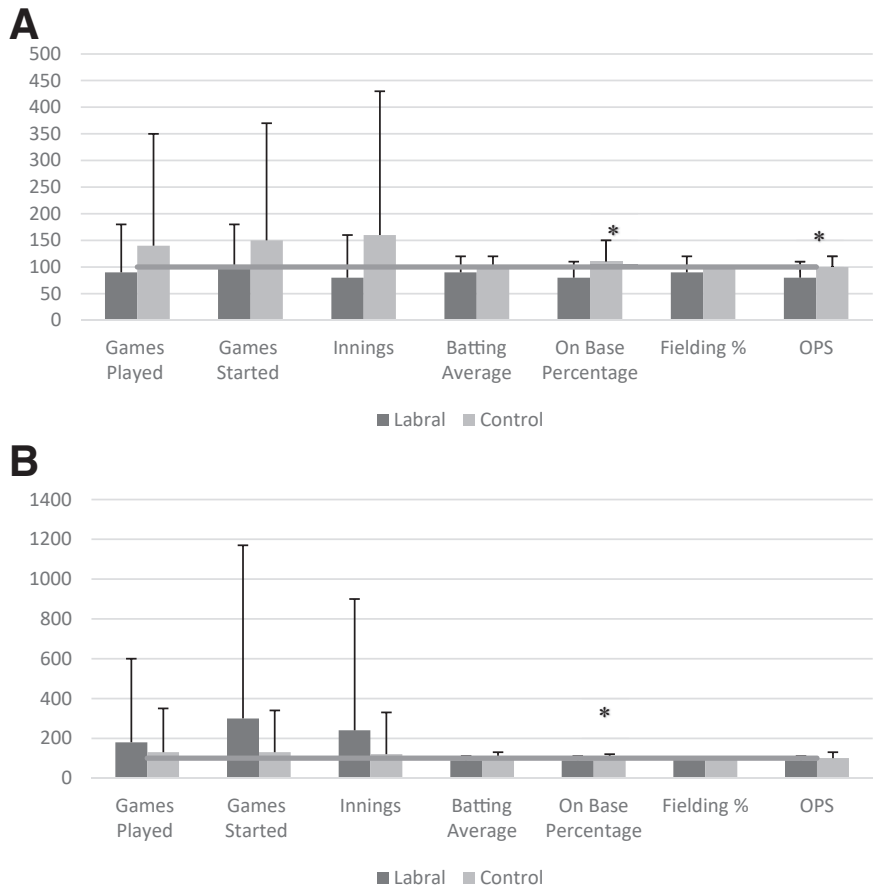


Figure 2. Relative Percentage of Game Utilization and Performance (A) One Season and (B) Three Seasons Following RTP from Arthroscopic Shoulder Labral Repair in MLB Positional Players Pre-index baseline is represented by the horizontal line (100%) across all variables. Relative percentages below this line indicate that the post-index variable was less than baseline. * $P < 0.05$: indicates significant differences between labral surgery and control groups Abbreviations: WHIP, walks/hits per inning pitched; ERA, earned run average

baseball players with MRI-identified superior labral anterior to posterior (SLAP) tears, with 45 pitchers and 23 positional players.²² They defined RTP as participation of at least 1 game in any league and found that only 48% of pitchers and 85% of positional players returned to play. However, only 7% of pitchers and 26% of positional players were able to meet the definition of return to previous performance (RTPP), which accounts for RTP to the player's previous performance level preoperatively. Smith et al. identified 24 MLB pitchers who underwent surgical management of SLAP tears and found a 62.5% RTP rate, with 86.7% of those who RTP returning to prior performance level (RTPP), with 54.2% of all players RTPP.¹¹ Our study similarly found differential rates of RTP, with 66% of pitchers and 72% of positional players successfully returning to the MLB. Accounting for return to previous performance, however, may be a more accurate depiction of true success in returning to high-level competition. Our results demonstrate that positional players RTPP after three seasons at a higher rate than pitchers, 72% versus 46.2%, respectively. While both pitchers and positional players place substantial demands on the shoulder, these data together suggest that pitchers have more

trouble returning to high-level competition and performance. This phenomenon may be attributable to pitchers' reliance on proper shoulder function and mechanics, which may be compromised due to altered anatomy and biomechanics postoperatively.

Following shoulder labral repair, professional baseball players are not only concerned with returning to competition but performing at a similarly high level. Cerynk et al. reported on 42 MLB pitchers with surgically treated isolated glenoid labral tears with 69% returning to play in at least 1 season and 29% at 3 seasons after surgery. These pitchers had no significant differences in ERA or WHIP at 1 and 3 seasons postoperatively.²³ Ricchetti et al. also followed 51 MLB pitchers who underwent isolated glenoid labral repairs, and 72.5% returned to play at a mean 13.1 months.²⁵ These pitchers had no significant differences in performance after surgery. Starting pitchers were more likely to undergo repair, and those who pitched greater innings before surgery were more likely to RTP. It should be noted that these studies only focused on MLB pitchers and positional players were excluded. Higgins et al. compared RTP outcomes of athletes undergoing a heterogeneous grouping of shoulder procedures across

