1  RAT ROTATOR CUFF REPAIR USING A CELL SHEET
COMPOSED OF HUMAN ROTATOR CUFF DERIVED CELLS
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We developed a cell sheet constructed with rotator cuff (RC) derived cells and examined its therapeutic effect on prompt healing after RC repair in rat models. RC derived cells were isolated from human RC tissue, and a cell sheet was made using temperature-responsive culture plates (UpCell). For animal models, we made rotator cuff injury in the bilateral infraspinatus tendons of 12 immunodeficient rats, and repaired them by McLaughlin method. The repaired RC in the right shoulder was covered with a cell sheet (sheet group), and no additional treatment was given in the left shoulder (control group). In Sheet group at week 4 after operation, numerous chondrocytes at the repaired sites were confirmed by Toluidine blue staining, and Immunofluorescence staining for type II collagen and Isolectin B4 around the repaired sites showed more positive stained cells in the sheet group than the control group. Moreover, immunofluorescence staining for human specific CD31 displayed some positive cells in the sheet group. In the mechanical test, significantly higher tensile strength was seen in the sheet group than in the control group at week 8. Our results indicated that RC derived cell sheet could promote type II collagen synthesis and angiogenesis at around the RC repaired sites, resulting in enhancement in biomechanical strength in the repaired RC. The new treatment using RC derived cell sheet could become a promising strategy for superior and faster recovery in patients requiring RC repair.

2  COMPENSATORY CHANGE OF BRAIN IN RECURRENT ANTERIOR SHOULDER DISLOCATION -fMRI STUDY-
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It was revealed that the reorganization of the central nervous system (CNS) has occurred in not only brain disorders but also in spinal and musculoskeletal diseases. Then, the importance of considering the effect of CNS in orthopedic diseases was recognized. However, there was no research about compensatory change of the brain in RSI using functional magnetic resonance imaging (fMRI). Ten healthy volunteers (N-group) and 10 RSI patients (P-group) participated in this study. Brain activation was examined by fMRI technique. We applied active (AM) and passive (PM) shoulder motion task and motor imagery (MI) task during fMRI. In AM, there was significant activation in the left primary motor cortex, bilateral inferior parietal lobules, supplemental motor area (SMA) and bilateral cerebellum (P-group minus N-group). During imagery of maintenance of heavy kettle in shoulder abduction in MI, there was significant activation in the left premotor cortex, SMA, right cerebellum, right amygdala and left fusiform gyrus (P-group minus N-group). During passive external rotation at abduction in PM, there was significant activation in the right premotor cortex (N-group minus P-group). This study reveals that RSI can cause reorganization of the CNS, suggesting that such an injury might be regarded as a neurophysiologic dysfunction, not a simple peripheral musculoskeletal injury. This evidence could explain clinical symptoms that accompany this type of injury and lead to severe dysfunction.

3  THE EFFECT OF LOW-INTENSITY PULSED ULTRASOUND FOR TENOGENESIS OF HUMAN ROTATOR CUFF CELLS
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Introduction: Low-intensity pulsed ultrasound (LIPUS) has been used for fracture healing and its effectiveness has been confirmed. To prevent re-tear of the repaired rotator cuff, it is important to regenerate the tendon-to-bone interface after rotator cuff repair. Therefore, we have investigated the effect of LIPUS on human rotator cuff derived cells hypothesizing that their tenogenesis would increase by LIPUS exposure. Method: The human rotator cuff derived cells were adapted to a six well plate. The cells were divided into the two groups. In the LIPUS group, LIPUS was applied for 20 minutes every day for 5 and 10 days. Cells without LIPUS acted as a control group. Then they were analyzed by real time PCR analyses. Results: In the LIPUS group, the expressions of Scleraxis and Collagen I were higher than those in the control group at 5 and 10 days. In addition, expression of Collagen III was higher than that in the control group. Discussion: This study showed that the tenogenesis of human rotator cuff derived cells was increased by LIPUS exposure. These results could have the way for rotator cuff repair with early healing of the tendon-to-bone interface by LIPUS exposure.

