Short to Midterm Results of Arthroscopic Rotator Cuff Repair in Rajavithi Hospital

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Purpose: *Arthroscopic rotator cuff repair is the standard treatment for rotator cuff injury. This study aimed to determine functional outcomes after arthroscopic rotator cuff repair and assess the relationships between fatty degeneration, muscle atrophy, tendon retraction and clinical results after surgery.*

Methods: *Forty-six patients with rotator cuff injuries were treated with arthroscopic rotator cuff repair in Rajavithi Hospital between 2006 and 2012. Forty patients (17 men and 23 women) were examined at follow-up ranging from 12 to 96 months (average 46.13 months). Preoperative evaluation included clinical examination, plain radiograph and MRI. Plain radiographs were used to measure acromiohumeral distance, and MRI was used to assess fatty degeneration, muscle atrophy, and tendon retraction. Postoperative evaluations were made to assess pain, muscle power, ability to perform activities of daily living, and measure American Shoulder and Elbow Surgeons (ASES) scores at follow-up.*

Results: *Postoperatively, 33 patients had no pain, while 7 patients still had pain at night and usually took some pain killers. The success of the surgery was assessed using the visual analog scale (0-10), and the mean score was 9.50 (range 5-10). Pain scores decreased from 8.7 preoperatively to 1.1 at follow-up ($P<0.05$). Average ranges of motion were 173 degrees in flexion, 173 degrees in abduction, and 34 degrees in external rotation. Muscle power increased from 8 N preoperatively to 32 N at follow-up. Mean ASES scores improved significantly from 29.63 preoperatively to 91.27 at follow-up ($P<0.05$). The mean tendon retraction measurement was 23.17±13.02mm. There were relationships between tendon retraction and fatty degeneration ($P=0.007$) and between tendon retraction and muscle atrophy ($P<0.001$). The study was unable to identify any relationships between rotator cuff pathology (fatty degeneration, muscle atrophy, and tendon retraction and postoperative functional outcomes (post operative ASES scores ($P=0.146, 0.473, 0.717$)), and muscle power ($P=0.515, 0.435, 0.484$)).*

Conclusion: *Arthroscopic rotator cuff repair reduced pain and improved patients' ability to carry out daily activities. Tendon retraction was related to fatty degeneration and muscle atrophy. No relationship was found between rotator cuff pathology and postoperative functional outcomes.*

Keywords: *Shoulder, rotator cuff tear, arthroscopic repair, Goutallier staging, tangent sign, tendon retraction*

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Introduction

The rotator cuff tendons are important in the movement of the shoulder joint in lifting up the arms at the first movement, and they give stability to the shoulder joint. Injury of the rotator cuff tendons is commonplace, especially in the elderly. The main cause is degeneration of the tendons, leading to tendon tear and mostly is not the cause of severe injuries. Rotator cuff tendon tear is a common cause of shoulder pain, weakness of the injured arm, and loss of joint movement capability[1-4]. Patients may feel pain at night, or when moving the shoulder, and may not be able to fully control the movement of the rotator cuff, causing shoulder joint stiffness.

There are several factors that need to be considered before performing a rotator cuff repair, including the patient's age, symptoms, behavior at work and in daily life, and disease progression. Rotator cuff repair surgery is extremely popular because it can return the torn tendon to its footprint. Previous studies have found that rotator cuff repair can reduce pain, increase muscle strength, and enable the injured arm to be used normally[5]. Rotator cuff repair can be carried out using open or arthroscopic rotator cuff repairs. The arthroscopic technique is very widely used because

it reduces postoperative pain, shortens the rehabilitation period, and results in a smaller surgery wound.

However, the repaired tendon may have recurrent tearing varying from around 20% to 94%[1, 6-10]. Factors affecting the treatment of rotator cuff tear include tear size, tendon retraction range, number of torn tendons, quality of torn tendons, and ability to repair the tendons back to their footprint. If the largest dimension of the tear is more than 5 cm[11], or if there are more than 2 affected tendons[12], a diagnosis of massive rotator cuff tear is confirmed which is difficult to repair and often results in unsatisfactory surgical outcomes.[1] There are some cases in which the tendons cannot be fully repaired because they have already shrunk too much from their footprint. Previous studies have shown that partial repair is relatively effective because it is able to improve functional scores and range of motion[3, 9, 13].

