Return to Play After Arthroscopic Management of Rotator Cuff Tears in Professional Athletes of Contact Sports

Gautam P. Yagnik,*† MD, Patrick F. Szukics,† MD, Jacob R. Seiler,† MD, Jonas W. Ravich,† MS, Luis A. Vargas,† MD, PhD, John E. Zvijac,† MD, and John W. Uribe,† MD
Investigation performed at the Baptist Health Orthopedic Institute, Baptist Health South Florida, Coral Gables, Florida, USA

Background: Rotator cuff tears are rare injuries in professional athletes who participate in contact sports, and limited data exist to guide players and team physicians regarding outcomes after surgical management.

Purpose: To report the outcomes and return-to-play rates of professional contact sport athletes who underwent arthroscopic management of rotator cuff tears.

Study Design: Case series; Level of evidence, 4.

Methods: All professional athletes of contact sports who underwent arthroscopic management of a rotator cuff tear between 2002 and 2019 at the institution were identified. Patient information collected were age, sport, position, date of injury, date of surgery, and time to return to play; surgical data included tear size, acuity, pattern, and procedure performed. The primary outcome measure was the ability to return to play and the number of games played after surgery.

Results: Overall, 10 rotator cuff tears in 9 professional athletes (8 tears in football players and 2 tears in hockey players) were identified; 9 of the tears were full-thickness tears that underwent arthroscopic single-row repair, while 1 was a partial tear that was debrided. Of the 9 athletes, 8 were able to return to play at the same level, at a mean time of 9.5 $\pm$ 4.3 months. The mean playing time after surgery was 32 $\pm$ 25 games (2.7 $\pm$ 2 seasons) for the football players and 22 games (1 season) for the hockey player who returned. Postoperative imaging was available in 8 of the 10 tears, and 7 of 8 (88%) demonstrated a healed repair. One football player and 1 hockey player with large ($>$3 cm) full-thickness tears did not return to play. The mean age of these players was 34.5 years and both had $>$10 years of professional playing experience.$\geq$

Conclusion: The study findings demonstrated that the majority (80%; n = 8) of the professional athletes in contact sports in this series were able to return to play at the same level after arthroscopic management of a symptomatic rotator cuff tear.

Keywords: rotator cuff repair; contact athletes; football; hockey; return to play

The rotator cuff plays a critical role in stabilizing the humeral head within the glenoid and mobilizing the shoulder. This important structure helps athletes perform complex shoulder motions specific to their sports, such as throwing, tackling, and lifting weights.[11] A tear in the rotator cuff in a high-level athlete can lead to catastrophic alterations in his or her biomechanics and functional movements, limiting performance and increasing the risk for future injury.[14] Accordingly, optimal management is paramount in order to properly diagnose and treat these injuries in high-level athletes. To expedite return to play and quicken recovery, arthroscopic rotator cuff repair has gained popularity as the treatment of choice, helping to return these athletes back to play sooner.[8,15,24]

Shoulder injuries are common in professional athletes of contact sports, comprising roughly 10% to 20% of all injuries.[3,5,12,13] Despite the frequency of these injuries, rotator cuff tears (both partial and full-thickness) are relatively rare. A study of elite-level collegiate American football players from the National Football League (NFL) Combine

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demonstrated that rotator cuff tears made up only 1.8% of all shoulder injuries.[12] Although rotator cuff injuries are rare in elite contact athletes, their significance should not be underestimated. These injuries lead to pain, weakness, and functional limitations that can result in a significant amount of lost playing time and can affect overall career length. Surgical intervention in these athletes is typically reserved for full-thickness tears or high-grade partial tears that have not improved with conservative treatment.[21] However, because of the infrequency of these injuries, there is a paucity of data regarding the clinical outcomes after surgical treatment of rotator cuff tears in elite-level contact athletes.

The purpose of this study was to report the outcomes and return-to-play rates of professional contact athletes who underwent arthroscopic management of symptomatic rotator cuff tears at our institution. We hypothesized that the majority of these athletes would be able to return to the same level of play after surgical intervention.

