

Which Shoulder Motions Cause Subacromial Impingement?

- Evaluating the vertical displacement and peak strain of the coracoacromial ligament by ultrasound speckle tracking imaging

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COI Disclosure Information

presenter : Dong-Jin Kim, M.D.

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Introduction

- **Subacromial impingement**
 - Common cause of shoulder pain
 - One cause of rotator cuff disease
- **It is necessary to know and avoid several shoulder motions that cause subacromial impingement**
- **The purpose of this study is to evaluate impingement by measuring vertical displacement and strain of CAL during several shoulder motions using ultrasound speckles tracking imaging**

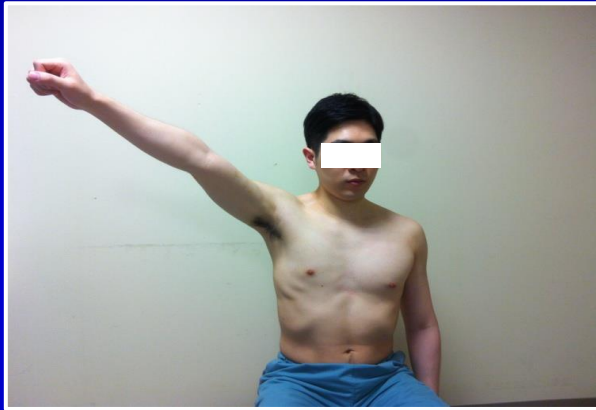
Materials and Methods

- **8 healthy volunteers (16 shoulders)** with no history of shoulder disability
- Average age : 28.63 years-old (all were men)
- **2D speckles tracking echocardiography (2D STE)** in the long axis direction on the CAL
 - Echocardiogram system (Vivid S5, GE Vingemed ultrasound AS, Horten, Norway)
 - 12L-RS linear probe in harmonic mode (frequency 6-13 MHz)



Materials and Methods

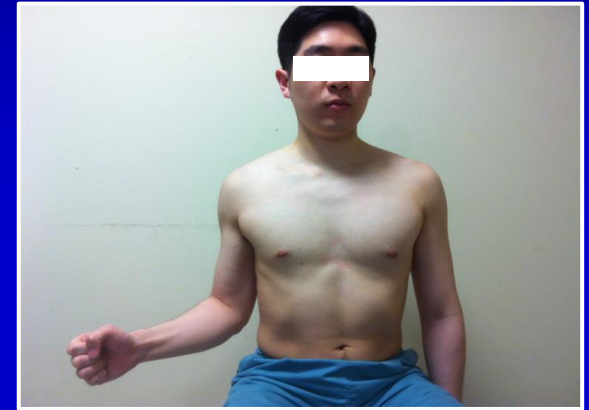
- Vertical displacement and peak strain of CAL during active assisted motions



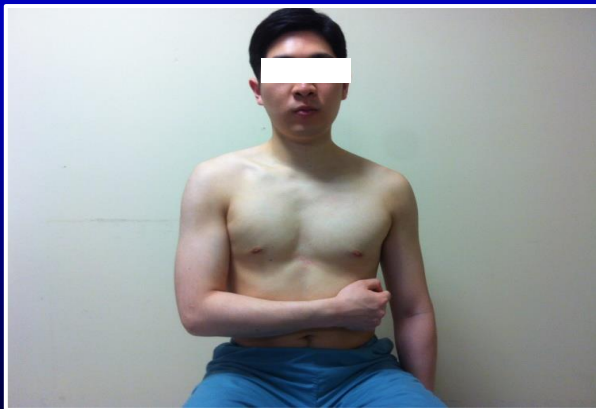
Flexion (scapular plane)



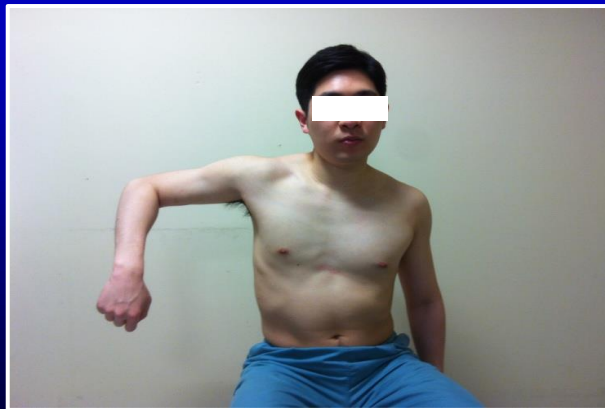
Horizontal abduction



E/R (arm 0° abduction)