Tearing of rotator cuff tendons can cause tendon retraction which results in loss of muscle tension, and this causes muscle degeneration. Magnetic resonance imaging is used to view the appearance of fatty infiltration in the muscle (fatty degeneration).[14] Fatty degeneration has 5 levels of severity, and the severity of fatty degeneration has been found to be related to the results of surgery and the occurrence of retear after the tendon has been repaired[15]. Furthermore, it also causes muscle atrophy, and it can have a major impact on surgery results[16].

Chronic rotator cuff tears cause medial muscle contractions which impact the rotator cuff repair's ability to bring the tendons back to the anatomical footprint. The muscle contracture and adhesion contracture may cause difficulty in pulling and stretching the tendons, as they contain a lot of tension. Performing rotator cuff repair while there is high tension in the tendons may increase the risk of retear[17- 21].

Rajavithi Hospital is a tertiary hospital that receives referral patients from various hospitals under the care of the Ministry of Public Health across the country. Rajavithi Hospital has treated patients with rotator cuff tear using the arthroscopic rotator cuff repair method since 2006. The purposes of this study were to study the outcomes of rotator cuff tear repair using the arthroscopic technique in Rajavithi Hospital, and to compare the results of rotator cuff repair in patients with muscle retraction and muscle atrophy.

Patients and methods

A retrospective study was performed to investigate the results of treatment for rotator cuff injury by arthroscopic rotator cuff repair in Rajavithi Hospital.

Inclusion criteria

Patients were included in the study who had been admitted to Rajavithi Hospital, were diagnosed with rotator cuff tear by physical examination, radiographs, or magnetic resonance imaging, and who underwent arthroscopic rotator cuff repair in Rajavithi Hospital between January 1st 2006 and December 31st 2012.

Surgical techniques

- The patients were placed in the beach chair position (Fig. 1) and received general anesthesia. Bleeding was reduced by controlling blood pressure with systolic pressure at 100 mmHg., and intra-articular pressure was maintained using a water pressure adjustment device set at 40 mmHg.
- Sterile and waterproof plastic sheets were used.
- Lines were drawn to locate the bone position and portal for insertion of an arthroscopic camera and tools using the posterior portal, anterior portal, middle working portal and rear working portal.
- Subacromial bursectomy was performed to allow clear vision and to provide space for surgery. Subacromion decompression was used in cases of an acromion spur.
- The size and form (crescent, U-shaped, or L-shaped) of the tendon tear was estimated together with the tendon contracture and the ability to stretch and pull the tendon back to the anatomical footprint.
- The positions for insertion of the suture anchors were marked, setting the suture anchors about 1cm apart from each other.
- In the case of a U-shaped massive tear, margin convergence was sutured, stitching the sides of the tear areas together first to reduce tendon tension and perform a single-row repair with a suture anchor (Fig. 2).
- In cases of medium tear, rotator cuff repair was performed using the double-row technique (Fig. 3).
- The range of motion was rechecked before the wound was closed.

Fig. 1 Patients in beach chair position and portal. The portal placements were defined as (a) anterosuperior portal (b) anterolateral portal (c) lateral portal (d) posterior portal

