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The timing of rotator cuff repair for the restoration of function

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Introduction: This study was developed to test the hypothesis that there is a period in which a painful, traumatic rotator cuff tear, with associated weakness and the inability to abduct above shoulder level, should be repaired to allow for improvement in function.

Methods: Forty-two consecutive, prospectively followed patients met the criteria for entrance into this study. Of those, 36 patients were available for a minimum 9 months follow-up (average, 31 months; range, 9−71) by office visit. Patient outcomes were measured using the UCLA End-Result and ASES scoring systems. Patient variables, including time from injury to repair, tear size, degree of preoperative fat infiltration, patient satisfaction, and improvement in pain, were evaluated for their association with surgical outcome using independent t testing. Time to repair was evaluated at 0−2 months, 2−4 months, and greater than 4 months.

Results: Pain scores improved from 7 to 1.4 ($P < .01$) and active elevation improved from 55° to 133° ($P < .01$). UCLA/ASES scores improved from 8/30 to 26/79, respectively ($P < .01$, $P < .01$). All but 2 of the 36 patients were satisfied with their result. Preoperative fatty atrophy did not correlate with postoperative function. Rotator cuff tear size had no influence on patient outcome if repaired before 4 months. Massive tears repaired after 4 months had the worst outcome.

Conclusion: Our results emphasize that the treatment outcome for traumatic rotator cuff tears of all sizes, with associated weakness, is not compromised up to 4 months after their injury.

Level of evidence: Level III, Retrospective Case Control Study, Treatment Study.

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Keywords: Rotator cuff repair; timing; function; open repair

Full thickness tears of the rotator cuff are a common source of shoulder pain and disability. The majority of rotator cuff tearing is a result of degenerative changes within the tendon. Acute, traumatic, full thickness rotator cuff tears, with immediate weakness and pain account for only 8% of those who present with symptomatic rotator cuff tears.[2] While the results for surgical treatment of full thickness rotator cuff tears is well documented,[1,3,5,6,8,11,13,15-17,19,20,22,23,25,26,32,36,37,39] to our knowledge there is only 1 paper in the literature which addresses timing and functional improvement of acute rotator cuff tears.[2] Bassett and Cofield[2] reported on a series of 37 patients to determine if there is an optimal time for repair of a rotator cuff after an acute injury. They found that surgical repair within 3 weeks of injury led to a much better functional outcome than those whose rotator cuffs were repaired after 3 weeks time. Others have suggested that patients who sustain a full thickness tear

Institutional review board approval was not obtained for this study, as it was not a requirement, at our institution, at the time that the data was collected. All of the patients returned to the office on their own accord, after a thorough explanation of the study, to be examined.

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of their rotator cuff undergo early surgical repair, with the expectation that they regain useful overhead function.[13,23] There is little else in the literature that addresses timing of repair and functional improvement.

It has been our experience that most patients who sustain such an injury to their shoulder initially present for treatment more than 3 weeks after their injury. While significant pain relief following rotator cuff repair is well documented,[1,2,4,6,7,9,11-18,21,29,30,32] there is little guidance regarding the timing of surgery and its expected functional improvement.

The purpose of our study was to evaluate the time to repair and subsequent functional outcome in patients who sustain an acute loss of shoulder strength as the result of a painful, traumatic, full thickness rotator cuff tear. Our hypothesis is that there is a period in which a rotator cuff can be repaired after an acute loss of shoulder strength, which will allow for pain relief and improvement in function.

Materials and methods

Institutional review board approval was not obtained for this study, as it was not a requirement at our institution at the time that the data were collected. All of the patients returned to the office on their own accord, after a thorough explanation of the study, to be examined.

All patients were prospectively evaluated, with the patient data analysis performed retrospectively. Only those patients who sustained an acute, traumatic, full thickness tear of the rotator cuff, which resulted in the inability to achieve greater than 90° of active abduction of the shoulder, were included in the study. In all instances, the patients experienced a traumatic injury from a variety of mechanisms that resulted in their shoulder symptoms. This was a specific inclusion criterion for our study. All study patients had an asymptomatic, fully functional shoulder prior to injury.

From 1992 to 2002, a total of 462 rotator cuff tears were performed by the senior author (SP) at the Wayne State University Shoulder Service. Forty-two consecutive patients (9%) met the criteria for inclusion into the study. Of those, 36 patients were available for a minimum 9-month follow-up visit (average, 31 months; median, 30 months; range, 9−71).