I/R (arm 0° abduction)



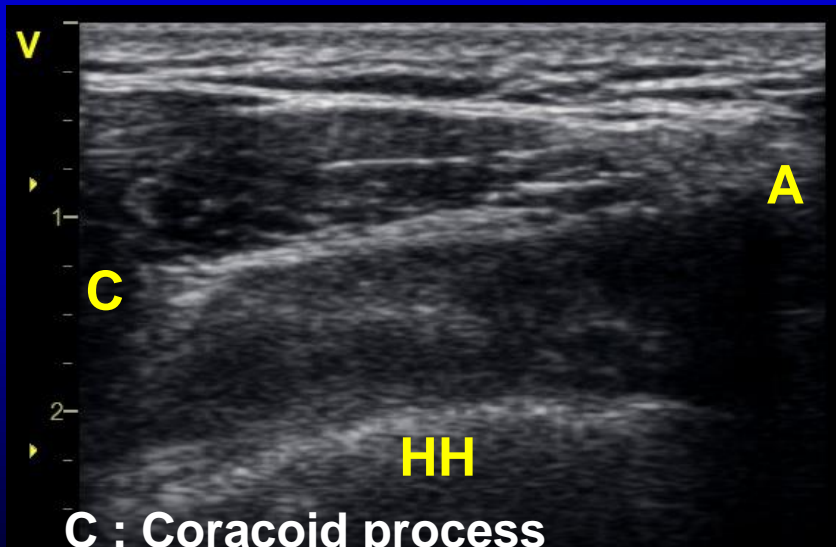
I/R (arm 90° abduction)



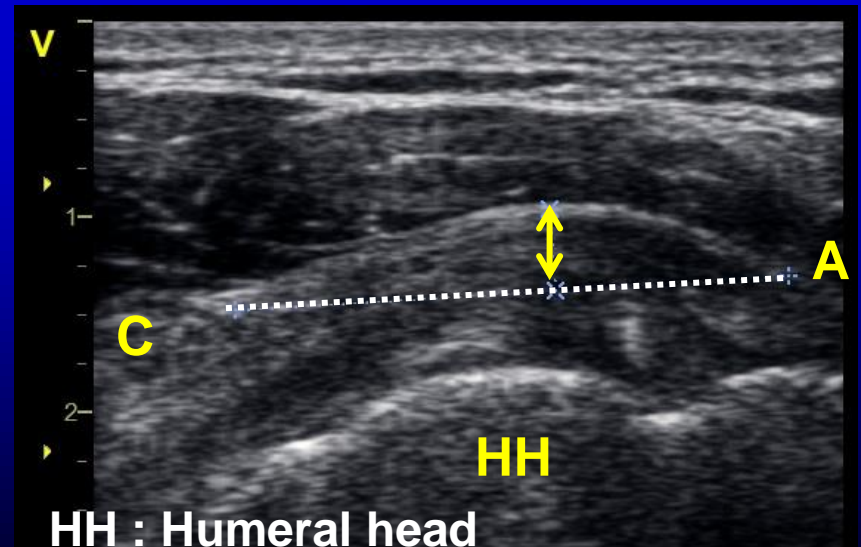
I/R at back side

Materials and Methods

- CAL was identified with a transducer placed between the coracoid process and the acromial tip
- **Vertical displacement** was measured from the vertex of the CAL convexity to a line connecting the acromion and coracoid process at the CAL attachment