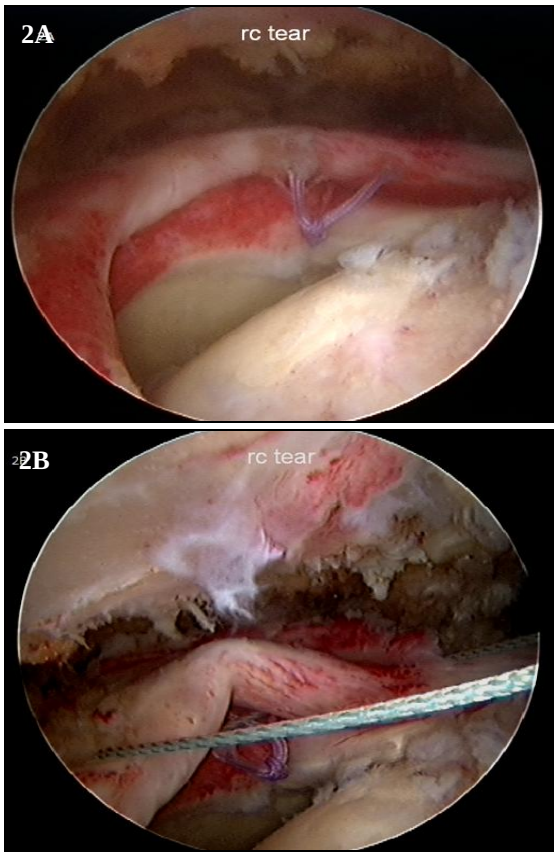
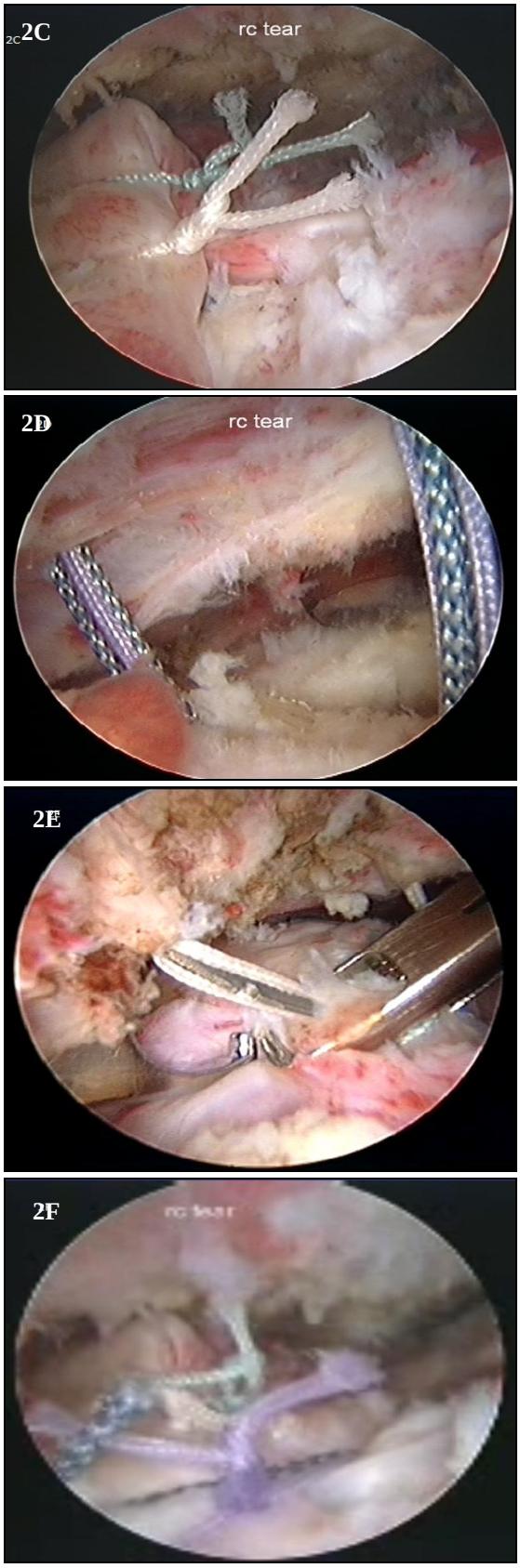


Fig. 2 Massive rotator cuff tear. (A) U-shape massive tear (B) side-to-side suture (C) side-to-side repair (D) two suture anchors were inserted (E) single-row repair by suture passer device (F) after single-row repair



