

4 MILD INFLAMMATION PERSISTS IN THE GLENOHUMERAL JOINT OF PATIENTS WITH RECURRENT SHOULDER DISLOCATION

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Purpose: Approximately two-thirds of patients with a history of shoulder dislocation have the potential to develop OA in the future; however, the cause is unclear. The purpose of this study was to evaluate the expression of inflammatory mediators in the glenohumeral joint of patients with recurrent shoulder dislocation (RSD). We hypothesized that the high prevalence of OA in RSD is due to persistent mild inflammation.

Methods: This study included 26 patients with RSD who underwent arthroscopic Bankart repair and 25 patients with rotator cuff tears (RCTs) who received arthroscopic rotator cuff repair (control group). Synovial tissue samples were harvested from the patients in both test groups for the analysis of *TNF-α*, *IL-1β*, *β-FGF*, and *VEGF* expressions using quantitative reverse transcription polymerase chain reaction. Differences between the samples of the patients with RSD and those with RCT were compared using the Welch *t* test or Mann-Whitney *U* test.

Results: The expression levels of *TNF-α*, *IL-1β*, *β-FGF*, and *VEGF* were significantly higher in the RSD group than in the control group ($p < .01$).

Discussion: Cartilage abrasion occurs in the glenohumeral joint owing to dislocation or joint instability. The destructive response of the synovium, which is induced by cartilage damage, upregulated the inflammatory mediators. Inflammatory mediators can act independently or in conjunction with other cytokines to initiate and propagate inflammation. In addition, mild inflammation may play a role in the development of shoulder OA, similarly to hip and knee OA.

Conclusion: Mild inflammation persists in the shoulder with RSD and can induce OA progression.



5 FOUR-DIMENSIONAL COMPUTED TOMOGRAPHY EVALUATION OF THE SHOULDER JOINT IN BASEBALL PLAYERS

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Background: Glenohumeral (GH) joint instability and internal impingement have been recognized as causes of shoulder pain in throwing athletes; however, in vivo GH joint kinematics is controversial. The GH contact patterns reflect joint pathogenesis. **Purpose:** The purpose of this study was to evaluate the GH contact area (GHCA) and the center of the GHCA (CGHCA) during simulated pitching motion in baseball players using a 4-dimensional (4D) computed tomography (CT) device.

Methods: We obtained 4D CT data from the dominant and nondominant shoulders of 8 baseball players (mean age, 18.6 years) during the cocking motion. The humeral head and glenoid surface were extracted, and the GHCA and CGHCA were calculated from 3-dimensional bone models using a custom-written computer program. The GHCA and translation of the CGHCA between the dominant and nondominant sides were statistically compared.

Results: There was no apparent difference in mean GHCA between the dominant and nondominant sides. No remarkable change in mean GHCA was observed during the cocking motion. The CGHCA was remarkably translated from anterior to posterior during maximum external rotation to maximum internal rotation.



Conclusion: Our 4D CT analyses produced interesting results. The CGHCA was translated during shoulder external rotation to internal rotation in abduction on both the dominant and nondominant sides. Further, 4D CT scanning and the tracer program for bone surface modeling of the GH joint could quantitatively assess the GH micromotion and could be used for kinematic evaluation with low radiation exposure.

6 THREE-DIMENSIONAL ANALYSIS OF WINGED SCAPULA USING FOUR-DIMENSIONAL COMPUTED TOMOGRAPHY

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Background: It is difficult to evaluate complicated motions of winged scapula in the presence of dyskinesia. This study aimed to analyze the 3-dimensional (3D) motion of winged scapula using upright 4-dimensional computed tomography (upright 4DCT) during elevation.

