Recovery of Shoulder Rotational Muscle Strength After Arthroscopic Bankart Repair

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Background: Shoulder rotational muscles act as dynamic stabilizers of the glenohumeral joint, and the recovery of muscle strength plays an important role in stabilizing the joint during postoperative rehabilitation. However, temporal changes in muscle strength after arthroscopic Bankart repair have not been clarified.

Purpose: To better understand the temporal recovery of shoulder rotational muscle strength after arthroscopic Bankart repair.

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

Methods: Isokinetic concentric shoulder rotational muscle strength was evaluated in 50 patients who were diagnosed with recurrent dislocations of the glenohumeral joint and treated with arthroscopic Bankart repair.

Results: The mean peak torque/weight and total work were reduced significantly at 1.5 months after surgery ($P < .0001$) and returned to preoperative levels by 6 months for external rotation and 4.5 months for internal rotation. The contralateral peak torque ratios reached preoperative levels by 6 months after surgery. The ipsilateral peak torque ratios were reduced between 1.5 and 3 months after surgery and returned to preoperative levels at 6 months for external rotation and 4.5 months for internal rotation.

Conclusion: Isokinetic shoulder rotational muscle strength after arthroscopic Bankart repair recovered to preoperative levels by 6 months for external rotation and 4.5 months for internal rotation.

Keywords: shoulder; instability; postoperative rehabilitation; isokinetic muscle strength; arthroscopic Bankart repair

Glenohumeral instability after recurrent dislocations or subluxations of the shoulder is a serious problem for athletes or military personnel who want to resume sports activities or military duties.[4,12,22] Surgical stabilization of the shoulder is currently considered to be the "gold standard" for the treatment of chronic, unidirectional, and traumatic instability, and several surgical procedures have been developed to stabilize the shoulder.[7,16,28] Of the various procedures available, arthroscopic Bankart repair using bioabsorbable suture anchors offers good results and has a low recurrence rate.[10,20] This procedure is less invasive than other surgical options, and patients can attain high satisfaction with a low redislocation rate and a high rate of resumption of sports activities. However, other studies have shown that the long-term recurrence rate after arthroscopic Bankart repair is greater than that of open Bankart repair.[19]

Shoulder rotational muscles act as dynamic stabilizers of the glenohumeral joint, and the recovery of muscle strength plays an important role to stabilize the joint during the postoperative rehabilitation program.[13,23] Previously, we reported the time course of rotational muscle strength before and after open Bankart and modified Bristow procedures, and found that sufficient muscle strength can be obtained at 6 months after surgery.[2] Rotational muscle strength correlates with shoulder function and might be used as a functional index of glenohumeral instability after surgery. However, the temporal change in isokinetic rotational muscle strength after arthroscopic Bankart repair has not been clarified.[3]

In this study, we investigated isokinetic shoulder rotational muscle strength after arthroscopic Bankart repair to determine the timeline of muscle strength recovery, which allows patients to return to sports or high-demand physical activities such as military duties. We hypothesized that

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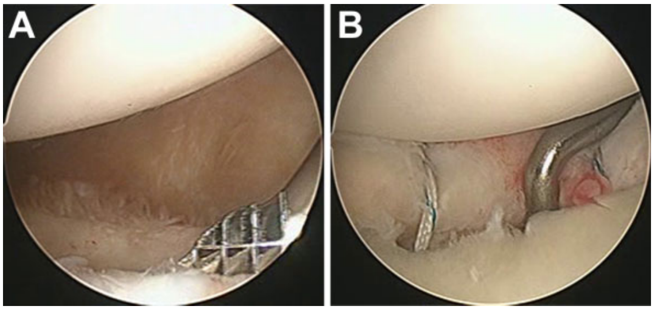

Figure 1. Arthroscopic view of Bankart repair. (A) Preparation of the Bankart lesion. (B) Bankart repair with a single-suture technique.

muscle strength after arthroscopic Bankart repair can be recovered sufficiently and that functional recovery can be obtained at less than 6 months after surgery.

METHODS

With approval of our institutional review board (No. 2164), isokinetic concentric shoulder rotational muscle strength was evaluated in patients diagnosed with a recurrent dislocation or subluxation of the glenohumeral joint and treated with arthroscopic Bankart repair. Eighty-three shoulders from 79 consecutive patients with glenohumeral instability underwent arthroscopic Bankart repair between 2005 and 2012.