To evaluate patient outcomes as a function of time to repair, patients were placed into 1 of 3 groups based on the elapsed time from their injury to the surgical repair of their rotator cuff. Group I consisted of patients who had their rotator cuff repaired within 0−8 weeks of their injury. Group II consisted of patients who had their rotator cuff repaired within 9−16 weeks of their injury. Group III consisted of patients who had their rotator cuff repaired greater than 16 weeks from their injury. There were 15 patients in Group I, 15 patients in Group II, and 6 patients in Group III.

Patients were also grouped to assess their treatment outcomes as a function of rotator cuff tear size. The size of the rotator cuff tear was determined by an intraoperative measurement in each patient. Patients were placed into one of 3 groups based on the size of their rotator cuff tear. The involved area of the rotator cuff tear, as described by Galatz et al,[11] was used to describe the size of the tear. Small tears were those measuring ≤ 4 cm^2, medium/large tears were those measuring 5−17 cm^2, and massive tears were those that measured ≥ 18 cm^2.

Table I Modified Goutallier classification of fatty degeneration

Grade 0- no fatty deposits
Grade 1- some fatty streaks
Grade 2- more muscle than fat
2A - $\leq$ 25 % fat
2B - $>$ 25-50 % fat
Grade 3- muscle = fat
Grade 4- less muscle than fat

Preoperative magnetic resonance imaging (MRI) was utilized to determine the presence of fat infiltration of the rotator cuff musculature. To assess the influence of the chronicity of tendinopathy on repair outcomes, rotator cuff repairs were evaluated on the degree of preoperative fatty degeneration involving the rotator cuff muscle that had the greatest involvement. The grading system developed by Goutallier et al was modified to define the effect of preoperative fat infiltration on patient outcomes, with Grade 2 subdivided into Grade 2A and 2B (Table I).[16] Muscle involvement of Grade 2 or less has been associated with an acute rotator cuff tear.[34] The global fatty degeneration index (GFDI) has been associated with rotator cuff healing after repair, and was calculated for all patients with available preoperative MRI studies.[17] The GDFI is the mean value of graded fatty degeneration involving the subscapularis, supraspinatus, and infraspinatus musculature. Repair integrity was associated with a GDFI less than 0.5, with recurrences in all patients with an index of greater than 2.[17] We compared the GFDI to the outcomes measurements for both the time to repair and tear size. Furthermore, infraspinatus atrophy has been reported to adversely affect rotator cuff healing, and patients' outcomes were compared by the presence or absence of infraspinatus atrophy of Grade I or more on their preoperative MRI studies.[16,17,26]

Patient outcomes were measured using the American Shoulder and Elbow Surgeons (ASES) subjective shoulder scale,[28,31] the UCLA End Result Score,[8] improvement in active elevation, improvement in strength as measured by manual muscle testing, a visual analog scale for pain, and a patient satisfaction survey.[33] Patients were asked to fill out both the pain and functional sections of the ASES subjective shoulder scale both pre- and postoperatively. Pain was evaluated using the 10-point visual analog scale from the ASES subjective shoulder scale. Patients were also asked in a questionnaire if they were satisfied with their surgery. They rated their shoulder as much better, better, same, or worse, and answered if they would have surgery again under the same circumstances. The patients were said to have a satisfactory outcome if they responded much better or better.

Paired *t* tests were utilized to determine if there were any differences between the preoperative and postoperative ASES subjective shoulder scale values, UCLA end result scores, pain, and improvement in active elevation. Independent Student *t* tests were used to determine if there were significant differences between preoperative and postoperative exam findings among the various time to repair and tear size groups, and whether the patients' demographic variables impacted their outcome.

Demographic variables evaluated included gender, tobacco use, workman's compensation, and tearing of the dominant shoulder. All calculated P values were considered significant if less than .05. Standard statistical software (SPSS Inc., Chicago, Illinois) was used to analyze the data.