Methods: Two patients with a unilateral winged scapula caused by long thoracic or accessory nerve palsy were prospectively included in this study. Upright 4DCT of the bilateral shoulder girdles during elevation was performed for 10 seconds at 5 frames per second. Three-dimensional surface models of the thorax, clavicle, scapula, and humerus in all frames were reconstructed using 3-dimensional (3D)-3D registration. We evaluated shoulder girdle motion relative to the thorax using Euler angles. The angles of the clavicle and scapula during elevation were compared between the affected and intact shoulders and between the patients with long thoracic nerve palsy and those with shoulder accessory nerve palsy.

Results: The motions of the clavicle and scapula during elevation were different between the affected and intact shoulders and between the patients with long thoracic nerve palsy and those with shoulder accessory nerve palsy. An obvious difference was observed in the horizontal plane of motion. Long thoracic nerve palsy delayed the clavicular retraction and scapular external rotation during elevation compared with those in the intact shoulders. Shoulder accessory nerve palsy increased the clavicular protraction and scapular internal rotation during elevation.

Conclusion: Upright 4DCT enables visualization of the motion of winged scapula and 3-dimensional analysis. The study findings indicate that on the basis of the differences between long thoracic and accessory nerve palsies, not only scapular motions but also clavicle motions due to the trapezius muscle can be detected.

7 DYNAMIC IN VIVO RELATIONSHIP BETWEEN ACROMIOCLAVICULAR JOINT AND CORACOCALVICULAR SPACE DURING HUMERAL ELEVATION

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Clinically, the best treatment for acromioclavicular joint impairment is controversial. The coracoclavicular ligament is speculated to be important in the treatment of acromioclavicular joint impairment; however, limited information is available on acromioclavicular kinematics. Several studies have attempted to analyze the acromioclavicular kinematics, but few noninvasive and high-accuracy dynamic studies have been conducted. Moreover, there is limited objective information on how the body posture affects the shoulder motion. This study aimed to compare the kinematic features of the



acromioclavicular joint and coracoclavicular space during arm elevation and evaluate the influence of the body posture (standing or supine) on shoulder kinematics. A total of 25 shoulders of 15 patients (7 males and 8 females) were enrolled in this study. The shoulder motion during elevation was analyzed using previously repeated 3D/2D model-image registration methods. The fluoroscopic images were acquired in the standing and supine postures. Two-way repeated analysis of variance was performed to compare kinematic data between postures. With the arm in the side position, acromion in the standing posture was more depressed than that in the supine posture (-7.0 vs. -4.8 mm). As the humerus was elevated, the acromion showed medial, superior, and anterior translation in both postures. However, the coracoclavicular distance was the longest with the arm in the side position and became narrower during elevation. As the humerus was elevated, a coracoid process showed medial, superior, and posterior translation relative to the clavicle in both postures. These results suggest that coracoclavicular translation was not the same as acromioclavicular joint translation during elevation. In addition, the body posture affected each kinematics. This knowledge would be useful for developing clinical insight.

8 ELASTICITY EVALUATION OF THE FIBER BUNDLE FORMING THE COMMA SIGN WITH ULTRASOUND MICROSCOPY

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Purpose: The comma sign is a well-known marker of the torn edge of the subscapularis tendon (SSC). The purpose of this study was to evaluate the elasticity of the supraspinatus tendon (SSP), the fiber bundle forming the comma sign (FBCS), and the SSC in intact and cuff-torn shoulders using ultrasound microscopy to examine the reason why the FBCS is maintained even in cuff-torn shoulders.

Methods: We used formalin-fixed cadavers. Of 6 intact shoulders of 6 cadavers (mean age, 74.5 years) and 5 cuff-torn shoulders of 3 cadavers (mean age, 88.0 years), serial histological sections, including the SSP, FBCS, and SSC, were created. One section with the most clearly visible FBCS and SSP/FBCS and FBCS/SSC connections were selected from each specimen and observed using ultrasound microscopy. In each selected section, new images of the SSP/FBCS and FBCS/SSC boundaries colored according to the sound speed of the reflected wave were created. In addition, the sound speeds of the substantially tendinous portion of the SSP/SSC and the central portion of the FBCS were recorded.