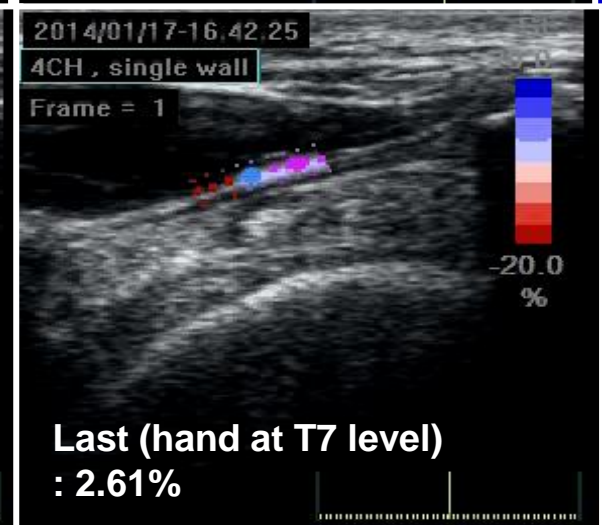
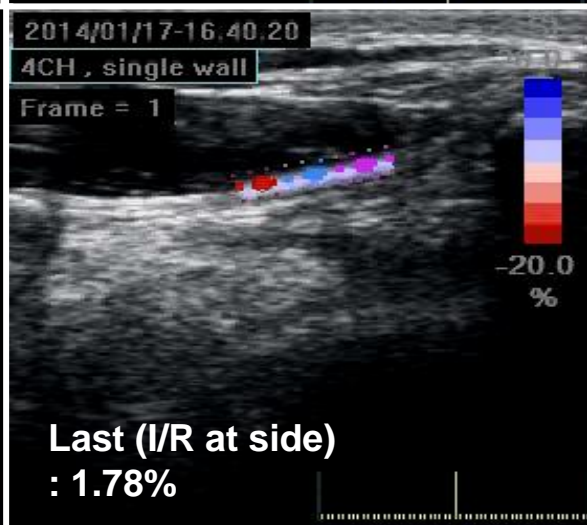
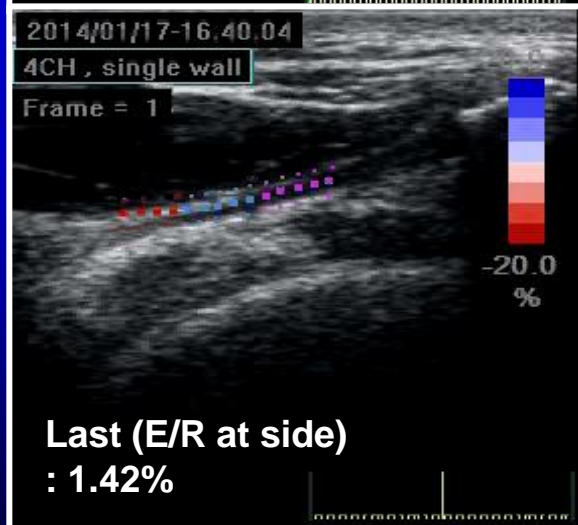
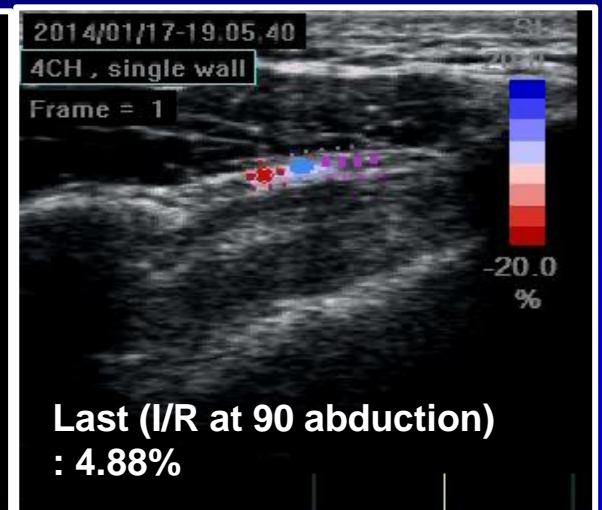
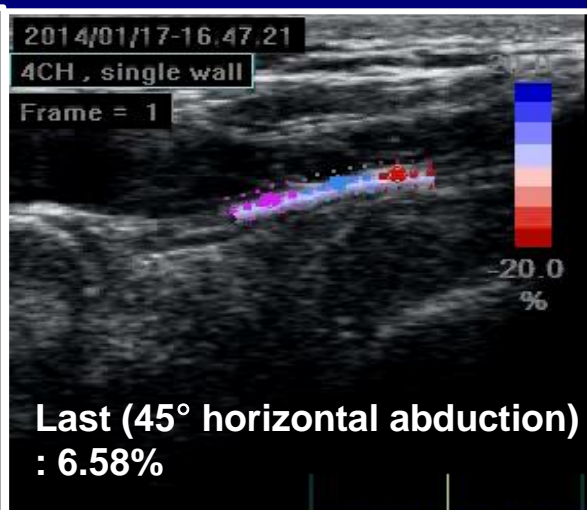
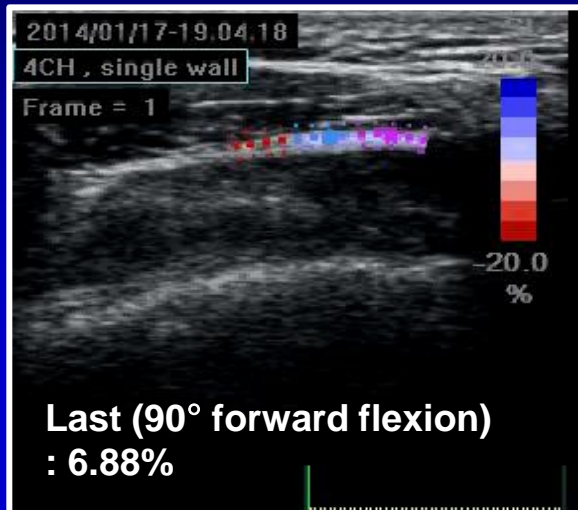