METHODS

This study was conducted after approval by the institutional review board at a large private hospital system. All patient data and information were deidentified and protected. A retrospective review was performed on all professional contact-sport athletes who underwent arthroscopic management of a rotator cuff tear between 2002 and 2019 at our institution. Patients were identified via a systematic search of an institutional computerized database utilizing applicable Current Procedural Terminology and International Classification of Diseases codes. Inclusion criteria included the following: (1) full- or partial-thickness rotator cuff tears that underwent arthroscopic management, (2) currently an elite professional contact athlete, and (3) preoperative magnetic resonance imaging (MRI) confirming the presence of a rotator cuff tear. Exclusion criteria were (1) nonprofessional athlete, (2) noncontact sport, (3) not active in sport at time of injury, and (4) history of previous ipsilateral rotator cuff surgery. Ten rotator cuff tears were identified in 9 professional contact athletes. A total of 8 tears occurred in elite professional American football players; the remaining 2 rotator cuff tears were identified in professional hockey players. All players included had pain and functional deficits in their shoulder that limited their ability to play, necessitating surgical intervention. Surgical management was defined as arthroscopic rotator cuff repair or debridement and all procedures were performed by 1 of 3 fellowship-trained sports medicine surgeons (G.P.Y., J.E.Z., and J.W.U.).

All available clinic notes, operative reports, and pre- and postoperative imaging as well as physical therapy/athletic training notes were reviewed. Surgical data collected included tear characteristics (size, acuity, etc), type of procedure performed (debridement vs repair), and concomitant injuries and procedures performed at the time of the index procedure (ie, acromioplasty, distal clavicle excision, etc). Both intraoperative and postoperative complications were recorded. Tear type was categorized by percentage of tendon thickness; all bursal-sided tears involving >90% of the tendon thickness were considered full-thickness tears.[16] Tear size was classified as small (<1 cm), medium (1-3 cm), or 2 large (>3 cm) per the Cofield classification.[7] Tears were also classified as either acute or chronic. For the purposes of this study, tears were classified as acute if they were the result of a single traumatic event that resulted in pain and functional impairment that did not allow the player to return to play in the same season. Chronic tears were defined as attritional type tears that allowed players to complete the season but were symptomatic enough to require surgical intervention in the off-season.

Patient demographics (age, sport, position played, date of injury, date of surgery, time from surgery to return to play, and playing time before surgery) were recorded. The primary outcome measure was the ability to return to play, and the number of games played/time played after surgery were documented. As in similar studies, return to play was defined as the ability to participate in ≥1 full regular-season game after surgery.[2,14] Return-to-play and career-length data were collected through publicly available internet sources (https://www.pro-football-reference.com, https://stats.cfldb.ca, https://www.footballdb.com, and https://www.hockey-reference.com) as well as from rehabilitation/progress notes that were uploaded to the treating physician's electronic medical record. Multiple internet sources were used when possible to ensure accuracy of reporting.[17,18] Postoperative rotator cuff healing was assessed via MRI in 6 patients and ultrasound in 2 patients. Postoperative imaging was interpreted by an independent musculoskeletal radiologist or ultrasonographer who confirmed integrity of the repair or repair failure. Repairs were classified as healed on MRI when there was visible continuity of the rotator cuff from its

*Address correspondence to Gautam P. Yagnik, MD, Baptist Health Doctors Hospital, 5000 University Drive, Coral Gables, FL 33146, USA (email: gautamy@baptisthealth.net).
†Baptist Health Orthopedic Institute, Baptist Health South Florida, Coral Gables, Florida, USA.
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muscle belly to its tendinous insertion. Repairs were classified as healed on ultrasound when there was visible continuity of the rotator cuff at its insertion, with an absence of any large intrasubstance hypoechoic lesions that would indicate a focal defect.

Operative Technique

A similar arthroscopic technique was used in all cases. After the induction of general anesthesia, patients were positioned in the lateral decubitus position with the operative extremity placed in suspension at approximately 60° of shoulder abduction using 10 or 15 lb (4.5 or 6.8 kg) of traction. Weight-based intravenous antibiotics were administered per protocol. A standard posterior viewing portal was initially established, followed by a working portal through the rotator interval. Routine diagnostic arthroscopy was performed, during which the surgeon addressed any concurrent intra-articular pathology and performed a debridement of any partial-thickness articular-sided rotator cuff tear.