the National Hockey League, National Football League, National Basketball Association, and Major League Baseball.⁹ Among MLB pitchers and positional players, 48 (41.4%) underwent surgery for shoulder labral tears; they found no significant differences for WHIP in pitchers and OPS in positional players at one or two seasons postoperatively. Their analysis was, however, limited by few analyzed performance variables and a lack of stratification based on injury or surgery performed. In contrast to the aforementioned studies, the present study analyzed performance in both pitchers and positional players, finding acute reductions in performance one season after surgery. Compared to matched controls, pitchers demonstrated significant declines with increased runs allowed per 9 innings and increased WHIP, while positional players experienced only a decrease in OPS. After 3 seasons, both groups of players were able to achieve performance levels similar to their baselines. In contrast to historical studies, our study uniquely found that shoulder labrum repair significantly affected performance in both pitchers and positional players in the first season but not long term.

The ability of an elite baseball player to resume a similar workload of innings played and to maintain this performance for multiple seasons after surgery is an important consideration. In the aforementioned study, Smith et al. found that MLB pitchers who underwent SLAP repair experienced a significant decrease in mean innings pitched (IP) per season for the remainder of the players' careers after surgery.¹⁴ However, their analysis included all full seasons played after injury, including the first season after surgery, and did not break down IP by season, which may have skewed their results. In contrast, Cerynk et al. reported that MLB starting pitchers had a significant reduction in innings pitched (156.6 vs 74. Innings pitched; $P = .0005$) in the first season of RTP.²¹ The present study confirms these observations with significant reductions in games and innings played for both pitchers and positional players 1 season but not 3 seasons after surgery. This may be a result of team's limiting player participation after surgery in the acute setting to allow for a controlled return-to-throw protocol. Although recovery in game utilization was achieved, both groups experienced reductions in postoperative career longevity (2.3 ± 2.6 vs. 5.8 ± 2.8 seasons after RTP, $P = .001$ for pitchers; 2.9 ± 2.5 vs. 5.3 ± 2.3 ; $P = .002$ for positional players), similar to the findings of Higgins and colleagues.

Another important consideration is that the biomechanics of the shoulder may be altered after a labral tear,²⁶ and players may continue to experience alterations after repair. Chalmers and colleagues examined 18 pitchers, including 6 pitchers who underwent SLAP repair and 5 after subpectoral biceps tenodesis, using

motion analysis.²⁷ Their group found no differences in neuromuscular control, but those who underwent SLAP repairs had alterations in thoracic rotation compared to controls and biceps tenodesis, suggesting alterations in pitching mechanics. While the clinical significance of this result remains to be elucidated, these data begin to suggest that shoulder mechanics may not be the same after labral surgery, including procedures undergone by our study population. Additional attention may be required in rehabilitation to restore normal mechanics. Furthermore, Mazoue et al. found that MLB pitchers recovering from full-thickness rotator cuff surgery were able to throw effectively but fatigued early.²⁸ Although rotator cuff injuries were not included, this phenomenon may apply to the pitchers in our study, as we see improvement in pitching performance after three seasons but decreased career longevity leading to retirement. Further studies would be needed to elucidate the influence of labral surgery on pitching fatigue following RTP.

Limitations

The present study is not without limitations. The retrospective design of this study relies on publicly available sources. Certain players may receive more attention in the media and, therefore, injuries may be missed due to lack of public reporting. We attempted to exclude concomitant injuries, such as shoulder instability to isolate glenoid labral repairs only, such as superior labrum anterior to posterior (SLAP) tears; however, injuries potentially could be misclassified in the publicly available sources. Furthermore, it was not possible to identify the exact labral pathology that was experienced by the players. Although we attempted to exclude concomitant injuries, such as shoulder instability, to isolate glenoid labral repairs only, such as superior labrum anterior to posterior (SLAP), injuries potentially could be misclassified in the publicly available sources. Understanding the location and extent of a labral tear, as well as concomitant pathology, such as rotator cuff tearing, capsule laxity, or biceps pathology may dictate operative decision making and have the potential to confound results. The lack of patient medical records untimely leads to a more heterogeneous study population. These limitations in our methodology may have introduced bias, heterogeneity, and ambiguity into the sample population. It is important to note our methodology has been used in multiple previous studies, and data were crosschecked against multiple sources to confirm our data was as accurate as possible.^{10,17-20} Another limitation of our analysis was that information stratifying pitchers between starter and relievers was not collected due to sample size of available players. Substratifying the pitchers would

have likely unpowered any statistical analysis. Additionally, it is important to note that due to the sample population consisting of MLB athletes it may limit the generalizability to recreational athletes. Finally, we attempted to capture a variety of performance metrics commonly used to assess a player's baseball value, but there are several other intangibles that lead to a player's success that are more difficult to quantify, such as playmaking.

Conclusion

Following arthroscopic shoulder labral surgery, most MLB pitchers and positional players were able to RTP successfully but experienced shorter careers thereafter. These players also experienced declines in game utilization and performance 1 season after surgery but were able to return to baseline at 3 seasons after surgery.

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