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Original Article

Observation of arthroscopic suture bridge technique in the treatment of traumatic shoulder dislocation combined with rotator cuff injuries

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Abstract: Objective: The aim of this study was to observe the clinical effects of arthroscopic suture bridge technique in the treatment of traumatic shoulder dislocation with rotator cuff injuries. Methods: A total of 150 cases of traumatic shoulder joint dislocation, combined with the rotator cuff injuries, were randomly selected. The research duration lasted from March 2015 to March 2017. Patients were divided into the control group (conservative treatment, 75 cases) and experiment group (suture bridge technology under arthroscopy, 75 cases). One year after intervention, the two groups were compared for shoulder joint activity (forward bending and abduction), shoulder joint function (constant score and University of California at Los Angeles (UCLA) scoring system), pain degree (visual analogue scale (VAS), numerical rating scale (NRS)), muscle strength (abductors and flexor anterior), and recurrent rate of dislocation. Results: In the experiment group, abduction activities, bending range, UCLA scores, constant scores, abductor muscle strength, and bending strength were significantly higher than those in the control group. VAS and NRS scores and dislocation recurrence rates, however, were significantly lower (all $P<0.01$) than the control group. Conclusion: Arthroscopic suturing can improve the strength and mobility of shoulder joints in patients with traumatic shoulder dislocation and rotator cuff injuries, reducing recurrence rates of dislocation. This method exhibits positive effects and is worthy of clinical use.

Keywords: Arthroscopy, suture bridge technique, traumatic shoulder dislocation, rotator cuff injuries, clinical curative effect

Introduction

Traumatic dislocation of shoulder joints is a clinical common disease, more often occurring in young people. At present, with the rapid pace of life, incidence of this disease has increased significantly. Further development of the disease can easily trigger rotator cuff injuries, leading to shoulder joint dysfunction, significantly reducing patient quality of life. Conservative treatment is initially used in clinic to treat traumatic dislocation of shoulder joints accompanied with rotator cuff injuries. This treatment includes brake, rehabilitation therapy, and pain relief. However, conservative treatment is usually modest and slow, with lower acceptability of patients [1].

With the rapid development of medical science and technology, the arthroscopic technique has gradually been applied in clinic. More and more patients know the advantages of surgical treatment. Suture bridge under arthroscopy, which takes effect quickly, has advantages that conservative treatment cannot compete with. However, arthroscopy suture bridge is difficult and special instruments are used when arthroscopy is used to repair rotator cuffs. Therefore, there is no unified scheme in the treatment for dislocation of rotator cuff with rotator cuff injuries. Clinical studies have shown that the latest arthroscopy suture bridge does not need to separate the deltoid muscle, which is a deficiency of conventional surgery. Thus, it has unique effects in the treatment of this disease,

Table 1. Comparison of baseline information

Groups	Gender (M/F)	Average age (y)	Average onset (d)	MNA scores (points)	COFIELD and DEORIO rating criteria	
					Large lacerations	Medium lacerations
Experiment group (n=75)	47/28	40.1±6.2	6.12±2.21	22.52±1.26	12	63
Control group (n=75)	45/30	41.2±5.7	6.04±2.18	22.56±1.21	13	62
χ^2/t	0.1124	1.1311	0.2232	0.1983	0.0480	
P	0.7374	0.2598	0.8237	0.8431	0.8266	

Note: M, male; F, female; MNA, mini-nutritional assessment.

Table 2. Comparison of abduction and forward bending activity of shoulder joints

Groups	Abduction activity of shoulder joint (°)		*t*	P
	Before treatment	After treatment		
Experiment group (n=75)	92.26±6.17	129.98±16.25	18.7934	<0.001
Control group (n=75)	92.28±6.22	106.26±10.08	10.2216	<0.001
t	0.0198	10.7469	-	-
P	0.9843	<0.001	-	-

effectively speeding up the healing of rotator cuff repairs [2]. To analyze the clinical efficacy of arthroscopic suture bridge in the treatment of traumatic shoulder dislocation and rotator cuff injuries, the present study analyzed 150 cases treated in the Shoulder Department of Qilu Hospital of Shandong University (Qingdao), from March 2015 to March 2017.