Arthroscopic surgery was performed by a single senior surgeon (M.A.) and 2 junior surgeons (Y.T. and T.T.). Bioabsorbable suture anchors (3-5 anchors; Panalok; DePuy Synthes) were inserted on the anterior glenoid ridge, and the capsulolabral complex was reattached (Figure 1). Combined superior labrum anterior to posterior (SLAP) lesions were repaired with 2 suture anchors.[18] Rotator interval closure was added in all patients using 2 strong sutures.[11] The surgical technique did not change during the study period. After surgery, the patients wore a shoulder immobilizer for 3 weeks. Isometric exercise in the sling was started at 1 day postoperatively. Increasing range of motion exercises were prescribed for 2 weeks after surgery. The shoulder immobilizer was removed, and active flexion exercise in the supine position and passive external rotation exercise were started at 3 weeks postoperatively. Rotator cuff exercise was started using a rubber band at 4 weeks postoperatively, and unlimited activities of daily living were allowed at 6 weeks postoperatively. Upper limb muscle training was permitted using a <2-kg dumbbell at 2 months, and push-ups were permitted at 3 months. Noncontact sports were permitted at 2 to 3 months, and contact sports and overhead throwing were permitted at 6 months.

Shoulder rotational muscle strength was measured using an isokinetic dynamometer (Biodex III; Biodex).[2] The patients were seated with their shoulders in a neutral position, at 45° of abduction, and with elbows at 90° of flexion. Strength was measured under angular velocities of 60° and 180°. After conditioning, 5 trials were performed using an angular velocity of 60 deg/s, and 10 trials were performed using an angular velocity of 180 deg/s. We measured the peak torques (PTs) in both shoulders at 60- and 180-deg/s angular velocities and calculated the weight-standardized peak torque (PT/W; expressed as a percentage), total work (expressed in ft-lb), the contralateral PT ratio (the PT value on the injured side divided by the PT value on the contralateral side), and the ipsilateral PT ratio (the postoperative PT value on the injured side divided by the preoperative PT value). Muscle strength was measured at 1.5, 3, 4.5, 6, 9, 12, and 24 months after surgery (Figure 2).

Figure 2. Isokinetic shoulder rotational exercise test using a dynamometer.

A shoulder functional evaluation was performed in all patients before surgery and at 3, 6, 9, 12, and 24 months after surgery by using the Rowe score, Japanese Orthopaedic Association (JOA) shoulder score, and Disabilities of the Arm, Shoulder and Hand (DASH) outcome measure. The Rowe score consists of 3 individual measures for function (30 points), stability (50 points), and mobility (20 points). The JOA score consists of 5 individual measures for pain (30 points), function (20 points), range of motion (30 points), radiographic findings (5 points), and stability (15 points). The DASH is a 30-item, self-reported questionnaire designed to measure physical function and symptoms in patients with any or several musculoskeletal disorders of the upper limb. The DASH is scored on a 0-to-100 scale, with a higher score indicating greater disability.

Study inclusion criteria were recurrent dislocations or subluxations of the glenohumeral joint as the main cause of Bankart lesions, treatment by arthroscopic Bankart repair using suture anchors, and assessed isokinetic concentric shoulder rotational muscle strength preoperatively and postoperatively. Exclusion criteria included bilateral injuries, multidirectional instability of the shoulder, repeated surgery, humeral avulsion of the glenohumeral ligament lesions, rotator cuff tears, and redislocations or subluxations during the study. Patients with a large bony Bankart lesion (>25% of the diameter of the glenoid) were indicated for open surgery (Latarjet or Bristow procedure) in our hospital. Patients with a primary dislocation or subluxation and patients with bilateral instability without a traumatic injury were excluded from this study. We excluded 4 cases of redislocations and 6 cases of bilateral or multiple joint instability. Three patients refused to participate in the prospective study, and the remaining 70 patients were included in the study. However, complete data sets of muscle strength during the study were obtained in only 50 patients (follow-up rate: 71.4%). There were 47 male and 3 female study patients, with a mean age at the time of surgery of 25 years (range, 15-38 years). Thirty-eight patients were right-limb dominant, and the dominant limb was affected in 39 participants. The patients included 41 military personnel and 9 amateur athletes. All had more than 1 prior glenohumeral dislocation or subluxation.

Statistical analyses were performed using JMP 10 (SAS Institute). We expressed values for each parameter as mean ± SD. *P* values of <.05 were considered significant. One-way analysis of variance was utilized to examine the difference from the preoperative parameters. The Tukey-Kramer honest significant difference test was used for post hoc analysis.