4  THE ROLE OF OXIDATIVE STRESS ON DEGENERATION OF ROTATOR CUFF ENTHESIS-AN ANALYSIS OF THE EFFECT OF AN ANTI-OXIDANT TREATMENT
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Purpose: Rotator cuff degeneration is one of the multiple factors that lead to rotator cuff tear, but the mechanism of degeneration still remains unclear. Last year, we reported that an antioxidant enzyme, Superoxide dismutase 1 (Sod1), deficiency in mice induced degeneration changes in supraspinatus tendon enthesis, recapitulating the human rotator cuff degeneration. In this study, we analyzed the effect of antioxidant treatment for the degeneration changes to confirm the link between oxidative stress and rotator cuff degeneration. Method: We administered Vitamin C (1%) or vehicle in drinking water to wild-type (WT) and Sod1-/- male mice from 12 weeks of age for 8 weeks (N=3-4 / each group). At 20 weeks of age, we made histological sections of supraspinatus enthesis and performed immunohistochemical analysis of type II and type III collagen. Results: This study showed that the tenogenesis of human rotator cuff derived cells was increased by LIPUS exposure. These results could have the way for rotator cuff repair with early healing of the tendon-to-bone interface by LIPUS exposure.

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OR 2005). Results: In vehicle drinking group, Sod1-/- mice showed a decrease in the evaluation parameters, number of chondrocytes, the percentage of aligned chondrocytes, the area of fibrocartilage and spatial arrangement collagen fibers, compared to WT mice. Furthermore, in Sod1-/- mice, vitamin C treatment significantly increased these parameters compared to vehicle group and improved to the same level as WT mice. In WT mice, no difference was observed between vitamin C and vehicle group. Conclusion: Sod1-/- mice showed decreases of histologic evaluation parameters and vitamin C treatment improved the reduction of these parameters. These results suggest that oxidative stress induced degeneration of supraspinatus enthesis.

5 3D-ULTRASTRUCTURAL ANALYSIS AT REPAIRED SUPERSPINATUS TENDON/BONE INSERTION IN RAT Tomonoshin Kanazawa, Masafumi Gotoh, Hidehiro Nakamura, Naoto Shiba, Kensei Nagata, Division of Microscopic and Development Anatomy, Department of Anatomy, Kurume University School of Medicine; Department of Orthopaedic Surgery, Kurume University School of Medicine; Department of Orthopaedic Surgery, Kurume University Medical Center

Introduction: To obtain a successful outcome after rotator cuff repair, repaired tendon requires to be anchored biologically to the bone. Initially, the repaired tendon-bone interface is mechanically weak, and its histological structure is totally different from that of the normal insertion. Recently, a new scanning electron microscopic method (FIB/SEM tomography) has been developed; therefore, we analyzed the ultrastructure of the repaired supraspinatus tendon-bone insertion in rat using this method. Materials and methods: Acute rotator cuff repair model was made using adult SD rats. The repaired supraspinatus tendon-bone interface was observed at 2 and 4 weeks after the surgery. The supraspinatus tendon insertion of age-matched adult SD rats was used as normal control. Results: Normal tendon-bone insertion The ultrastructure of the normal supraspinatus tendon-bone insertion was smooth. The cells were arranged regularly with their cell processes oriented to the longitudinal direction of the collagen bundles. Repaired tendon-bone interface The fibro-vascular tissue, which had no linkage to the bone, intervened between the tendon and the bone without cartilage formation. At 2 weeks after the surgery, the cells in the fibro-vascular tissue were arranged irregularly: At 4 weeks, part of the cells became arranged regularly and participated in linkage between the fibro-vascular tissue and the bone, extending their processes to the tendon side. Conclusion: In light of ultrastructural data obtained from this study, we suggest that at 4 weeks after the surgery, the repaired supraspinatus tendon-bone insertion continues to be immature and biologically weak.