Next, the subacromial space was accessed via the same posterior viewing portal. Accessory lateral and anterolateral working portals were employed for mobilization of soft tissues as well as for surface preparation and anchor placement. A limited subacromial bursectomy was performed for the purpose of visualization and to minimize postoperative adhesion formation.[19] The lateral edge of the supraspinatus tendon was identified, debrided of any devitalized tissue, mobilized and approximated to its anticipated insertion, with consideration given to the length-tension relationship. Nonabsorbable sutures were placed in a mattress configuration with a suture passer. In the two included cases with tear sizes >3 cm that were L-shaped in appearance, a marginal convergence technique was utilized to approximate the longitudinal L component and decrease strain on the lateral margin. All knots utilized in the surgeries were arthroscopic sliding knots that were backed up with multiple half hitches. All repairs were performed with a single-row suture anchor configuration using knotless biocomposite, polyether ether ketone (PEEK), or metallic anchors.

After repair, the coracoacromial ligament was inspected and released as per surgeon preference upon perceived pathology. After confirmation of repair integrity and the absence of mechanical impingement beneath the acromial arch, the arthroscopy was terminated, and arthroscopic portals were closed per surgeon preference. If subscapularis repair or biceps tenodesis was indicated, these procedures were performed using a mini-open approach with the use of an additional suture anchor.

Postoperatively, rehabilitation varied based on the surgical procedure. Patients with partial-thickness tears who underwent debridement were treated with immediate passive- and active-assisted motion and allowed to progress to activities as tolerated. Patients with full-thickness tears were placed in an abduction sling for 4 weeks. Gentle passive motion was permitted in the second postoperative week, with active-assisted motion beginning in the fifth week under the direction of the treating physical therapist. These patients then followed a standard postoperative rotator cuff repair rehabilitation program and were allowed to return to play approximately 6 months after surgery.

RESULTS

Patient Characteristics and Injury Patterns

A total of 10 rotator cuff tears underwent arthroscopic management in 9 male professional contact sports athletes; 8 tears in football players and 2 tears in hockey players. All patients had a history of sport-related trauma to the involved shoulder (ie, tackling for football, checking for ice hockey), resulting in a rotator cuff tear that was confirmed by history, physical examination, diagnostic imaging, and later during arthroscopy. The mean age for all patients was 28.7 ± 4.8 years. The mean in-office follow-up was 19.1 weeks; however, most players were evaluated until they returned to play by their team's medical staff. Most of the tears occurred in veteran players who had played 5 or more seasons in professional sports. The mean playing time before surgery for all players was 6.3 ± 4.7 seasons (161.8 ± 202.4 games played). The mean playing time before surgery was 5.09 ± 4.0 seasons (66.2 ± 64.7 games played) for the football players and 11.5 ± 3.5 seasons (544 ± 73.0 games played) for the hockey players.

A description of the characteristics of each tear according to patient characteristics and injury details is depicted in Table 1. Nine of the tears were complete full-thickness tears that underwent arthroscopic repair, and 1 tear was a partial articular-sided supraspinatus rotator cuff tear involving <50% of the tendon thickness that underwent arthroscopic debridement. Three tears were classified as chronic tears, and all 3 of these players were able to finish the season before undergoing surgical repair in the off-season. Of the 7 tears classified as acute, all of these players experienced significant pain and weakness that did not allow them to return to play in the same season. These players all underwent surgical management within 3 weeks from their date of injury.

Of the 8 tears in football players, 6 occurred in defensive players (Table 1). One player with bilateral rotator cuff injuries had an injury-free interval of 3 seasons between the 2 injuries; 2 players were injured at the end of their college careers and underwent surgical intervention before their rookie season in professional football. Both of the tears seen in hockey players occurred in offensive players, 1 wing and 1 center.