C : Coracoid process
A : Acromial tip



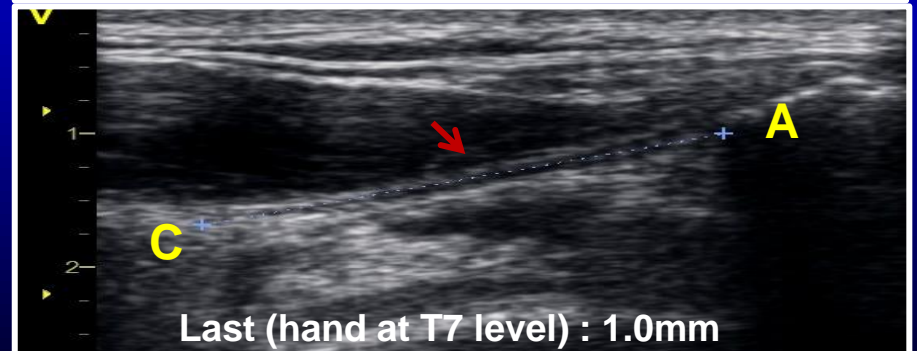
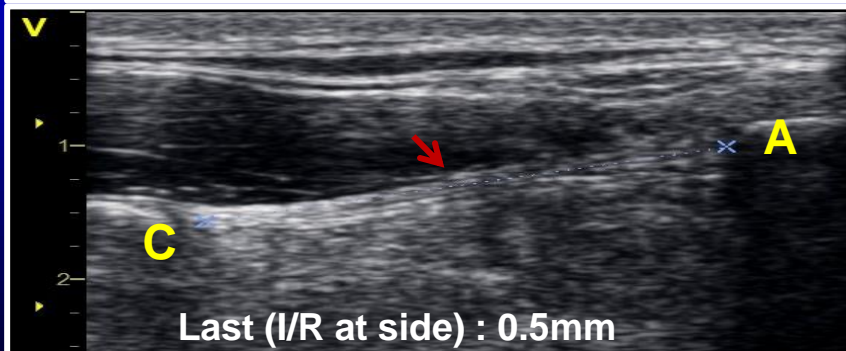
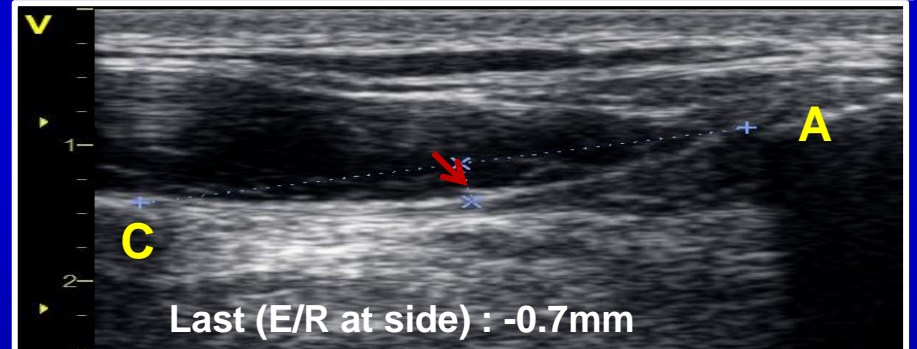