Materials and methods

Baseline information

This study was approved by the Ethics Committee of Qilu Hospital of Shandong University (Qingdao). A total of 150 cases of traumatic shoulder dislocation with rotator cuff injuries were randomly selected from Qilu Hospital of Shandong University (Qingdao). All patients provided informed consent before surgery. The research period ranged from March 2015 to March 2017. Research subjects were divided into the experiment group (75 cases) and control group (75 cases). The ratio of female to male cases in the experiment group was 28:47. Patients were aged from 22.1 to 59.6 years, with an average age of (40.1±6.2 years). The onset time was 3-9 days, with an average time of (6.12±2.21) days. MNA (mini-nutritional assessment) score was 20-25 points and 22.52±1.26 on average. According to COFIELD and DEORIO grading standards, 12 cases had large lacerations while 63 cases had medium lacerations [3]. The ratio of female to male cases in the control group was 30:45. Patients were aged from 24.2 to 60.1 years, with an average age of (41.2±5.7 years). The onset time was 2-9 days and the average time was (6.04±2.18) days. MNA score was 21-25 points and 22.56±1.21 on average. According to COFIELD and DEORIO grading standards, 13 cases had large lacerations while 62 cases had medium lacerations. Baseline data of the two groups were statistically analyzed one by one and statistical differences indicated that P>0.05 for all. The two groups of patients were comparable, as shown in **Table 1**.

Inclusion criteria: (1) Patients meeting the diagnostic criteria of traumatic shoulder dislocation and rotator cuff injury in *Orthopedics* (version 3, 2015) [4]: shoulder pain, flat anterior shoulder, protruded posterior shoulder, accessible coracoid process, obvious shoulder peak, positive active external rotation disorder of the injured limb, positive arm drop sign, positive impact test; positive pain arc syndrome, friction in the glenohumeral joint, CT and MRI showing tears, hyperemia, and edema in the whole layers or part of the supraspinatus tendon, the humeral head rotates inward and the overlapping semicircular teardrop-like shadow of the articular surface of the humeral head with the shoulder glenoid cavity disappeared, the relationship between the humeral head and the shoulder glenoid cavity was not symmetrical and the glenohumeral joint space was widened, and axillary image showed dislocation to the back of the humeral head; (2) Patients with stable vital signs and conditions; and (3) Volunteering to participate in this study.

Table 3. Comparison of abduction and forward bending activity of shoulder joints

Groups	Abduction and forward bending activity of shoulder joint (°)		*t*	P
	Before treatment	After treatment		
Experiment group (n=75)	102.64±9.26	139.96±18.28	15.7723	<0.001
Control group (n=75)	103.77±9.24	110.06±10.71	3.8510	0.0002
t	0.7481	2.2221		
P	0.4556	<0.001		

Table 4. Comparison of VAS scores

Groups	Before treatment (points)	After treatment (points)
Experiment group (n=75)	5.26±0.98	1.42±0.25
Control group (n=75)	5.28±0.95	2.98±0.34
t	0.1269	32.0128
P	0.8992	<0.001

Note: VAS, Visual Analogue Scale.

Exclusion criteria: (1) Combined with other organic diseases; (2) Combined with blood disease and coagulopathy; (3) Females during pregnancy and lactation; (4) Combined with communication disorders, hearing and language disorders, and mental illness; (5) Combined with heart failure and tumors; and (6) With surgical contraindications.