Operative Findings

All tears involved the supraspinatus rotator cuff tendon, with the mean tear size being 1.95 ± 0.9 cm. In 90% of cases, the tear was managed with arthroscopic single-row rotator cuff repair, with 2 tears requiring additional

TABLE 1
Tears According to Patient Characteristics, Injury Details, and Surgical Management[a]

				Tear Details			
Player	Sport	Position	Age, y	Acuity[b]	Type	Size[c]	Surgical Management
1	Football	OL	32	Acute	Full thickness	Large	ARCR, CA ligament release, labral debridement
2[d]	Football	DL	29	Acute	Full thickness	Small	ARCR, CA ligament release, labral debridement
2[d]	Football	DL	31	Chronic	Full thickness	Medium	ARCR, acromioplasty, CA ligament release, labral debridement, biceps debridement
3	Football	RB	21	Chronic	Partial articular-sided	Partial	Arthroscopic debridement, distal clavicular excision, labral debridement
4	Football	LB	22	Acute	Full Thickness	Small	ARCR
5	Football	LB	26	Acute	Full thickness	Medium	ARCR, loose body removal
6	Football	DB	31	Acute	Full thickness	Medium	ARCR, labral repair
7	Football	DB	25	Acute	Full thickness	Small	ARCR, CA ligament release, labral debridement
8	Hockey	W	33	Chronic	Full thickness	Medium	ARCR, CA ligament release
9	Hockey	C	37	Acute	Full thickness	Large	ARCR/mini-open subscapularis repair, CA ligament release, biceps tenodesis

[a]ARCR, arthroscopic rotator cuff repair; C, center; CA, coracoacromial; DB, defensive back; DL, defensive line; LB, linebacker; OL, offensive line; RB, running back; W, winger.
[b]Tears were defined as acute if they were the result of a single traumatic event that resulted in pain and functional impairment that did not allow the player to return to play in the same season and chronic if they were attritional-type tears that allowed players to complete the season but were symptomatic enough to require surgical intervention in the off-season.
[c]Small tears, <1 cm; medium tears, 1-3 cm; large tears, >3 cm.[7]
[d]This was a single player who had a right- and left-sided rotator cuff injury at different time intervals.

marginal convergence sutures. The mean number of suture anchors used was 1.35 ± 0.7. The single partial-thickness articular-sided tear (player 3) was treated with arthroscopic debridement. Concomitant surgical procedures are detailed in Table 1. There were no intraoperative complications noted in our series.

Postoperative Imaging

Postoperative imaging was available in 8 of the 10 tears (Table 2). Six players underwent postoperative MRI and 2 players underwent dynamic ultrasound. Seven players (88%) demonstrated complete healing of the repair on postoperative imaging, while 1 football player (player 1) demonstrated repair failure on MRI at 6 months. This player was an offensive lineman with a tear size >3 cm who was originally treated nonsurgically for a partial-thickness tear that progressed to full-thickness before operative intervention.

Return to Play and Outcomes

Overall, 80% of the players (n = 8) were able to return to play at the same professional level in the season after surgery (Table 2). All players who returned regained sufficient range of motion, strength, and function to pass a preparticipation physical examination performed by their team's medical staff. Of the players who were able to return to play, the mean age was 27.3 ± 4.2 years and the mean time to return was 9.5 ± 4.3 months. All players participated in ≥1 regular season game. The mean playing time after surgery was 2.2 ± 2.1 seasons (27.9 ± 24.2 games played). For the football players, the mean playing time after surgery was 2.7 ± 2 seasons with 32 ± 25 games played. The single hockey player who returned played for 1 season with 22 games played. In the 3 players with chronic tears who underwent delayed surgical intervention, the delay did not appear to negatively affect healing rates or the ability to return to play. Other factors that did not appear to influence return to play included type of sport, position, type of procedure (debridement vs repair), or the number of suture anchors used in the repair.