Surgical technique and postoperative rehabilitation

All rotator cuff tears were repaired with an open deltoid splitting approach, utilizing braided nonabsorbable suture and repairing the tendon to the greater tuberosity through prepared trans-osseous tunnels. All procedures included an anterior acromioplasty.[30] A standard postoperative rehabilitation program was utilized for study patients. In the immediate postoperative period, passive range of motion exercises were begun within a tension free range that was determined intraoperatively. The patients were advanced to full passive range of motion at 6-8 weeks postoperatively and to full active-assisted range of motion at 10-12 weeks. A strengthening program for the periscapular and rotator cuff musculature was started at 10-16 weeks, depending on the rotator cuff tear size and integrity of the repair. Patients with large to massive tears were immediately protected in an abduction pillow for 4 weeks, with passive motion above the level of the brace determined at surgery. After removal of the pillow, a sling was worn for another 2 months. All other patients were protected in a sling for 2 months.

Results

There were 22 males and 14 females included in this study. Six patients were smokers. The injury was work associated in 12 patients. Twenty-nine patients sustained the injury to their dominant shoulder. Fourteen patients had undergone some form of physical therapy prior to initial presentation, and 9 patients had received an intra-articular cortisone injection prior to presentation. The mean age at time of surgery was 57 years (range, 21−74). The mean time from injury to the first office visit was 9 weeks (range, 1−19). The mean elapsed time from date of injury to surgical repair was 11 weeks (range, 2−24 weeks; median, 13).

There were 8 massive tears, 6 medium/large tears, and 1 small tear in Group I, with an average age of 58 years. Four massive, 8 medium/large, and 3 small tears comprised Group II, with an average age of 53 years. Three massive, 2 medium/large, and 1 small tear were in Group III, with an average age of 61 years (Table II).

All patients in the study had marked pain relief following their rotator cuff repair. The mean visual analog scores improved from 7 to 1.4 ($P \leq .01$) and significantly improved in all groups regardless of the time to repair or the rotator cuff tear size. Thirty-four of the 36 patients were satisfied with their results and regarded their shoulders as much better or better. Both dissatisfied patients had massive tears repaired after 4 months. Thirty-three of the 36 patients would have had their surgery again under the same circumstances.

The average preoperative active elevation was 55° (range, 10−90°). The average postoperative active elevation was 133° (range, 55−170°) ($P < .01$). The average preoperative active external rotation measured 39° (range, 0−65°). The average postoperative active external rotation was 49° (range, 15−75°) ($P < .01$). The average preoperative active internal rotation was to the second lumbar vertebrae (range sacrum - thoracic vertebrae 5). The average postoperative active internal rotation was to the tenth thoracic vertebrae (range sacrum − thoracic vertebrae 5) ($P < .01$). None of the patients had evidence of post-traumatic shoulder arthrofibrosis involving the glenohumeral joint preoperatively.

The average preoperative strength of the supraspinatus was 2.7 (range, 2−4). The average postoperative strength of the supraspinatus was 4.1 (range, 2−5). There was a significant increase in strength of the supraspinatus postoperatively ($P < .01$). The average preoperative strength of the infraspinatus was 3.7 (range, 2−5). The average postoperative strength of the infraspinatus was 4.2 (range, 3−5). There was a significant increase in strength of the infraspinatus postoperatively ($P < .01$).

Active elevation in Group I improved from 54° to 137° ($P \leq .01$). Group II elevation improved from 52° to 142° ($P < .01$) and elevation in Group III improved from 66° to 100° ($P < .01$). A significant difference was found in the comparison of postoperative active elevation between Groups I and II to Group III ($P \leq .05$). The ASES scores of group I improved from 28 to 82 ($P \leq .01$). Group II scores improved from 31 to 79 ($P \leq 01$). Group III scores improved from 24 to 65 ($P \leq .01$). The UCLA scores for Group I improved from 6 to 30 ($P \leq .01$). Group II improved from 9 to 30 ($P \leq .01$). Group III scores improved from 9 to 25 ($P \leq .01$). A significant difference ($P \leq .05$) was found when the postoperative scores for Groups I and II were compared to Group III (Table III).

All patients experienced improvement in active elevation, ASES score and UCLA score after rotator cuff repair, regardless of the size of their tear. Active elevation improved from 68° to 145° for those with small tears. Those with medium/large tears had improvement from 52° to 141°. Those with massive tears improved from 53° to 120°, though massive tears had less active elevation than medium/large tears ($P \leq .05$). The UCLA scores for small and medium/large tears both improved from 9 to 29 ($P \leq .01$), and for massive tears improvement from 7 to 27 ($P \leq .01$) was noted. The ASES scores for small tears improved from 22 to 79 ($P \leq .01$), medium/large tears improved from 27 to 75 ($P \leq .01$) and massive tears improved from 30 to 73 ($P \leq .01$). Significant postoperative differences in both UCLA and ASES scores were not found among the different tear sizes (Table III).