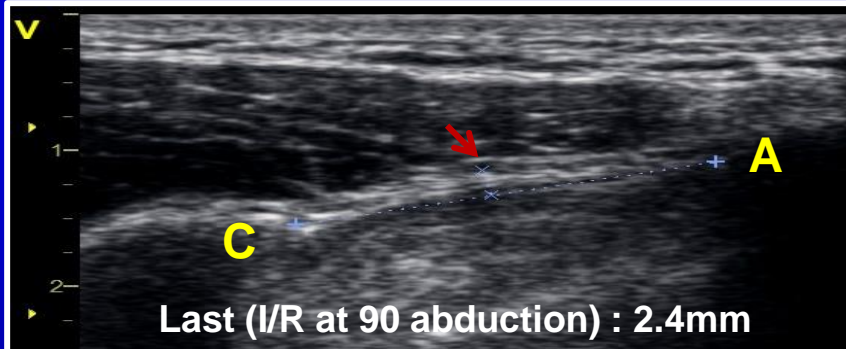
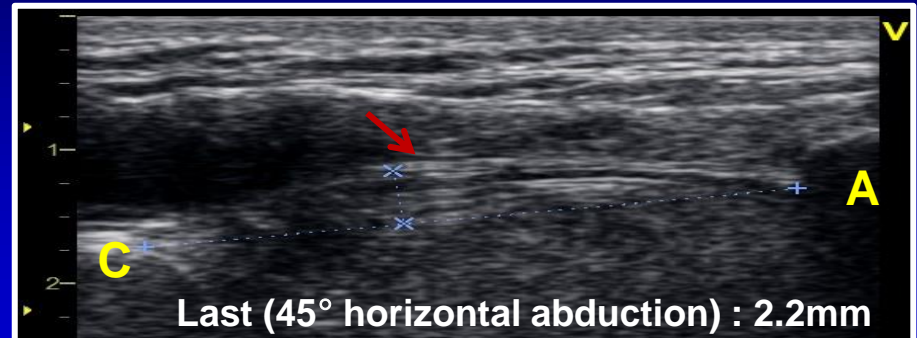
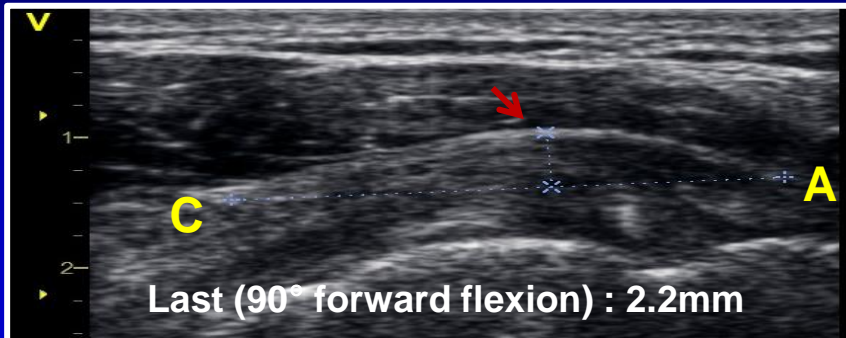
HH : Humeral head
2 way arrow : vertical displacement