Two veteran players with large (>3 cm) full-thickness tears (players 1 and 9) did not return to play. The mean age of these players was 34.5 years, and both had >10 years of professional playing experience. One was a football player who demonstrated a repair failure at 6 months on postoperative imaging and elected to retire rather than undergo revision surgery. The second was a hockey player who retired for reasons unrelated to his shoulder despite a good clinical outcome and a healed repair on postoperative imaging. None of the remaining players underwent subsequent surgical intervention or revision surgery on their injured shoulder.

DISCUSSION

In this study, 80% (n = 8) of the professional contact-sport athletes who underwent arthroscopic management of

TABLE 2
Tears According to Postoperative Imaging and Return-to-Play Data[a]

	Postoperative Imaging			Playing Time After Surgery	
Player	Obtained?	Healed?	Time to Return, mo	No. of Seasons	No. of Games
1	Yes	No	No return	—	—
2[b]	Yes	Yes	7.6	5	73
2[b]	Yes	Yes	9.4	2	32
3	Yes	Yes	18.9	2	10
4	Yes	Yes	8.2	2	22
5	Yes	Yes	7.8	4	70
6	Yes	Yes	10.6	3	36
7	No	—	9.1	1	14
8	No	—	4.3	1	22
9	Yes	Yes	No return	—	—

[a]Dashes indicate areas not applicable.
[b]This was a single player who had a right- and left-sided rotator cuff injury at different time intervals.

a symptomatic rotator cuff tear were able to return to play at the same level the following season, and 88% of the tears that underwent postoperative imaging demonstrated a healed repair. Most of the tears were acute full-thickness tears that occurred in veteran players, with 7 of the 10 tears occurring in players with >5 years of professional experience. The mean time to return to play was 9.5 ± 4.3 months, with the mean playing time after surgery being 32 ± 25 games for football players and 22 games for the hockey player. There was 1 repair failure that occurred in an 11-year veteran professional football player who had a large rotator cuff tear.

Rotator cuff tears are rare injuries in professional contact athletes, and there are limited data to help guide players and team physicians regarding clinical outcomes and return-to-play rates after surgical management. The primary expectation of any athlete after surgical repair is to return to sport at the same preinjury level of play. A recent systematic review and meta-analysis by Altintas et al[1] included 347 athletes, 81 of whom self-reported as competitive athletes, and found that after arthroscopic treatment of rotator cuff tears, the overall rate of return to sport was 87.3% with 71.2% returning at an equivalent level of play. However, further analysis of the data revealed that only 61.5% of competitive athletes and 38% of overhead athletes were able to return to play at the same level.[1] These authors mentioned that athletes who compete in overhead and contact sports are potentially more susceptible to failing to return to their previous level of sport compared with nonoverhead/noncontact athletes.[1,22] A systematic review and meta-analysis from 2016 reported fair outcomes in 683 athletes, 286 of which were competitive or professional athletes, with an overall return-to-sport rate of 84.7%, and 65.9% returning at an equivalent level of play, after 4 to 17 months.[14] Subgroup analysis of the professional and competitive athletes showed that only 49.9% returned to the same level of play.[14] At the professional level, most of the return-to-play data after rotator cuff surgery come from the baseball literature. In these athletes, the results of rotator cuff surgery are also generally disappointing, with return-to-play rates ranging between 8% and 73% depending on the size, pattern, and chronicity of the tear.[6,18,20,23,26]

While there are far fewer data in professional athletes involved in contact sports, the results have generally been more promising. In 1996, Blevins et al[4] reported on a series of 10 contact athletes (9 professional football players, 1 recreational football player) with rotator cuff tears that underwent operative management. A 90% return-to-play rate was noted in this series, 80% at the same level.[4] However, only 3 of the 10 tears were full-thickness tears.[4] In 2002, Foulk et al[9] published the results of a survey of NFL team physicians that examined the incidence and clinical outcomes of rotator cuff tears in NFL players over a 10-year period from 1983 to 1993. The authors identified 51 tears in 49 players, and 90% of these tears underwent surgical repair with either an open or a mini-open technique.[9] A total of 93% of players returned to play at a mean of 5 months, while 3 players elected for retirement.[9] In a 2009 study, Tambe et al[25] reported their results of arthroscopic rotator cuff repair in elite rugby players. The authors reported on 11 players, all with full-thickness rotator cuff tears that underwent acute arthroscopic repair (<5 weeks from date of injury).[25] Ten of the 11 players (91%) were able to return to play at the preinjury level at a mean of 4.8 months after surgery, and postoperative imaging confirmed a healed repair in 9 players.[25]