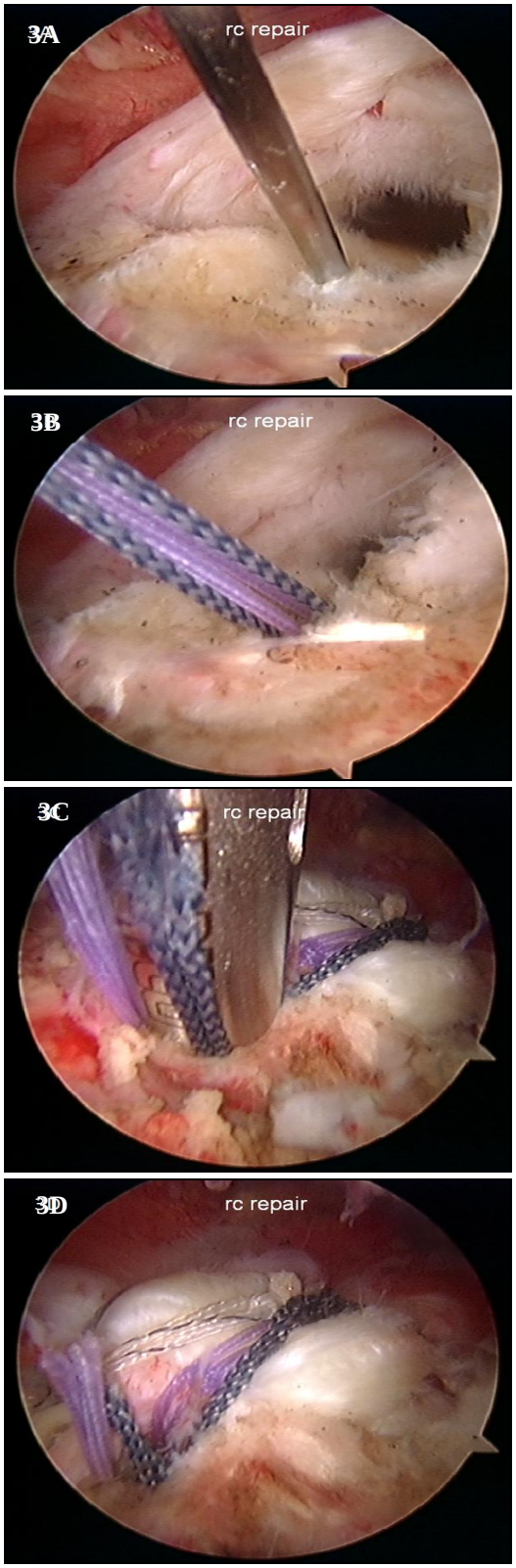


Fig. 3 Medium rotator cuff tear. (A) medium rotator cuff tear (B) suture anchors inserted (C) double-row fixation (D) after double-row repair

Rehabilitation Protocol

The use of a shoulder-immobilizing sling with an abduction pillow was prescribed, and instructions were given to maintain the shoulder at 30 to 40 degrees of internal rotation and 20 degrees of abduction for 6 weeks.

Postoperative(weeks)	Activity
0-2 weeks	• Cold compression • Pendulum exercises • Range of motion - wrist and hand exercises • Range of motion - elbow exercises • Passive and active assisted range of motion forward flexion 0-90 degrees of shoulder joint • Passive and active assisted range of motion external rotation to neutral position of shoulder joint
3-4 weeks	• Passive and active assisted range of motion forward flexion 0-130 degrees of shoulder joint • Passive and active assisted range of motion external rotation to 30 degrees of shoulder joint
5-6 weeks	• Passive and active assisted range of motion forward flexion 0-180 degrees of shoulder joint • Passive and active assisted range of motion external rotation to 60 degrees of shoulder joint

Postoperative(weeks)	Activity
7-8 weeks	• Progress active range of motion forward flexion to full after 8 weeks • Progress active range of motion abduction to full after 8 weeks
9-12 weeks	• Resistance strengthening exercises using rubber rope
> 12 weeks	• Deltoid and rotator cuff strengthening

Analysis

- Treatment results were evaluated taking into account pain, function of shoulder, and strength of the affected arm for at least 12 months after the surgery.
- Pain in the affected shoulder was assessed using the visual analog pain scale of 0-10, where 0 represents no pain and 10 represents the maximum pain.
- Functional evaluation was performed using the American Shoulder and Elbow Surgeons (ASES) score[27] with scores of 0-100, where 0 represents no ability to do any activity and 100 represents great ability to do various activities.
- The strength of the affected arm was measured by letting the patient perform weight lifting in the shoulder abduction position and internal rotation position, increasing the weight by 0.5 kg each time. The heaviest weight that the patients were able to lift as high as their shoulders was recorded.
- Imaging of the patient's shoulder in the shoulder anteroposterior view was used to measure acromio-humeral distance, and in the supraspinatous outlet view to evaluate acromion type.
- Magnetic resonance imaging was used to evaluate fatty degeneration and muscle atrophy[22], and to measure tendon retraction.
- Fatty degeneration was evaluated according to the Goutallier classification system[23-24] using the T1 weighted sagittal section, where stage 0 represents normal condition, stage 1 represents a small amount of fat, stage 2 signifies fatty infiltration less than muscle, stage 3 indicates as much fat as muscle, and stage 4 represents more fat than muscle.
- Supraspinatus muscle atrophy was measured using Tangent sign[25], the line from the peak of the coracoids to the peak of the scapula spine. It is considered negative when supraspinatus muscle is higher than this line, and positive when it is lower.
- Tendon retraction[26] was evaluated using the T2 weighted oblique coronal section. From the center of the supraspinatus tendon, a line was drawn between the supraglenoid and infraglenoid tubercles, then another perpendicular line was drawn from this line to the edge of the articular cartilage. Finally the retraction range was measured at these parallel lines.