Methods

Control group: The patients did shoulder joint exercises. After successful reduction, the shoulders were suspended with a triangle towel with the elbows bent in 90 degrees. The shoulder joint was rotated inside and adducted for 3 weeks. After removal of fixation, the patients did shoulder swings and scapula planar activity for 1 week, avoiding external rotation and abduction of the shoulder. Exercise of muscles surrounded with scapula mainly included shrugging shoulders with elbows bended, extending shoulders with elbows bended, adducting shoulder, abducting back, extending limbs, bending and circling, rotating upper limbs, climbing, and pulling, for 2-4 weeks. Rotator cuff muscle training adopted rubber bands for anti-resistant rotator cuff rotation and adduction. This was conducted for 4-6 weeks [4].

Experiment group: The patients accepted surgeries with general anesthesia, in the lateral position of the healthy side, with the diseased shoulder flexed in anterior 30° and outward 70°. The arthroscopy lens was placed from the posterior shoulder, extending to the subacromial space, to thoroughly and completely clean up the subacromial clearance, deciding whether the surface of the acromion was damaged. If there was an injury, further analysis was carried out on the condition of the damaged clearance. The rotator cuff was thoroughly cleaned. Combined with the bone condition, reasonable absorbable screws were selected and implanted from the inner edge of the cartilage. The length from the broken end of the rotator cuff to the needling point was determined comprehensively with the rotator cuff tension and bone window size. It was usually 10-12 mm. It was connected on the surface from the posterior rotator cuff, the inner edge of the bone bed, and the proximal broken end of the rotator cuff were fixed. The excreted absorbable screws were inserted from the knotted tail end. The screw was implanted 0.5-1.0 cm from the outer edge of the greater tuberosity of the humerus. The broken end of the rotator cuff was closely pressed to the bone bed of the greater tuberosity. The number of the screws was determined combined with the degree of the rotator cuff tear. The rotator cuff was fixed with the shoulder brace after the operation, with abduction angles at 20° and internal rotation angle at 30°, for successive 6 weeks.

Outcome measures

Range of shoulder abduction and forward flexion was recorded, before and after treatment, for all subjects. The normal range of abduction was 0-180°. The normal range of forward flexion was 0-180°.

Pain rating: VAS (visual analogue self-rating scale) was used to evaluate the pain degree of all subjects before and after treatment, with 10 as a full score, 0 score as painless, <3 point (s) as mild pain, 4-6 points as moderate pain, but

Table 5. Comparison of VAS scores

Groups	Before treatment (points)	After treatment (points)	*t*	P
Experiment group (n=75)	5.26±0.98	1.42±0.25	32.8810	<0.001
Control group (n=75)	5.28±0.95	2.98±0.34	19.7407	<0.001

Note: VAS, Visual Analogue Scale.

Table 6. Comparison of NRS scores

Groups	Before treatment (points)	After treatment (points)
Experiment group (n=75)	5.28±0.89	1.40±0.26
Control group (n=75)	5.27±0.91	2.96±0.42
t	0.0680	27.3502
P	0.9458	<0.001

Note: NRS, numerical rating scale.

Table 7. Comparison of NRS scores

Groups	Before treatment (points)	After treatment (points)	*t*	P
Experiment group (n=75)	5.28±0.89	1.40±0.26	36.2401	<0.001
Control group (n=75)	5.27±0.91	2.96±0.42	19.9602	<0.001

Note: NRS, numerical rating scale.

Table 8. Comparison of UCLA scores

Groups	Before treatment (points)	After treatment (points)	*t*	P
Experiment group (n=75)	15.26±2.62	32.69±9.28	15.6540	<0.001
Control group (n=75)	15.33±2.51	28.77±6.28	17.2103	<0.001
t	0.1671	3.0297	-	-
P	0.8675	0.0029	-	-

Note: UCLA, University of California at Los Angeles.

affecting sleep, and 7-10 points as intense pain. Lower scores indicated lower pain degrees [5, 6]. NRS scores were used to reassess the pain degree of all subjects before and after treatment, with 0 points for painless, 1-3 points for mild pain, 4-6 points for moderate pain, 7-9 points for severe pain, and 10 points for intense pain. Lower scores indicated lighter pain [7].