Our findings are in concordance with these studies in contact athletes, demonstrating a similar return-to-play rate (80%) and similar percentage of healed repairs (88%) on postoperative imaging. The data both from our study and previous studies suggest a better return-to-play rate after rotator cuff surgery for professional athletes of contact sports when compared with those of overhead sports. The reasons for this difference are likely multifactorial but could be explained by the different demands placed across the shoulder in each sport. It is possible that a subtle loss of strength or motion in the shoulder postoperatively is better tolerated in a contact athlete than a throwing athlete due to complex interworking with the shoulder

musculature seen in these overhead sports. Another possible explanation is that most of the tears encountered in contact sports tend to be acute tears compared with chronic attritional–type tears seen in overhead sports. Historically, acute tears managed surgically tend to do better postoperatively compared with chronic attritional tears, perhaps contributing to these strikingly different results.[10]

Acute surgical repair is generally recommended for young patients who are diagnosed with symptomatic rotator cuff tears. While all of the tears in our cohort were the result of a single traumatic event, we were surprised to find that 30% of the players were able to recover enough strength and motion to return to play in the same season as their initial injury. The delay in surgical intervention for these chronic tears did not appear to negatively affect healing rates or the ability to return to play. Other factors that did not appear to influence return to play included type of contact sport, position, type of procedure (debridement vs repair), or number of suture anchors used in repair. Older age, more seasons played, and larger tear size all appeared to negatively affect the ability to return to play. Both players who did not return to play were >30 years of age, had >10 years of professional playing experience, and had large 2-tendon rotator cuff tears.

The risk of rotator cuff tear progression has been well-defined in the general population but has not been discussed previously with respect to contact athletes. Given the large external forces exerted on the shoulder, one would expect contact athletes to demonstrate a high risk for cuff tear progression. Further analysis of the 2 players who did not return to play in our series revealed that their tears demonstrated this type of significant cuff tear progression. Both of these veteran players had minimally symptomatic, small (<1 cm) full-thickness rotator cuff tears that were diagnosed at the end of a season by MRI during exit physical examinations. These players elected for nonsurgical treatment in the offseason and then suffered a significant acute injury in their first regular season game the following season. After this acute injury, there was significant progression of their tears to large, 2-tendon tears with increased pain and functional deficits necessitating acute surgical intervention. For a multitude of reasons, older veteran players may be more inclined to play through a rotator cuff tear. In their survey study, Foulk et al[9] reported that 41 of the 49 NFL players with rotator cuff tears were able to continue playing football for an unspecified period after the onset of rotator cuff injury. Based on our experience, players should be counseled about the risk of rotator cuff tear progression, and early surgical intervention should be considered once a full-thickness tear is identified.

Limitations

Despite the encouraging outcomes, there are significant inherent limitations to this study including study design, limited information regarding tear size, pattern, and location as well as the lack of postoperative imaging.[9] In addition, the sample size, while similar to other series, was still small and led to limited statistical analysis. There was no control group of players with rotator cuff tears who underwent nonoperative treatment to compare the clinical outcomes and return-to-play rates. In addition, some career-length data were acquired using publicly available internet sources, and inaccuracies in this reporting could have influenced the results. Long-term follow-up also was not available, and we therefore cannot comment on the long-term success and durability of the repair. Finally, as with any study analyzing return to play in professional contact athletes, the incentives and motivations were unique to each player's contract and situation and may not be generalizable to other athletic populations.

CONCLUSION

The majority (80%; n = 8) of the professional contact-sport athletes in this series were able to return to play at the same professional level after arthroscopic management of a symptomatic rotator cuff tear, and 88% of the tears that underwent postoperative imaging demonstrated a healed repair.

ORCID iD

Luis A. Vargas https://orcid.org/0000-0003-1148-5835

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