6 INHIBITORY EFFECT OF PLATELET RICH PLASMA ON ADIPOGENESIS OF ROTATOR CUFF-DERIVED CELLS Yutaoka Mifune, Takeshi Kubuki, Atsuyuki Inui, Tomoyuki Muto, Yoshifumi Harada, Fumiaki Takase, Isser Nagura, Masahiro Kurosaka, Department of Orthopaedics, Kobe University Graduate School; Kobe Rosai Hospital

Fatty degeneration was frequently seen in patients with chronic massive rotator cuff (RC) tears. Surgical outcomes of the rotator cuff repair are deteriorated in cases with severe fatty muscle degeneration. Recently, Platelet rich plasma (PRP) was reported to suppress adipogenesis within the marrow. Furthermore, PRP can induce human tenocyte proliferation and collagen synthesis. Based on these backgrounds, we hypothesized that PRP could suppress adipogenesis of RC-derived cells. Human tissues were obtained from torn edges of human supraspinatus tendons during arthroscopic RC repair. For PRP preparation, 4 systemically healthy volunteers participated in this study, and PRP was prepared following the protocol of double spinning method. After cells were cultured in standard medium for 3 days, the cells were subjected to the following 2 kinds of treatment for 3 weeks, 1) adipogenic medium + 10% PRP (PRP group) and 2) adipogenic medium alone (Control group). Cell viability was measured by WST assay, and adipogenic differentiation was evaluated by real time PCR for adipogenic markers and Oil red-O staining. The cell viability in PRP group was significantly greater than that in the Control group. The real-time PCR revealed that the expressions of adipogenic markers were significantly suppressed in PRP group compared to the Control. Oil red-O staining showed that the number of positive cells in PRP group was significantly less than that in the Control. We firstly reported that PRP could suppress adipogenesis of RC-derived cells without inhibiting cell viability in vitro. Further animal studies will be needed to assess the in vivo effect of PRP on adipogenesis within RC.

7 THE COMPENSATORY HYPERTROPHY OF THE INFRASPINAUS MUSCLE IN ROTATOR CUFF TEAR MODEL RATS Tsuoshiki Ichinoose, Atsushi Yamamoto, Tsutomu Kobayashi, Hitoshi Shiota, Daiisko Shiomoya, Toshihisa Osawa, Noriyuki Koibuchi, Kenji Takagoshi, Department of Orthopedic Surgery, Gunma University Graduate School of Medicine; National Hospital Organization Takasaki General Medical Center; Department of Integrative Physiology, Gunma University Graduate School of Medicine

Purpose: The purpose of our study was to determine if the compensatory hypertrophy of the remaining muscles and the acceleration of this process are caused by exercise using RCT model rats. Methods: Forty male Wistar rats with a body weight of 220-260g were used in this study. The rats were divided into two groups, and all underwent detachment of the Supraspinatus tendon. One group was forced to run on the treadmill from day 14 after the surgery (exercise group), and the other group was allowed cage activity (sedentary group). Rats were sacrificed 0, 14, 28 and 56 days after the surgery, and the infraspinatus (ISP) muscles were collected to investigate the weight and the gene expression of IGF-1 and its receptor. Results: The weight of the ISP muscle in the sedentary group had increased significantly at 28 days compared to day 0 after the surgery. On the other hand, the weight of the ISP muscle in the exercise group had increased significantly at both 28 and 56 days compared to day 0. The IGF-1 mRNA and IGF-1 receptor mRNA expression levels only increased significantly in the exercise group. Discussion: Past studies showed that rats which had ablated soles and gastrocnemius muscles showed sufficient hypertrophy of the remaining plantar muscle. In this study, the weight of the ISP muscle showed a temporary increase in the sedentary group. However, these results indicated that exercise intervention can facilitate and prolong the hypertrophy process and the expression of muscle hypertrophy-related genes.