Result Peak Strain



Result

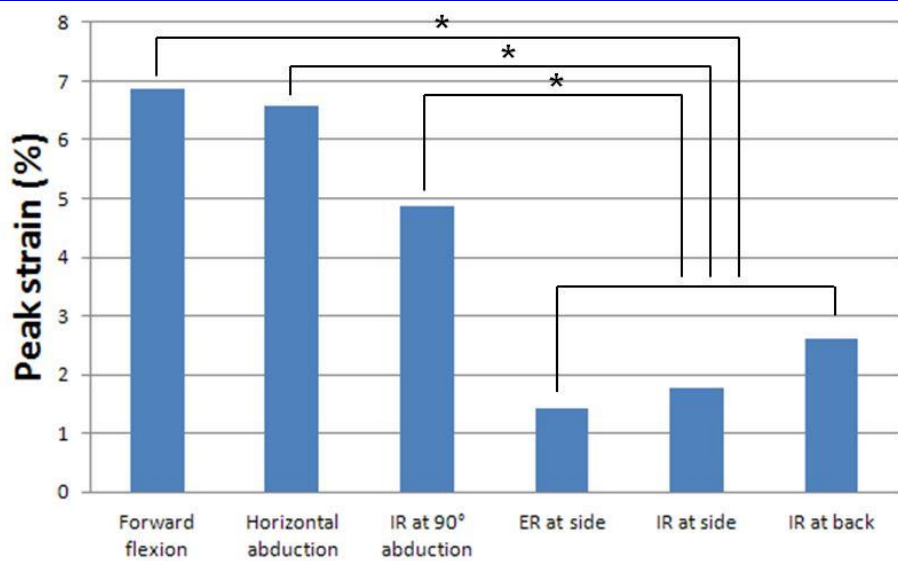
Vertical displacement



Result

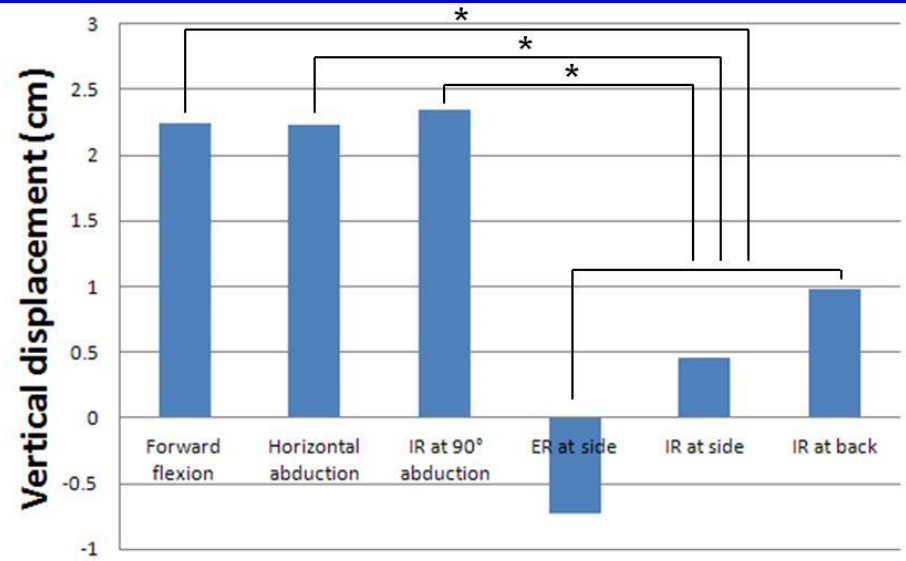
Peak strain

* $p < .003$



Vertical Displacement

* $p < .003$



Summary of Results

- **Forward flexion, horizontal abduction and IR at 90° abduction** showed significantly increased peak strain and vertical displacement than other motions ($p < 0.05$)



Limitations

- **Relatively small sample size**
- **Only young normal man were included**
- **No subjects with shoulder disease like impingement syndrome, RCT, etc**
- **Technical problem (it's difficult to trace CAL during shoulder motion)**

Conclusion

- **Forward flexion, horizontal abduction and IR at 90° abduction can cause the subacromial impingement**
- **The patients with impingement syndrome or repaired cuff tendon were recommended to avoid these shoulder motions**