The preoperative MRI studies of 34 patients were available for review. Twenty-four patients had evidence of preoperative fatty atrophy of Grade 2A or less and 10

Table II Patient data

Case No.	Age	Tear size (cm^2)	No. tendons torn	Time to repair (weeks)	Elevation pre-	post	GDFI	Atrophy SS	Atrophy IS	Satisfied
1	52	35	2	8	90	130	2	3	2a	Yes
2	63	24	2	5	20	120	1.33	3	1	Yes
3	45	24	2	8	80	145	1.33	2a	2a	Yes
4	21	35	3	9	90	110	1	2a	0	Yes
5	64	24	2	21	80	115	1.33	2a	2a	Yes
6	61	35	2	16	20	115	1.66	2a	1	Yes
7	57	21	2	8	20	140	3	4	1	Yes
8	60	28	2	6	40	85	2.33	2b	1	Yes
9	63	42	2	16	90	165	2	3	3	Yes
10	51	28	3	4	20	130	2.33	4	1	Yes
11	71	35	2	8	70	145	1	2a	1	Yes
12	50	28	2	14	15	150	1.33	2b	2a	Yes
13	56	27	2	8	30	130	1.66	2a	3	Yes
14	65	28	3	18	90	60	2.66	4	2a	No
15	74	9	1	7	90	150	1	2a	1	Yes
16	47	9	1	5	60	130	1.33	2a	1	Yes
17	44	9	1	10	30	160	1	1	1	Yes
18	64	12	1	4	90	130	0.66	2a	1	Yes
19	69	12	1	9	10	100	0.66	2a	1	Yes
20	43	16	1	24	70	130	0.66	2a	0	Yes
21	53	9	1	11	10	130	1.33	2a	0	Yes
22	66	9	1	8	90	150	0.33	1	0	Yes
23	72	6	1	2	60	155	0.33	2a	1	Yes
24	54	8	1	4	20	150	1	2a	1	Yes
25	58	6	1	13	30	150	1.33	2a	0	Yes
26	64	7	2	11	65	170	0.33	0	1	Yes
27	53	6	1	9	60	150	0	0	0	Yes
28	50	13.5	1	9	40	110	0	0	0	Yes
29	55	3	1	15	85	170	1	2b	1	Yes
30	58	3	1	16	90	125	0.66	0	0	Yes
31	37	2	2	13	90	165	0.66	2a	0	Yes
32	45	3	1	4	30	165	0.33	0	0	Yes
33	70	5	2	22	30	110	0.66	2a	0	Yes
34	72	0.5	1	21	80	130	1.66	2a	1	Yes
35	52	48	2	24	45	55	NA	NA	NA	No
36	56	9	1	10	60	155	NA	NA	NA	Yes

GDFI, global fatty degeneration index; *SS*, supraspinatus; *IS*, infraspinatus.

patients had evidence Grade 2B or greater atrophy involving the rotator cuff musculature. The average age of those with preoperative fatty atrophy ≤2A and those ≥2B was 57 years (Table II). Eleven patients displayed no evidence of infraspinatus atrophy and 23 patients had Grade 1 or greater infraspinatus atrophy. The average age was 50 years for those with the presence of preoperative infraspinatus atrophy, and 60 years for those without preoperative infraspinatus atrophy (Table II).

There was not a significant difference in the mean postoperative active elevation between those that had ≤2A preoperative fatty atrophy (137°) and those with ≥2B preoperative fatty atrophy (128°). Likewise, there was not a statistical difference in the postoperative UCLA scores or ASES scores between those that had ≤ Grade 2A preoperative atrophy (28/75) and those with ≥ Grade 2B atrophy (28/80) (Table IV).