Results: In 6 intact shoulders, 3 SSP/FBCS borders and 3 FBCS/SSC borders were clear. However, all 5 cuff-torn shoulders demonstrated unclear SSP/FBCS and FBCS/SSC boundaries. The sound speed of the reflected wave was significantly slower in the FBCS than in the SSP or SSC in both the intact and cuff-torn shoulders.

Discussion: The FBCS was not considered as robust as the SSP or SSC. The gradual change of the elasticity in the SSP/FBCS and FBCS/SSP borders would lead to avoid stress concentration and rupture of the FBCS.

9 INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS OF ANATOMICAL TOTAL AND REVERSE SHOULDER ARTHROPLASTIES: A MULTICENTER STUDY

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Purpose: Reverse shoulder arthroplasty (RSA) has relatively high risks of perioperative complications. We performed a multicenter study to clarify the complications of anatomical total shoulder arthroplasty (aTSA) and RSA.

Materials and Methods: Of the 474 patients enrolled in this study, 302 underwent RSA and 172 underwent aTSA. The mean age at operation was 75.6 years. The mean follow-up period was 22.3 months. Perioperative complications were identified, and the severity was classified into G0 (no), G1 (healed), G2 (residual dysfunction), G3 (operation), and G4 (death). These data were analyzed using χ^2 test and logistic regression analyses, and the statistical significance was set at $p < .05$.

Results: The complication rates of aTSA and RSA were 10.3% and 17.9%, respectively. The odds ratio for aTSA was 47% lower than that for RSA. G0, G1, G2, G3, and G4 complications were identified in 141, 3, 1, 0, and 0 patients during aTSA; in 126, 3, 6, 1, and 0 patients after aTSA; in 283, 0, 8, 8, and 0 patients during RSA; and in 260, 12, 11, 16, and 3 after RSA, respectively. RSA had a statistically significant higher risk of perioperative complications than aTSA intraoperatively ($p < .01$; odds ratio, 0.55), while it had a relatively higher risk than aTSA postoperatively, but there was no statistically significant difference ($p = 0.09$). The major complications of RSA during operation were humeral and glenoid fractures, and those after operation were scapular fractures, dislocations, glenoid component failures, neurological disorders, and perioperative death. We could not detect any related factors for the complications of RSA.

Conclusion: RSA has a high risk of complications without predicting factors, and careful patient evaluation, care, and operative procedures are essential.

10 OUTCOMES AFTER ROTATIONAL INFRASPINATUS MUSCLE TRANSFER FOR IRREPARABLE MASSIVE ROTATOR CUFF TEARS AND LONG-TERM FOLLOW-UP

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Background: We developed a surgical technique for rotational infraspinatus muscle transfer in cases with irreparable massive rotator cuff tears while avoiding strong tension at the repaired site to avoid causing paralysis of the suprascapular nerve. Our method involves detaching the infraspinatus muscle, including the portion where the infraspinatus and supraspinatus muscles are connected to the scapula. With this rotational transfer of the infraspinatus muscle, reconstructions of the damaged infraspinatus and supraspinatus muscles are possible by elongation of the supraspinatus muscle.

Methods: We assessed 9 shoulders in 9 patients (6 men and 3 women, mean age: 71 years, range: 66–78 years) with rotator cuff tears with a maximum diameter > 5 cm and 2 tendons involved in the tear who were followed up for a mean period of 11.4 years (range: 10.1–12.8 years). The Japan Orthopedic Association and University of California Los Angeles scores were evaluated.

Results: Eight patients showed no pain, and the remaining patient showed reduced pain at the last follow-up. Before operation, 2 years after operation, and at the last follow-up, the mean ranges of active flexion, abduction, and external rotation were 88, 90, and 32; 159, 169, and 31; and 160, 159, and 13, respectively; the JOA scores were 47.8, 90.4, and 85.8 points, respectively, and the UCLA score were 7.2, 33.7, and 32.8 points, respectively.