References

1. Altiok E, Tiemann S, Becker M, Koos R, Zwicker C, Schroeder J, et al. Myocardial deformation imaging by two-dimensional speckletracking echocardiography for prediction of global and segmental functional changes after acute myocardial infarction: a comparison with late gadolinium enhancement cardiac magnetic resonance. *J Am Soc Echocardiogr* 2014;27:249-57.
2. Amundsen BH, Helle-Valle T, Edvardsen T, Torp H, Crosby J, Lyseggen E, et al. Noninvasive myocardial strain measurement by speckle tracking echocardiography: validation against sonomicrometry and tagged magnetic resonance imaging. *J Am Coll Cardiol* 2006;47:789-93.
3. Bigliani LU, Cordasco FA, McIlveen SJ, Musso ES. Operative treatment of failed repairs of the rotator cuff. *J Bone Joint Surg Am* 1992;74:1505-15.
4. Bigliani LU, Ticker JB, Flatow EL, Soslowsky LJ, Mow VC. The relationship of acromial architecture to rotator cuff disease. *Clin Sports Med* 1991;10:823-38.
5. Blaine TA, Kim YS, Voloshin I, Chen D, Murakami K, Chang SS, et al. The molecular pathophysiology of subacromial bursitis in rotator cuff disease. *J Shoulder Elbow Surg* 2005;14:84S-9S.
6. Budoff JE, Nirschl RP, Guidi EJ. Debridement of partial-thickness tears of the rotator cuff without acromioplasty. Long-term followup and review of the literature. *J Bone Joint Surg Am* 1998;80:733-48.
7. Chopp JN, O'Neill JM, Hurley K, Dickerson CR. Superior humeral head migration occurs after a protocol designed to fatigue the rotator cuff: a radiographic analysis. *J Shoulder Elbow Surg* 2010;19:1137-44.
8. Flatow EL, Soslowsky LJ, Ticker JB, Pawluk RJ, Hepler M, Ark J, et al. Excursion of the rotator cuff under the acromion. Patterns of subacromial contact. *Am J Sports Med* 1994;22:779-88.
9. Goffinet C, Chenot F, Robert A, Pouleur AC, le Polain de Waroux JB, Vancrayenest D, et al. Assessment of subendocardial vs. subepicardial left ventricular rotation and twist using two-dimensional speckle tracking echocardiography: comparison with tagged cardiac magnetic resonance. *Eur Heart J* 2009;30:608-17.
10. Gotoh M, Hamada K, Yamakawa H, Inoue A, Fukuda H. Increased substance P in subacromial bursa and shoulder pain in rotator cuff diseases. *J Orthop Res* 1998;16:618-21.
11. Kim YS, Bigliani LU, Fujisawa M, Murakami K, Chang SS, Lee HJ, et al. Stromal cell-derived factor 1 (SDF-1, CXCL12) is increased in subacromial bursitis and downregulated by steroid and nonsteroidal anti-inflammatory agents. *J Orthop Res* 2006;24:1756-64.
12. Kim YS, Kim JM, Bigliani LU, Kim HJ, Jung HW. In vivo strain analysis of the intact supraspinatus tendon by ultrasound speckles tracking imaging. *J Orthop Res* 2011;29:1931-7.
13. Korstanje JW, Selles RW, Stam HJ, Hovius SE, Bosch JG. Development and validation of ultrasound speckle tracking to quantify tendon displacement. *J Biomech* 2010;43:1373-9.
14. Lee HJ, Kim YS, Ok JH, Song HJ. Apoptosis occurs throughout the diseased rotator cuff. *Am J Sports Med* 2013;41:2249-55.
15. MacDonald P, McRae S, Leiter J, Mascarenhas R, Lapner P. Arthroscopic rotator cuff repair with and without acromioplasty in the treatment of full-thickness rotator cuff tears: a multicenter, randomized controlled trial. *J Bone Joint Surg Am* 2011;93:1953-60.
16. Neer CS 2nd. Anterior acromioplasty for the chronic impingement syndrome in the shoulder: a preliminary report. *J Bone Joint Surg Am* 1972;54:41-50.