RESULTS

Weight-Standardized Peak Torque

The mean postoperative PT/W value of the uninjured side remained at the same level throughout the study period. However, the postoperative values were 10% higher than the preoperative values. On the injured side, compared with preoperatively, the mean PT/W was reduced significantly at 1.5 and 3 months postoperatively for external rotation ($P < .0001$ and $P < .01$, respectively) and at 1.5 months for internal rotation ($P < .0001$). These values increased significantly at 3 and 4.5 months postoperatively ($P < .01$ and $P < .05$, respectively), and the mean values reached preoperative mean values at 6 months for external rotation and 4.5 months for internal rotation. The mean PT/W plateaued after 6 months for external rotation and 4.5 months for internal rotation both in the 60- and 180-deg/s angular velocity conditions. Compared to the uninjured side, the mean PT/W on the injured side was significantly lower between preoperatively and 6-month follow-up for external rotation ($P < .0001$); on the other hand, the values were significantly lower between preoperatively and 4.5-month follow-up for internal rotation ($P < .0001$). After 4.5 months, there was no significant difference; however, the values on the injured side were 10% lower than those on the uninjured side. The mean PT/W in the 60-deg/s condition for both external and internal rotation was higher than that in the 180-deg/s condition throughout the study period, and in particular, the values in the 60-deg/s condition for external rotation were significantly lower than those in the 180-deg/s condition at 1.5 and 3 months postoperatively ($P < .001$). The mean PT/W for external rotation was two-thirds of the value for internal rotation in both the 60- and 180-deg/s conditions throughout the study period (Table 1).

Total Work

The mean total work value was reduced significantly at 1.5 and 3 months postoperatively for external rotation ($P < .0001$ and $P < .01$, respectively) and at 1.5 months for internal rotation ($P < .0001$). These values increased significantly at 3 and 4.5 months postoperatively ($P < .01$ and $P < .05$, respectively), and they recovered to preoperative levels at 6 months for external rotation and at 4.5 months for internal rotation. These values plateaued after 6 months for external rotation and at 4.5 months for internal rotation in both the 60- and 180-deg/s conditions (Table 1).

Contralateral PT Ratio

The mean preoperative contralateral PT ratio was approximately 0.9 for both external and internal rotation. This value was reduced significantly for both external and internal rotation at 1.5 and 3 months after surgery ($P < .0001$), but there was no significant difference between the preoperative PT ratio and those measured at 4.5 months and later. The mean values reached mean preoperative values at 6 months in both external and internal rotation. The values for external rotation were lower than those for internal rotation, but the differences were not significant (Table 2).

Ipsilateral PT Ratio

The mean ipsilateral PT ratio significantly increased between 1.5 and 6 months postoperatively for external rotation ($P < .0001$), reaching approximately 1.0 at 6 months for external rotation and 4.5 months for internal rotation. The mean ipsilateral PT ratio stayed between 1.0 and 1.2 at all follow-up points after 6 months. There was no significant difference between the 60- and 180-deg/s angular velocity conditions (Table 2).

Functional Evaluation

The mean Rowe score significantly increased between preoperatively and 3 months postoperatively ($P < .0001$) and gradually increased over time. The mean JOA score also significantly increased at 3 months postoperatively and gradually increased during the follow-up period ($P < .0001$). The mean DASH score decreased between preoperatively and 4.5 months postoperatively, slightly increased at 6 months postoperatively, and decreased again later than 9 months postoperatively. A significant decrease was obtained at 12- and 24-month follow-ups (Table 3).

TABLE 1
Temporal Distribution of Weight-Standardized Peak Torque (PT/W) and Total Work[a]