Statistical Analysis

Statistical analysis was performed using SPSS 17.0. Paired *t*-tests were used to assess pain scores (visual analog scale, VAS), American Shoulder and Elbow Surgeons (ASES) scores, and muscle power before and after surgery. The relationships between fatty degeneration, muscle atrophy, tendon retraction, postoperative ASES scores, and muscle power were determined using the Spearman' rho correlation test. A *P*-value <0.05 was considered statistically significant.

Results

A total of 46 patients were diagnosed with a rotator cuff injury and received arthroscopic rotator cuff repair from January 1st 2006 to December 31st 2012 and 40 of these were included in this study. Their demographic characteristics are shown in Table 1.

Postoperatively, 33 patients showed no sign of pain and did not need to use pain killers. The other 7 patients still had pain at night and usually took some pain killers. The surgery success was measured by the visual analog scale (0-10), and the mean score was 9.50 (range 5-10).

Results of the Visual Analog Scale (VAS), American Shoulder and Elbow Surgeons (ASES) score[27], muscle power and postoperative range of motion of the affected shoulder joint are shown in Tables 2 and 3.

Table 1 Patient Demographic data

Age (Mean±SD), years.	55.54±10.07
Male Gender, n (%)	17 (42.5%)
Site of surgery Right, n (%)	31 (77.5%)
Dominant site, n (%)	33 (82.5%)

Table 2 Comparison of preoperative and postoperative pain scores, ASES score, and Muscle power

	Preoperative	**Postoperative**	***P*-value**
Pain score by VAS [0-10], mean	8.7	1.1	< 0.05
ASES score [0-100], mean	29.63	91.27	< 0.05
Muscle power (Kg), mean	0	3.2	< 0.05

VAS = Visual Analog Scale.
ASES = American Shoulder and Elbow Surgeons score.

Table 3 Mean values of postoperative range of motion of affected shoulder joints

Range of motion	**Average (degrees)**	**Range (degrees)**
Forward flexion	173	160-180
Abduction	173	160-180
External rotation	34	0-60

Radiographic findings

- Acromio-humeral distance 7.55±3.08 mm. (1.3-12)
  - AHD > 7 29 patients (72.5%)
  - AHD < 7 11 patients (27.5%)
  - AHD < 5 10 patients (25%)
- Acromion type
  - Flat type 24 patients (60%)
  - Curve type 5 patients (12.5%)
  - Hook type 11 patients (27.5%)
- Fatty degeneration according to Goutallier staging
  - Stage I 11 patients (27.5%)
  - Stage II 8 patients (20%)
  - Stage III 11 patients (27.5%)
  - Stage IV 10 patients (25%)
- Muscle atrophy by Tangent sign
  - Negative 28 patients (70%)
  - Positive 12 patients (30%)
- Tendon retraction, mean 23.17±13.02 mm.

There were relationships between tendon retraction and fatty degeneration (P=0.007), between fatty degeneration and muscle atrophy (P<0.001), and between tendon retraction and muscle atrophy (P<0.001). The study was unable to identify any relationship between rotator cuff pathology (fatty degeneration, muscle atrophy, and tendon retraction) and postoperative functional outcomes (post operative ASES scores (P=0.146, 0.473, 0.717), and muscle power of the affected arm (P=0.515, 0.435, 0.484)). No complications such as wound infection or death were found.