UCLA rating: Shoulder UCLA (University of California Los Angeles) scoring system was used to assess the shoulder joint function of all subjects, before and after the treatment. This system covers subjective satisfaction, muscle strength and angle at lifting, shoulder function, and pain assessment [8, 9]. The total score was 35 points. Scores of 34-35 points indicated excellent results, 28-33 points indicated good, 21-27 points indicated fair, and scores below 20 points indicated poor results. The score was positively correlated with shoulder joint strength [10].

Constant rating (European Society for Shoulder and Elbow Surgery): The total score was 100 points, consisting of pain, daily life activity, range of movement, and muscle strength. Subjective and objective components in the constant score system were 35/65, including 15 points for pain, 20 points for daily activities, 40 points for shoulder joint range, and 25 points for strength test. Scores above 90 points were excellent, 80-89 was good, 70-79 was fair, and scores below 70 points were poor, indicating that the patient needed medical treatment immediately. Higher scores indicated better shoulder joint function.

Muscle strength of abduction and forward flexion of all subjects was recorded, before and after treatment. According to clinical muscle strength grading standards [11, 12], muscle strength included grades 0, 1, 2, 3, 4, and 5. Grade 0 represented unpredicted muscle contractions, grade 1 was for slight contractions without joint activity, grade 2 was for joints moving in a full range with weight support, grade 3 was for resisting against gravity, but not resistance, grade 4 was for resisting both gravity and resistance, and grade 5 was able to resist gravity and resist resistance fully [13].

Recurrence rates of dislocation of all subjects were calculated in one-year follow-ups.

Statistical methods

SPSS24.0 was used to analyze data. Measurement data are expressed as mean ± stan-

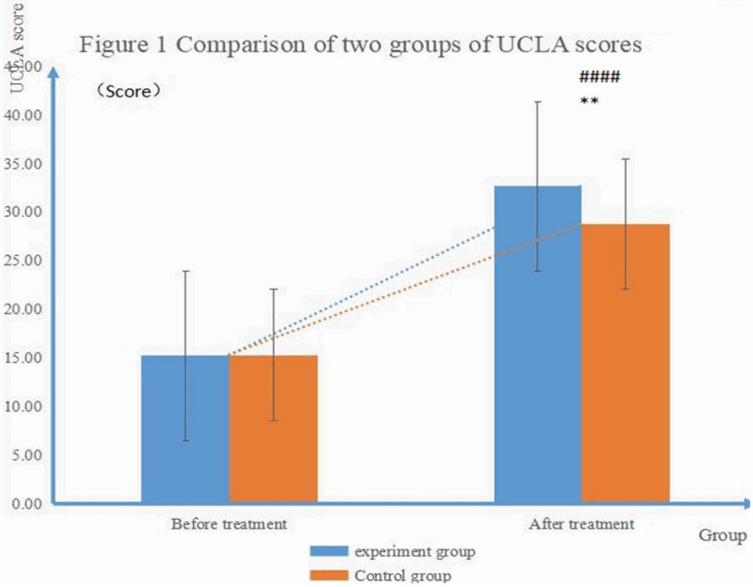

Figure 1. Comparison of UCLA scores The ordinate is the UCLA score. Shoulder function score at UCLA #### indicates in the experiment group, the degree of difference before treatment ** indicates between the two groups, the degree of difference after treatment.

dard deviation (mean ± sd). Independent *t*-test was used for two independent samples and paired t-test was used for self-matching comparisons. Enumeration data are represented by case number/percentage (n/%) and were analyzed by χ^2 test. P<0.05 indicates statistically significant differences.

Results

Comparison of baseline information

There were no statistical differences between the two groups regarding gender, age, average onset, MNA scores, COFIELD, and DEORIO rating criteria (all P>0.05), as shown in **Table 1**.

Comparison of abduction and forward bending activity of shoulder joint

There were no statistical differences between the two groups regarding abduction and forward bending activity of shoulder joints before treatment (both P>0.05). After treatment, the experiment group showed significantly higher indexes. Both groups showed higher activities after treatment than before treatment, with statistical differences (all P<0.05). Data are shown in **Tables 2** and **3**.