Subscapularis atrophy was graded and was used in the calculation of the GFDI for all patients. There were 3 patients with subscapularis tears, as noted in Table II. One of the patients was 21 years old and had no atrophy; the other 2 patients had grade 4 atrophy of their subscapularis. The rest of the patients had Grade 0 atrophy of their subscapularis and this was used in the calculation. There was a trend toward an increased GFDI as the time to repair increases from Group I to Group III ($P = .15$). The GFDI of Group I patients was 1.15, Group II patients averaged 1.1, and Group III patients averaged 1.41. There was a significant increase ($P < .01$) in the GFDI between massive tears (1.78) and both small (.82) and medium/large tears (.71).

Table III Outcomes for all groups and tear sizes

	Average active elevation		Average ASES score		Average UCLA score	
	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
Group I	54	137	28	82	6	30
Group II	52	142	31	79	9	30
Group III	66	100	24	65	9	25
Small	68	145	22	79	9	29
Medium/large	52	141	27	75	9	29
Massive	53	120	30	73	7	27

Table IV Outcomes measures dependent on preoperative fatty atrophy

	Average preoperative active elevation	Average postoperative active elevation	Avereage ASES scores		Average UCLA scores	
			Preoperative	Postoperative	Preoperative	Postoperative
≤2A	58	137	28	75	9	28
≥2B	50	128	28	80	7	28

There was a statistical difference in the mean post-operative improvement in active external rotation of those patients with preoperative infraspinatus atrophy (10° improvement) and those without preoperative infraspinatus atrophy (no improvement) ($P < .01$); however, the post-operative UCLA and ASES scores were not significantly different (Table V).

Gender, tobacco use, workman's compensation and tearing of the dominant shoulder did not influence the patients' outcomes in our study.

Discussion

Regardless of the timing of surgery or the size of the rotator cuff tear, surgical repair was successful in reducing pain in our series of patients, consistent with other studies that have investigated rotator cuff repairs.[1-3,5,8,11,13,15-17,19,20,22,23,25,26,32,36,37,39] Functional improvement was evidenced in all study patients that had a rotator cuff repair within 4 months following injury.

There is support in the literature for the nonoperative management of rotator cuff tears.[4,14,21,24,38,39] Bokor et al[4] reported that patients presenting for nonoperative treatment within 3 months of their injury had satisfactory outcomes. Successful nonoperative management has been associated with the presence of satisfactory motion and strength at the initiation of treatment.[24,39] Unfortunately, Itoi and Tabata[24] have demonstrated that the outcome of nonoperative management deteriorates over time, and Goldberg et al[14] concluded that the overall response of shoulder function to nonoperative intervention was poor. None of the patients in this study that had a preoperative trial of physical therapy had appreciable improvement in their shoulder pain or function.

All patients in this study had a previously asymptomatic shoulder prior to injury and had sustained an acute, traumatic, full-thickness rotator cuff tear that resulted in immediate pain and the inability to raise their arm. While early surgical repair has been advocated in these patients,[3, 13] there is only 1 study that has investigated the time to repair.[2] Utilizing improvement in active elevation as their outcome measure, they concluded that those patients who had their rotator cuff tears repaired within 3 weeks of their injury had a much better functional outcome than those who were operated on after 3 weeks time. Other studies have observed better functional results with early repair[3]; yet, no other study has investigated further the timing of repair and its effect on shoulder function.

We found that the average postoperative active elevation of all tear sizes significantly improved if repair took place within 4 months of their injury. Furthermore, we found that the postoperative ASES and UCLA scores of all tear sizes improved if repair takes place within four months of injury. Postoperative active elevation of massive rotator cuff tears was less than those of smaller tears and the function of massive tears repaired after 4 months time was worse than those repaired prior to 4 months. We did not find a difference in outcome measures when comparing small and medium/large tears. Interestingly, active external rotation only improved in those patients with preoperative infraspinatus atrophy. This is contrary to the observation of others and might optimistically be the result of a healed repair.[17]

The adverse effect of fatty degeneration of rotator cuff musculature on the prognosis of rotator cuff surgery has been studied.[10,16,17,37] Thomazeau et al[37] reported that preoperative atrophy of the supraspinatus was the main predictive factor for a postoperative retear of the rotator cuff. Goutallier et al[16] also found a significant association

Table V Outcomes measures dependent on preoperative infraspinatus atrophy

	Average preoperative external rotation	Average postoperative external rotation	Avereage ASES scores		Average UCLA scores	
			Preoperative	Postoperative	Preoperative	Postoperative
No infraspinatus atrophy	46	45	29	74	9	28
Infraspinatus atrophy	34	44	28	78	8	28

between a recurrent tear and pre-surgical fatty degeneration. They further observed, in a separate study,[17] that infraspinatus fatty degeneration can occur in large anterosuperior rotator cuff tears even if the infraspinatus is not torn and that infraspinatus degeneration had a highly negative influence on the outcome of supraspinatus repairs.