Discussion

Rotator cuff tendon tear is a degenerative process which is commonly found in elderly populations. This research involved patients with rotator cuff tendon tears aged 55.54±10.07 years (range 36-69), and a total of 23 women (57.5%) and 17 men (42.5%) participated in the study. Thirty-one patients had pathological right arms (77.5%), and 33 patients were right arm dominant (82.5%).

Rotator cuff injuries can prevent patients from leading a normal life. It was found that before surgery, the patients' average pain score was 8.7 which is a relatively serious pain. It was also clear from their ASES score of 29.63 that the patients were unable to perform a number of daily activities. Rotator cuff repair by reinserting tendons into their footprint helps to relief the patients' pain. Their postoperative VAS score of 1.1 shows that most of the patients no longer needed pain killers. They had improved quality of life, and they were able to perform many routine activities, as witnessed by their postoperative ASES score of 91.27; furthermore, the patients also had better muscle strength and could lift objects with an average weight of 3.2 kg. The range of motion of the affected shoulder joint after the surgery was close to normal because it could be moved almost normally, and could be used to perform various activities.

Acromio-humeral distance is associated with rotator cuff injuries. The study found that an acromio-humeral distance of less than 7 mm was associated with the occurrence of a rotator cuff tear. Also, an acromio-humeral distance of less than 5 mm was associated with the occurrence of massive rotator cuff tears. This study also found that 11 patients (27.5%) had acromio-humeral distances of less than 7 mm., and 10 patients (25%) had acromio-humeral distances of less than 5 mm.

Radiographs in the supraspinatus outlet view were used to evaluate the nature of the acromion and showed that a hook type acromion was associated with the occurrence of rotator cuff tears. The study found that 5 patients had an acromion of the curve type (12.5%), 24 patients had a flat type (60%), and 11 patients had a hook type (27.5%). However, estimating the acromion type by supraspinatus outlet view is inaccurate due to the lack of sensitivity of radiography and the subjective nature of its interpretation.

Fatty degeneration can indicate chronic rotator cuff tear. A significant amount of fatty degeneration will cause a reduction in the tendon quality, an inability to control the muscles normally which affects the patients' routine task performance, and an increased risk of tendon retear. According to the Goutallier classification, fatty degeneration, which is equal to or more than stage 3 is associated with poor treatment outcomes. This study found that 19 patients had fatty degeneration at stage 1-2 (47.5%), and 21 patients had stage 3-4 (52.5%).

Muscle atrophy within chronic rotator cuff tear is associated with poor treatment outcomes. This study used the Tangent sign to evaluate muscle atrophy. The study found that 28 patients (70%) had negative Tangent sign results, and 12 patients (30%) had positive Tangent sign results.

Chronic rotator cuff tendons and muscle tear cause retraction. The more muscle retraction, the more difficult repair is; sometimes, it may actually be impossible . Furthermore, muscle retraction is also associated with a risk of tendon retear. Currently, there is no standard method for measuring muscle retraction. This study found that there was a mean muscle retraction of 23.17±13.02 mm.

No relationship was found between tendon retraction and fatty degeneration, muscle atrophy and postoperative ASES scores, or muscle power of the affected arm. This is because in massive rotator cuff tears, we meticulously debrided and mobilized the retracted tendon with side-to-side and single-row repair with a tension-free technique.

Conclusions

Rotator cuff repair surgery can significantly reduce pain and allows patients to use their injured arms more effectively. No relationship was found between rotator cuff pathology and postoperative functional outcomes.

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ผลระยะกลางของการผ่าตัดเย็บซ่อมเส้นเอ็นรอบข้อไหล่ผ่านกล้องในโรงพยาบาลราชวิถี

พินิจ ศรีสุวรรณภรณ์, พบ, สิทธิพร กำจัดภัย, พบ, รุ่งโรจน์ ปัญญาสกุลวงศ์, พบ, สุกรม ชีเจริญ, พบ, วีระ ปรีชา, พบ