Comparison of VAS scores

There were no statistical differences between the two groups regarding VAS scores before treatment (P>0.05). After treatment, the experiment group showed significantly lower VAS scores, while both groups showed lower VAS scores than before treatment, with statistical differences (all P<0.05). Results are shown in **Tables 4** and **5**.

Comparison of NRS scores

There were no statistical differences between the two groups regarding NRS scores before treatment (P>0.05). After treatment, the experiment group showed significantly lower NRS scores, while both groups showed lower NRS scores than before treatment, with statistical differences (all P<0.05). Results are shown in **Tables 6** and **7**.

Comparison of UCLA scores

There were no statistical differences between the two groups in UCLA scores before treatment (P>0.05). After treatment, the experiment group showed significantly higher scores, while both groups showed higher UCLA scores than before treatment, with statistical differences (all P<0.05). Results are shown in **Table 8** and **Figure 1**.

Comparison of constant scores

There were no statistical differences between the two groups in constant scores before treatment (P>0.05). After treatment, the experiment group showed higher scores, while both groups showed higher scores than before treatment, with statistical differences (all P<0.05). Results are shown in **Table 9** and **Figure 2**.

Comparison of abduction and forward bending muscle strength

Before treatment, there were no statistical differences between the two groups regar-

Table 9. Comparison of constant scores

Groups	Before treatment (points)	After treatment (points)	*t*	P
Experiment group (n=75)	58.26±5.12	92.62±10.16	26.1547	<0.001
Control group (n=75)	58.33±5.16	79.88±8.16	19.3305	<0.001
t	0.0834	8.4668	-	-
P	0.9336	<0.001	-	-

Note: Constant, Constant Shoulder Score (European Society for Shoulder and Elbow Surgery).

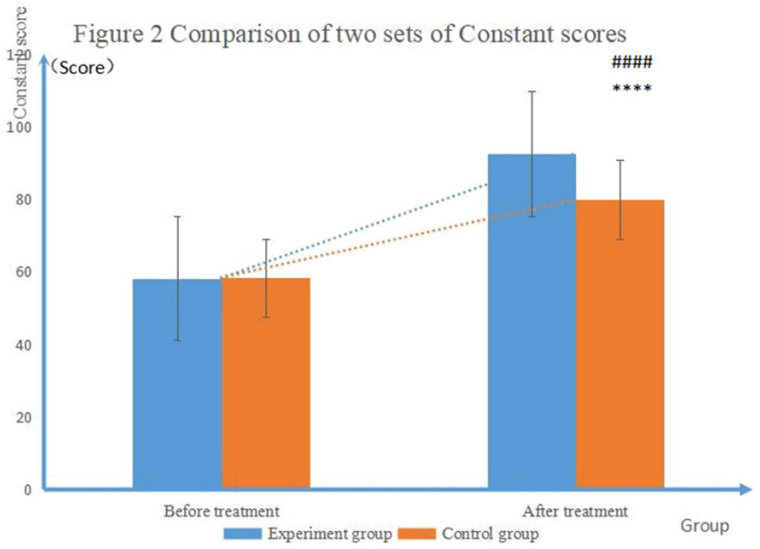

Figure 2. Comparison of constant scores The ordinate is the constant score. European Society for Shoulder and Elbow Surgery. #### indicates in the experiment group, the degree of difference before treatment. **** indicates between the two groups, the degree of difference after treatment.

ding abduction and forward bending muscle strength (both P>0.05). After treatment, muscle strength in the experiment group was significantly higher than in the control group. Both groups showed significantly higher muscle strength than before treatment, with statistically significant differences (all P<0.05). Results are shown in **Tables 10** and **11**.

Comparison of recurrence of dislocation

The experiment group had significantly lower recurrence of dislocation than the control group (2.67%, 16.00%), with statistical differences (P<0.05). Results are shown in **Table 12**.