8 CYTOTOXIC EFFECTS OF CORTICOSTEROIDS, LIDOCAINE AND HYALURONIC ACID ON FIBROBLASTS DERIVED FROM TORN HUMAN ROTATOR CUFF TENDON Hidehiro Nakamura, Masafumi Gotoh, Hideaki Shibata, Tomonoshin Kanazawa, Yasuhiro Mitsui, Fujo Higuchi, Naoto Shiba, Department of Orthopaedics, Kurume University; Department of Orthopaedics, Kurume University Medical Center; Division of Microscopic and Developmental Anatomy, Department of Anatomy, Kurume University School of Medicine

Introduction: Injections of corticosteroids (CS), lidocaine (LD), and hyaluronic acid (HA) are commonly used in the treatment of rotator cuff tears; however, little has been clarified, with regards to the cytotoxic effects of these drugs on the fibroblasts derived from torn human rotator cuff tendons. Purpose: The purpose of this study...
was to determine the cytotoxic effects of CS, LD, and HA on human tendon fibroblasts derived from rotator cuff tears in vitro. Methods: Seven patients with rotator cuff tears were the subjects of this study. The tendinous tissue was harvested during surgery, and cultivated in DMEM. The cultured fibroblasts were exposed to 24h to the presence of CS, LD, or HA (1.0, 0.5, 0.1 and 0.01mg/ml, respectively). The cytotoxicity to the cells was evaluated using MIT assay, fluorescence-activated cell sorting (FACS), and Live/Dead cell counts with a fluorescence microscope. Result: The MIT assay showed that CS and LD significantly decrease cell proliferation in a dose-dependent manner, compared with no inhibition with HA (p<0.01). The cell proliferation was significantly inhibited in CS-treated cells compared to the cells treated by LD at 1.0, 0.5, and 0.1mg/ml (p<0.01). Similar results were obtained from FACS quantification and Live/Dead cell counts analysis, under conditions treated at 1.0mg/ml. Conclusion: We found that the cytotoxicity is strongest in CS-treated fibroblasts derived from torn rotator cuff tendon, compared with the cells treated by LD or HA. Therefore, CS should be used carefully when performing intra-bursal/articular injections in the treatment of rotator cuff tears.

9 ELASTICITY OF THE ROTATOR CUFF TENDON BECOMES HARD AFTER ARTHROSCOPIC SURGERY: EVALUATION BY ULTRASOUND ELASTOGRAPHY
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Purpose: In order to prevent re-tear after surgery, the surgical techniques which have strong contact between the bone and tendon and a greater pull-out strength have been used recently. Whereas the initial pull-out strength increases, the tendon may lose the inherent elasticity. We investigated the elasticity of the rotator cuff tendon after surgery with use of ultrasound elastography. Materials and methods: Thirty-four patients (mean age, 59 years) with rotator cuff tears with mean follow-up period of 1.6 months were retrospectively reviewed. Twenty-four shoulders underwent arthroscopic cuff repairs; 10 shoulders had open repairs. They were examined using a linear-array transducer (Hi-vision Preirus, HITACHI). The elasticity of the superficial and deep layers of the supraspinatus tendon was measured with a newly developed coupler with known elasticity. Strain of the tissue was calculated from the color changes on the longitudinal images. The ratio of the tendon strain divided by the coupled strain (strain ratio) was compared to the contralateral side. Results: The strain ratios of the superficial layer after surgery were significantly smaller compared to those of the contralateral side. The strain ratios of the superficial layer after open surgery were significantly larger than those after arthroscopic surgery. Conclusion: Although there was no difference in the elasticity after open surgery between the operated and contralateral sides, the superficial layer, after arthroscopic surgery, was stiffer compared to the contralateral side.

10 THE APPEARANCE OF THE TERES MINOR MUSCLE IN ROTATOR CUFF TEARS
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Background: In large and massive rotator cuff repair or total shoulder arthroplasty with severe atrophy of rotator cuff muscle, the appearance of the teres minor was reported to be a prognostic factor postoperatively. The purpose of this study was to examine the appearance of teres minor on MRI in patients with the various types of rotator cuff tears. Materials and methods: This MRI study consists of 198 subjects (112 shoulders in males, 87 shoulders in females, average age of 61.9 years). We classified the 198 shoulders into the 7 groups of rotator cuff tears using conventional planes of MRI. Using the Image J software, we measured the area of ISP, TM, external rotation (ER) muscles area on the most lateral side on which the scapular spine was in contact with the scapular body on the oblique sagittal image of MRI. The size and quality of teres minor were compared in each group. The size of teres minor to the infraspinatus was assessed. One factor ANOVA was used for statistical analysis; p<0.05 was considered to indicate a statistically significant result. Results: The normal group was confirmed to apply to the normal distribution, so TM / ER less than 0.105 was defined as atrophic, and TM / ER greater than 0.304 as hypertrophic. TM / ER in the SSP+ISP group were statistically higher than those of other groups. A negative correlation was found between the size of infraspinatus and teres minor. Conclusions: The progression of atrophy of infraspinatus induced the hypertrophy of teres minor, especially in posterosuperior tears.