	PT/W, %				Total Work, ft-lb			
	External Rotation		Internal Rotation		External Rotation		Internal Rotation	
	60 deg/s	180 deg/s	60 deg/s	180 deg/s	60 deg/s	180 deg/s	60 deg/s	180 deg/s
Injured side								
Preoperative	12.3 ± 1.0	9.2 ± 3.3	16.8 ± 5.7	14.6 ± 5.6	72.3 ± 25.7	77.9 ± 38.2	103.5 ± 43.1	133.2 ± 71.1
1.5 mo	6.1 ± 2.4[b]	4.1 ± 2.9[b]	9.8 ± 3.9[b]	8.3 ± 4.3[b]	29.4 ± 15.7[b]	19.4 ± 19.2[b]	50.0 ± 28.3[b]	59.7 ± 50.9[b]
3 mo	8.8 ± 2.9[c]	7.4 ± 2.7[c]	14.8 ± 5.0	13.4 ± 5.0	51.8 ± 21.9[c]	55.4 ± 31.9[c]	87.2 ± 36.1	116.1 ± 62.9
4.5 mo	10.7 ± 3.1[d]	9.0 ± 2.9	17.3 ± 6.3	15.8 ± 6.4	62.8 ± 18.1	73.7 ± 32.0	103.7 ± 37.7	152.9 ± 76.1
6 mo	11.3 ± 3.1	9.6 ± 2.8	17.8 ± 5.5	15.8 ± 4.7	72.7 ± 22.0	86.9 ± 34.7	117.9 ± 37.5	174.6 ± 64.2
9 mo	10.8 ± 3.5	9.6 ± 3.8	18.0 ± 5.6	16.7 ± 7.0	75.5 ± 21.2	91.2 ± 35.6	123.2 ± 34.6	177.2 ± 65.5
12 mo	11.7 ± 2.9	9.9 ± 3.1	18.5 ± 4.3	16.7 ± 4.3	73.2 ± 19.4	84.6 ± 33.1	119.6 ± 37.1	178.7 ± 65.9
24 mo	11.4 ± 2.2	9.2 ± 2.2	20.0 ± 4.5	15.9 ± 3.8	73.4 ± 18.0	83.4 ± 31.6	121.2 ± 39.6	176.9 ± 69.4
Uninjured side								
Preoperative	12.3 ± 3.4	10.8 ± 3.4	18.8 ± 4.9	16.7 ± 5.4	89.0 ± 23.4	102.4 ± 35.1	129.5 ± 34.8	178.4 ± 67.5
1.5 mo	13.0 ± 3.1	10.7 ± 2.7	19.2 ± 4.7	17.4 ± 4.5	87.4 ± 23.1	100.4 ± 34.7	126.8 ± 34.3	183.7 ± 62.9
3 mo	12.8 ± 3.0	11.0 ± 2.9	19.7 ± 5.7	17.6 ± 5.4	89.7 ± 27.0	107.3 ± 39.5	135.5 ± 50.8	191.0 ± 84.2
4.5 mo	12.8 ± 3.1	10.6 ± 2.9	20.5 ± 6.6	18.2 ± 6.5	88.0 ± 21.7	104.6 ± 31.8	136.3 ± 37.7	190.4 ± 79.1
6 mo	12.9 ± 3.0	10.9 ± 2.7	19.9 ± 5.1	17.5 ± 4.8	88.5 ± 24.2	107.0 ± 37.5	138.1 ± 40.0	194.4 ± 75.9
9 mo	12.3 ± 2.9	11.1 ± 2.9	19.6 ± 5.7	17.7 ± 5.1	90.7 ± 25.7	114.2 ± 39.4	142.5 ± 38.2	209.1 ± 65.2
12 mo	13.4 ± 3.4	11.5 ± 3.0	20.6 ± 4.9	18.3 ± 4.1	88.9 ± 23.8	108.7 ± 34.5	140.4 ± 36.2	208.7 ± 61.1
24 mo	12.9 ± 3.3	11.0 ± 2.5	19.9 ± 4.9	17.8 ± 4.1	88.8 ± 20.0	108.7 ± 31.1	137.1 ± 34.6	203.9 ± 57.7

[a]Values are expressed as mean ± SD.
[b]Statistically significantly different from preoperative, $P < .0001$ (post hoc test).
[c]Statistically significantly different from preoperative, $P < .01$ (post hoc test).
[d]Statistically significantly different from preoperative, $P < .05$ (post hoc test).

TABLE 2
Time Course of Contralateral and Ipsilateral Peak Torque Ratios[a]