Discussion

Shoulder joints are one of the most active joints in the human body. If the rotator cuff is damaged, it will certainly damage the stable structure of the shoulder joint, causing dislocation of the shoulder joint. Typical clinical features of patients with rotator cuff injuries are neck and shoulder pain, limited joint activity, and weakness of shoulder joints, significantly reducing the quality of life of patients [14, 15]. The main principles of clinical treatment of shoulder joint dislocation are to repair the damaged shoulder joint, restore its function and structure, and avoid further dislocation [16, 17]. However, the conservative treatment method of rehabilitation exercise has a general effect on traumatic shoulder joint dislocation combined with rotator cuff injuries. The recurrence rate of dislocation is very high with certain limitations.

With the rapid development of medical technology, the technique of suture bridge under arthroscopy, with good tendon control, has gradually been applied in clinic. Results of the present study showed that recurrence rates, VAS scores, and NRS scores of the experiment group were significantly lower than the control group. Present results suggest that the technique of suture bridge under arthroscopy can better reduce the pain of patients and, to some extent, reduce the possibility of recurrence of dislocation. This may be because, compared with other repair methods, the arthroscopic suture bridge technology has a larger bone-tendon contact area and higher initial fixation strength. To some extent, this reduces the probability of suture fracture and detachment of screws and prevents re-tearing [18, 19]. Clinical biomechanical tests have also confirmed that suture bridge repair technology has significantly higher fixed strength and safety than other repair technologies [20]. Therefore, the second operation rate of patients may be effectively reduced and the prognosis and quality of life may be significantly improved.

Table 10. Comparison of abduction muscle strength

Groups	Abduction muscle strength (°)		*t*	P
	Before treatment	After treatment		
Experiment group (n=75)	82.13±9.26	168.25±18.13	36.6354	<0.001
Control group (n=75)	82.18±9.33	105.26±11.14	13.7553	<0.001
t	0.0329	25.6360	-	-
P	0.9738	<0.001	-	-

Table 11. Comparison of forward bending muscle strength

Groups	Forward bending muscle strength (°)		*t*	P
	Before treatment	After treatment		
Control group (n=75)	86.26±6.17	166.15±17.66	36.9848	<0.001
Experiment group (n=75)	86.28±6.22	108.26±11.18	10.3227	<0.001
t	0.0198	23.9861	-	-
P	0.9843	<0.001	-	-

Table 12. Comparison of the two groups in recurrence of dislocation (n, %)

Groups	Recurrence of dislocation	
	Yes	No
Experiment group (n=75)	2 (2.67)	73 (97.33)
Control group (n=75)	12 (16.00)	63 (84.00)
χ^2	7.8781	
P	0.0050	

Suture bridge repair is a double-row internal fixation technique. It can minimize the space between tendons and bone, increasing the contact pressure and the area between them. This technique obtains the highest initial fixation force, thus speeding up the recovery speed of shoulder joint function [21, 22]. Results of this study revealed that shoulder flexion, bending, UCLA scores, constant scores, and abduction and bending strength were significantly higher in the experiment group than in the control group. Suture bridge repair technology significantly increased the healing area and promoted the healing of tendons and bones. Compared with conventional conservative treatment, the short-term and long-term efficacy of suture bridge repair technology has obvious advantages [23]. Results also suggest the feasibility and effectiveness of suture bridge repair technology in the treatment of traumatic shoulder dislocation with rotator cuff injuries. This technique deserves to be the preferred treatment method.

There were some limitations to the present study, however. These limitations included the small sample size and short research period, possibly affecting the generality of results. Therefore, clinical studies with larger sample sizes and longer research periods are still necessary, exploring the long-term efficacy of the suture bridge technique under arthroscopy.

In conclusion, this arthroscopic suture technique for patients with traumatic shoulder joint dislocation and rotator cuff injuries can effectively promote functional recovery of shoulder joints, reduce pain, and reduce recurrence rates of dislocation. It is safe and effective, with significant short-term and long-term effects.

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Disclosure of conflict of interest

None.

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