11 OPERATIVE RESULTS FOR MASSIVE ROTATOR CUFF REPAIR USING HYBRID TYPE ARTIFICIAL LIGAMENT
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Purpose: We developed the hybrid type artificial rotator cuff material (Hybrid RC). We clinically used the Hybrid RC for the repair of massive rotator cuff injuries and reported the clinical results. Materials and methods: In Total 65 cases were included in this study, 37 cases were male, and 28 cases were female. The patch graft using Hybrid RC was performed in 33 cases (Hybrid RC group). Patch graft using fascia lata (FL group) was performed in 32 cases. The average age was 61.5 years old. We evaluated the clinical results using JOA score. The MRI findings were evaluated by using Spielberg criteria and Sugaya criteria. The clinical results were analyzed statistically. Results: The average JOA score improved from 54.9 points preoperatively to 93.7 points postoperatively in the Hybrid RC group and from 51.3 points preoperatively to 74.8 points postoperatively in the FL group. From the MRI findings, the Hybrid RC group showed a lower re-rupture ratio of 9.1% (3cases) compared with the FL group 37.5% (12 cases). We found collagen tissue in the biopsy samples of the re-rupture case. Discussion and conclusion: We developed hybrid type artificial rotator cuff materials. We clinically used the Hybrid RC for the repair of massive rotator cuff injuries and reported good clinical results. Long term follow-up would be necessary.

12 LIMITATIONS OF CONSERVATIVE THERAPY FOR MASSIVE ROTATOR CUFF TEARS-RELATIONSHIP BETWEEN RECOVERY OF SHOULDER ELEVATION AND DELTOID MUSCLE THICKNESS
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Hypothesis: We hypothesize recovery of the ability to elevate the shoulder with massive rotator cuff tear through rehabilitation has a relationship to the thickness of the deltoid muscle. Materials and methods: Among patients examined between March 2006 and December 2011 at our clinic, 21 patients were unable to elevate their shoulder joint over 60 degrees while in an upright position because of massive rotator cuff tear [pseudoparalysis]. Rehabilitation was performed for these 21 patients and was focused on training of the deltoid, scapular, and remaining rotator cuff muscles for 5 months. After 5 months they were divided into 2 groups: those that could elevate the shoulder joint to more than 150 degrees (group A) and those that were unable to elevate their shoulder joint (group B). The thickness of the deltoid muscles on MRI were compared between groups. Results: The mean thickness of the
deltoid muscle in groups A and B was 7.2 mm and 3.6 mm, respectively, showing a statistically significant difference. Discussion: The patients with pseudoparalysis who had a deltoid muscle thickness of less than 6 mm were unlikely to show improvement of impaired elevation despite continued rehabilitation. With regard to treatment for pseudoparalysis, it is believed that patients with deltoid muscle thicknesses greater than 6 mm will respond to conservative treatment. Consequently, although surgery should be decided with care, it is considered to be the preferred choice for patients with deltoid muscle thicknesses of less than 6 mm.

13 RELATIONSHIP BETWEEN KYPHOSIS AND SHOULDER DISORDER; AN EPIDEMIOLOGIC STUDY
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The purpose of this study was to investigate the relationship between kyphosis and shoulder disorder. 2448 residents who lived in a mountain village of Fukushima prefecture were investigated in this study. Occiput-wall distance (OWD) was used to assess the thoracic kyphosis, and rib-pelvis distance (RPD) was used to assess the lumbar kyphosis. The number in the OWD positive group was 571 (23.9%), and in the RPD positive group was 1095 (45.0%). In the OWD positive group, shoulder flexion was significantly limited and the incidence rate of shoulder pain and the positive subacromial impingement sign were significantly higher compared with the OWD negative group. In the RPD positive group, shoulder flexion was also significantly limited compared with the RPD negative group, however, there was no significant difference between RPD positive and RPD negative group in shoulder pain and the positive subacromial impingement sign. Thoracic kyphosis would influence on the sizeration of subacromial impingement by limiting the scapular adduction and retroversion as well as extension of thoracic spine.