By subdividing Goutallier's classification for the analysis of fatty degeneration of the most affected rotator cuff muscle, we attempted to further assess tear chronicity as a function of fatty infiltration. Fatty infiltration of the rotator cuff musculature impairs the physiologic properties of the muscle and is likely irreversible.[9,12,27] Meyer et al[29] demonstrated that the muscular changes following tendon tear were asymmetric and likely due to architectural changes within the muscle rather than from uniform muscle disease. As the tendon retracts and the pennation angle of the muscle fibers increases, the muscle fiber length decreases and the fiber gap increases, allowing fat cells to infiltrate the gap. Coleman et al[7] found, in a sheep model, that tendons repaired 6 weeks after section displayed better functional recovery as compared to those repaired 18 weeks after section. Safran et al[34] noted a 32% loss of muscle volume in the first 6 weeks after detaching canine infraspinatus tendons. Those repaired 18 weeks after section were considered irreparable. We used this data to evaluate the acuity of rotator cuff tearing in our patients. Patients with 2A atrophy could be considered as having a recent rotator cuff tear. However, we did not find that preoperative supraspinatus or infraspinatus fatty atrophy influenced patient outcomes to a significant degree. We did note an increase in the GFDI as time to repair increased and as tear size increased, suggesting that retears were likely present in this group of patients.[17] Unfortunately, postoperative imaging was not preformed to assess the integrity of the rotator cuff repairs, and we are unable to draw conclusions on the effectiveness of timing and tear size on the integrity of rotator cuff repair.

The importance of the functional integrity of the rotator cuff after repair is well accepted.[19,25,26] Harryman et al[19] found that those patients that did not have a full thickness, recurrent defect after rotator cuff repair had significantly better functional outcomes than those patients who did. When comparing preoperative tear size with postoperative outcomes, they found that tear size did not correlate with the patient's postoperative function, pain, and overall satisfaction; however, the time from injury to repair was not a variable in their study. Jost et al[25,26] found that despite a rotator cuff defect after repair, patients had improvement in pain and function when compared to their preoperative status and that this clinical improvement did not deteriorate over time.

Preinjury tendon pathology was likely present in our study participants, and its effect on resulting rotator cuff injury cannot be determined. In a histological analysis of 891 spontaneously ruptured tendons, Kannus and Jozsa reported that all specimens demonstrated degenerative changes within the tendons that preceded rupture.[27] Sher et al found the prevalence of rotator cuff tears to be 34% in their study of 96 asymptomatic individuals.[35] It is likely that many of our patients had long standing, asymptomatic pathology of their rotator cuff and subsequently sustained an acute extension of that pathology which led to their symptoms. We acknowledge that it can be difficult to diagnose a rotator cuff tear as acute without knowing the pre-existing condition of the tendon. We attempted to address this question by reviewing the preoperative MRI exams of those which were available to us and quantifying the degree of fatty infiltration present in the rotator cuff musculature prior to repair.

There are weaknesses of this study. We did not attain follow-up imaging to assess tendon integrity; all of our patients did not have preoperative MRI studies that could accurately assess muscle atrophy; statistical analysis was performed on a limited patient population; and there is always potential for bias introduced in a retrospective study. Furthermore, we cannot effectively assess the integrity of our patient's rotator cuff prior to injury.

The strengths of this study allow its comparison to previously published studies. One surgeon performed all of the rotator cuff repairs allowing for a consistent technique; data were prospectively collected; MRI data were analyzed to assess rotator cuff atrophy as an outcome measurement; and the number of patients included in our study was comparable in size to a similar study.[2]

Conclusion

In conclusion, the operative repair of an acute, traumatic rotator cuff tear with associated weakness function is predictably improved if the repair occurs within 4 months after injury. Massive rotator cuff tears have

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poorer functional outcome than smaller tears; however, significant pain relief can be attained with operative repair regardless of the size of the tear. The extent of preoperative fat infiltration did not appreciably affect the functional outcome of our patients following repair.

Disclaimer

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