วัตถุประสงค์: *การบาดเจ็บของเส้นเอ็นรอบข้อไหล่ทำให้ผู้ป่วยมีอาการปวดและอ่อนแรง ไม่สามารถใช้งานแขนข้างนั้นได้ตามปกติ การรักษาโดยการผ่าตัดเย็บซ่อมเส้นเอ็นรอบข้อไหล่ผ่านกล้อง ทำให้ผู้ป่วยหายปวด มีกำลังกล้ามเนื้อดีขึ้น สามารถใช้งานแขนข้างนั้นได้ และมีคุณภาพชีวิตที่ดีขึ้น วัตถุประสงค์ของการศึกษานี้เพื่อประเมินผลระยะกลางของผู้ป่วยที่เข้ารับการผ่าตัดเย็บซ่อมเส้นเอ็นรอบข้อไหล่ผ่านกล้องในโรงพยาบาลราชวิถี*

วิธีการศึกษา: *ผู้ป่วยจำนวน 46 ราย ได้รับการผ่าตัดเย็บซ่อมเส้นเอ็นรอบข้อไหล่ผ่านกล้อง ในโรงพยาบาลราชวิถี ตั้งแต่ มกราคม 2549 ถึง ธันวาคม 2555 ผู้ป่วยมารับการตรวจติดตามผลการรักษาหลังผ่าตัดตั้งแต่12เดือนถึง 96 เดือน (เฉลี่ย 46.13 เดือน)จำนวน 40 ราย ชาย 17 ราย และหญิง 23 ราย การบาดเจ็บเป็นในแขนข้างที่ถนัด 33 ราย ก่อนผ่าตัดผู้ป่วยจะได้รับการประเมินเกี่ยวกับอาการปวด กำลังของกล้ามเนื้อรอบข้อไหล่ข้างที่บาดเจ็บ การใช้ชีวิตประจำวัน และ ASES score ภาพรังสีได้รับการประเมินซ้ำ และวัดระยะห่างจากหัวกระดูกต้นแขนถึงกระดูกสะบักส่วนบน(acromio-humeral distance) acromion type และประเมินภาวะไขมันแทรกกล้ามเนื้อโดย Goutallier staging, Tangent sign และวัดระยะหดสั้นของเส้นเอ็นรอบข้อไหล่ (tendon retraction) ด้วยภาพคลื่นแม่เหล็กไฟฟ้า*

ผลการศึกษา: *ผู้ป่วยที่รับการผ่าตัดจำนวน 40 ราย มีอายุเฉลี่ย 56 ปี ผู้ป่วยจำนวน 33 ราย ไม่มีอาการปวด และไม่ต้องรับประทานยาบรรเทาอาการปวดสำหรับไหล่ข้างที่ได้รับการผ่าตัด ผู้ป่วย 7 ราย ยังมีอาการปวดตอนกลางคืน และยังต้องรับประทานยาบรรเทาอาการปวดเป็นประจำ visual analog scale ก่อนผ่าตัด 8.7 หลังผ่าตัด 1.1 (P<0.05), ASES score ก่อนผ่าตัด 29.63 หลังผ่าตัด 91.27 (P<0.05), กำลังกล้ามเนื้อก่อนผ่าตัดผู้ป่วยสามารถยกลูกน้ำหนักได้ 0กิโลกรัม หลังผ่าตัดยกได้ 3.2กิโลกรัม (P<0.05), ผู้ป่วยมีความพึงพอใจในการผ่าตัด 9.50 (5-10), พิสัยการเคลื่อนไหวของแขนข้างที่ได้รับการผ่าตัด forward flexion 173 องศา Abduction 173องศา External rotation 34 องศา กำลังของกล้ามเนื้อรอบข้อไหล่ดีขึ้นจาก 8 นิวตัน เป็น 32 นิวตัน พบว่า tendon retraction มีความสัมพันธ์กับการเกิด fatty degeneration (P= 0.007) และ muscle atrophy(P< 0.001) แต่ไม่พบความสัมพันธ์ระหว่าง fatty degeneration, muscle atrophy หรือ tendon retraction กับ post-operative ASES score และ muscle power ของแขนข้างที่ได้รับการผ่าตัด*

สรุป: *การผ่าตัดเย็บซ่อมเส้นเอ็นรอบข้อไหล่ผ่านกล้อง สามารถลดอาการปวดและทำให้ผู้ป่วยสามารถใช้แขนข้างที่มีการบาดเจ็บได้ดีขึ้นอย่างมีนัยสำคัญ ไม่พบความสัมพันธ์ระหว่างการเกิด fatty degeneration, muscle atrophy, tendon retraction กับ functional outcome ของผู้ป่วยหลังการผ่าตัด*