	Contralateral Peak Torque Ratio				Ipsilateral Peak Torque Ratio			
	External Rotation		Internal Rotation		External Rotation		Internal Rotation	
	60 deg/s	180 deg/s	60 deg/s	180 deg/s	60 deg/s	180 deg/s	60 deg/s	180 deg/s
Preoperative	0.93 ± 0.14	0.92 ± 0.18	0.91 ± 0.16	0.90 ± 0.15				
1.5 mo	0.48 ± 0.15[b]	0.39 ± 0.24[b]	0.51 ± 0.17[b]	0.48 ± 0.20[b]	0.54 ± 0.24	0.43 ± 0.31	0.63 ± 0.27	0.61 ± 0.30
3 mo	0.69 ± 0.15[b]	0.65 ± 0.18[b]	0.76 ± 0.16[b]	0.72 ± 0.16[b]	0.78 ± 0.26[b]	0.69 ± 0.23[b]	0.90 ± 0.36[b]	0.92 ± 0.35[b]
4.5 mo	0.82 ± 0.21[d]	0.83 ± 0.28	0.82 ± 0.18	0.83 ± 0.18	0.86 ± 0.16[b]	0.95 ± 0.28[c]	0.97 ± 0.21	1.03 ± 0.36
6 mo	0.89 ± 0.15	0.90 ± 0.20	0.93 ± 0.20	0.93 ± 0.15	1.14 ± 0.24	1.10 ± 0.34	1.01 ± 0.24	1.14 ± 0.38
9 mo	0.90 ± 0.14	0.89 ± 0.17	0.89 ± 0.17	0.92 ± 0.17	1.06 ± 0.29	1.16 ± 0.39	1.06 ± 0.23	1.12 ± 0.36
12 mo	0.90 ± 0.15	0.86 ± 0.17	0.86 ± 0.17	0.93 ± 0.17	1.12 ± 0.29	1.15 ± 0.33	1.23 ± 0.30	1.20 ± 0.36
24 mo	0.91 ± 0.16	0.85 ± 0.21	0.92 ± 0.18	0.92 ± 0.20	1.09 ± 0.26	1.10 ± 0.26	1.20 ± 0.26	1.17 ± 0.30

[a]Values are expressed as mean ± SD.
[b]Statistically significant difference, $P < .0001$ (post hoc test).
[c]Statistically significant difference, $P < .01$ (post hoc test).
[d]Statistically significant difference, $P < .05$ (post hoc test).

There was no correlation between rotational strength and functional scores at each evaluation time.

DISCUSSION

Arthroscopic Bankart repair is widely accepted for the treatment of glenohumeral instability, even in patients who require a high level of performance, such as military personnel and athletes.[10,22] The procedure establishes sufficient shoulder stability using a suture anchor technique.[5,19] It has been found that arthroscopic approaches result in better function as reflected by the Rowe score in randomized clinical trials.[18] Abouali et al[1] reported a recurrence rate of 12.7% at 34.4 months' follow-up, and Harris et al[15] analyzed 26 studies (1781 patients) and reported a

TABLE 3
Rowe, JOA, and DASH Scores[a]

	Rowe	JOA	DASH
Preoperative	36.6 ± 18.2	77.4 ± 11.4	14.0 ± 14.6
3 mo	83.3 ± 18.5[b]	89.2 ± 22.5[b]	11.8 ± 9.2
4.5 mo	88.3 ± 8.6	90.1 ± 8.3	5.7 ± 4.4
6 mo	88.5 ± 12.8	93.5 ± 6.2	7.5 ± 9.7
9 mo	90.3 ± 8.2	93.6 ± 6.2	4.1 ± 4.7
12 mo	92.3 ± 7.3	97.6 ± 12.0	3.5 ± 4.2
24 mo	97.3 ± 3.4	97.8 ± 3.0	2.1 ± 3.3

[a]Values are expressed as mean ± SD. DASH, Disabilities of the Arm, Shoulder and Hand; JOA, Japanese Orthopaedic Association.
[b]Statistically significantly different from preoperative, $P < .0001$ (post hoc test).

recurrence rate of 11%. However, after this procedure, patients have continued to suffer from a high rate of shoulder dislocations or subluxations after resuming physical performance.[6]

Shoulder rotational muscles act as dynamic stabilizers of the glenohumeral joint, and higher stability is obtained with strong rotational muscles.[27] However, little is known regarding the recovery of rotational muscles after stability surgery, and there is no scientific evidence to clarify when patients can return to their sports activities or military duties. Postoperative treatment has been determined by the experience of the surgeon or physical therapist. The time course of the recovery of rotational muscles should be correlated to the schedule of postoperative treatment.

A recent isokinetic study[13] investigated the recovery of strength in shoulder rotators after Bristow-Latarjet surgery. In their discussion concerning return to sports (including overhead and contact sports), the authors concluded that 6 months' postoperative recovery may be optimal for an athlete to resume sports.[13] We have previously investigated the recovery of shoulder rotational muscle strength in military personnel with glenohumeral instability after open Bankart and modified Bristow procedures[2,3] and found that isokinetic testing is useful to quantify strength recovery after these procedures, as a mild correlation was obtained between strength recovery and clinical outcomes. The recovery of strength after surgery required at least 6 months of rehabilitation. Moreover, the muscle balance between the 2 shoulders was normalized by 12 months after surgery. A more recent study investigated muscle strength 24 months after arthroscopic Bankart repair, and only internal rotation strength was significantly reduced, with excellent DASH and Oxford instability scores.[27] The authors reported that the main factors affecting the muscle strength deficit in internal rotation might be the recurrent dislocations, the loss of the capsuloligamentous balance, or the rehabilitation protocol.