14 IS CORACOID PROCESS LARGE ENOUGH FOR THE LATARJET PROCEDURE IN JAPANESE? MEASUREMENT BY 3-DIMENSIONAL COMPUTED TOMOGRAPHY
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Background: There have been few reports describing the anatomic assessment of the coracoid process (CP) for the Latarjet procedure. Object: To measure the anatomic parameters of the CP using 3-D CT. Method: The DICOM data of CT images of 102 shoulders from 51 patients with unilateral anterior instability were retrospectively reviewed. First, the anterosuperior view was constructed to observe the top of the CP. Next, the anteroinferior view was constructed to observe the base of the CP. Then, statistical analyses were performed to compare the changes in OR and FI. The OR was significantly improved only in SSP, and the FI was significantly improved in all three muscles. When the subjects were divided into three groups according to the tear size; partial, small-to-medium and large-to-massive tears, improvement of the OR in SSP was observed in partial and small-to-medium tears group, and improvement of the FI in all muscles was observed in only the large-to-massive tear group. In conclusion our results show the improvement of the muscle atrophy in SSP and fatty infiltration in SSR, ISP and SSC one year after successful rotator cuff repair.

15 DOES SUCCESSFUL ROTATOR CUFF REPAIR IMPROVE MUSCLE ATROPHY AND FATTY INFILTRATION OF THE ROTATOR CUFF?
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The purpose of this study was to investigate if successful rotator cuff repair improves muscle atrophy and fatty infiltration of the rotator cuff, using magnetic resonance imaging shortly after, and one year after surgery. We performed 132 cases of rotator cuff repair from April 2010 to March 2012. Excluding the patients with re-tear of the cuff after surgery, the subjects of this study were 52 patients, consisting of 35 males and 17 females with an average age of 63.2, who had magnetic resonance imaging done shortly after, and one year after surgery. The muscle atrophy of supraspinatus (SSP), infraspinatus (ISP) and subscapularis (SSC) was evaluated with occupation ratio (OR), and fatty infiltration (FI) was evaluated using Goutallier’s classification. Then, statistical analyses were performed to compare the changes in OR and FI. OR was significantly improved only in SSP, and FI was significantly improved in all three muscles. When the subjects were divided into three groups according to the tear size; partial, small-to-medium and large-to-massive tears, improvement of the OR in SSP was observed in partial and small-to-medium tear groups and improvement of the FI in all muscles was observed in only the large-to-massive tear group. In conclusion our results show the improvement of the muscle atrophy in SSP and fatty infiltration in SSR, ISP and SSC one year after successful rotator cuff repair.

16 NATURAL HISTORY OF ROTATOR CUFF TEARS MONITORED BY MAGNETIC RESONANCE IMAGING
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The present study was conducted to evaluate the natural history of rotator cuff tears monitored by MRI. Forty-three shoulders diagnosed as having rotator cuff tears by MRI were treated conservatively. More than a year after diagnosis, we performed MRI again. The mean age of the patients was 68.8 years. The mean follow-up period was twenty-six months. The average changes in tear size were 3.7 mm during follow-up and 2.1 mm per year. Shoulders that had 1-2 cm tears initially showed a significant increase in the size compared with ~1 cm tears and 4-5 cm tears. Furthermore, localized tears in the anterior part of the superior facet had significantly smaller progression in tear size compared with widespread tears in the superior facet. B shoulders (18.2%) had progression of fatty degeneration in rotator cuff muscle. The fatty degeneration in rotator cuff muscle progressed with increase of tear size. The results of the present study may be useful for determining the indications for treatment of rotator cuff tears.