In the present study, we showed that rotational muscle strength recovered to preoperative levels by 6 months for external rotation and 4.5 months for internal rotation after arthroscopic Bankart repair. The muscle balance between the 2 shoulders was normalized by 6 months after surgery. In particular, rotational muscle strength for internal rotation recovered earlier than for external rotation. Because dislocations of the glenohumeral joint occurred during external rotation, the apprehensive feeling would create external muscle strength loss. Moreover, the infraspinatus muscle was passed through by an arthroscope during surgery; on the other hand, the subscapularis muscle was not damaged. These would explain why muscle strength for external rotation recovered later than that for internal rotation. The PT/W values of the injured side could not reach those of the uninjured side during the study period, and even at the final examination, the values of the injured side were 10% lower than those of the uninjured side. The recovery of contralateral muscle strength would not be expected even after arthroscopic Bankart repair.

Rotational muscle strength was obtained more rapidly after arthroscopic Bankart repair than after the open Bankart and modified Bristow procedures.[3] Rhee et al[25] investigated isometric muscle strength in patients who had undergone arthroscopic and open Bankart repairs and observed that muscle strength recovered faster with an arthroscopic procedure than with an open procedure during the early postoperative periods and that strength was restored to the level of the unaffected side at 6 months postoperatively. Arthroscopic Bankart repair is less invasive to the muscles around the shoulder joint, and sufficient stability can be obtained using the suture anchor technique. In the current study, favorable progress was obtained during the postoperative rehabilitation program after arthroscopic Bankart repair.

Isokinetic muscle strength is reliable and reproducible but requires excluding individual variabilities and speed settings. Although contralateral PT ratios are commonly calculated to exclude individual differences, in this study, the postoperative PT/W values on the uninjured side were increasing compared to the preoperative values. The postoperative contralateral PT ratios were influenced by the values on the uninjured side. Therefore, we calculated ipsilateral PT ratios. Although there was no difference in contralateral PT ratios between external and internal rotation at 4.5 months postoperatively, ipsilateral PT ratios for external rotation were significantly lower than those for internal rotation. We believe that the ipsilateral PT ratios are more reliable to evaluate the recovery of muscle strength.

Speeds for testing have been recommended as low (60-120 deg/s), moderate (150-180 deg/s), and high velocities (270-360 deg/s).[9,14,17] Because muscle strength testing at high velocity was too much loading after surgery, we measured strength at 60 and 180 deg/s. Although PT/W values at 60 deg/s were higher than those at 180 deg/s, there was no difference in contralateral or ipsilateral PT ratios between the 2 conditions. Muscle recovery was not different between high-speed and moderate-speed motions.

Muscle strength may not be the only dynamic factor to prevent injury recurrence after arthroscopic Bankart repair. Sports activities, especially contact or collision sports, is a high risk factor for recurrence. Large bony defects of the glenoid (bony Bankart lesion) and/or the posterolateral aspect of the humeral head (large Hill-Sachs lesion) may be easily redislocated after arthroscopic Bankart repair, and they should be indicated for the Bristow or Latarjet procedure.[8,21] Glenoid rim fractures through the anchor point have been reported after arthroscopic Bankart repair.[24] Proprioception should be considered to prevent reinstability to return to high-risk activities.[26] Muscle strength can be improved easily during the postoperative rehabilitation program.

There are several limitations to this study. First, the number of patients was limited and homogeneous. They were young, physically active male soldiers or athletes. The follow-up rate was low because there were missing data for some patients during the follow-up period. The follow-up period was also limited. Although sports have been considered to necessitate the recovery to strength at high velocities (270 or 360 deg/s), the isokinetic evaluation in this study was limited to low velocities only because examinations at higher high velocities produced too much loading at 1.5 or 3 months postoperatively. A larger number and more diverse population of participants should be investigated over a longer period of follow-up to better define the advantages of arthroscopic Bankart repair.

CONCLUSION

Shoulder rotational muscle strength after arthroscopic Bankart repair recovered to preoperative levels by 6 months for external rotation and 4.5 months for internal rotation.

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