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# Interesting Articles for KEMA Members

Adaptive Patterns of Movement during Arm Elevation Test in Patients with Shoulder Impingement Syndrome

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ABSTRACT: The purpose of this study was to determine if a distinctive characteristic exists in the pattern of movement (scapular elevation and upward rotation to reduce impingement) and associated muscular activities during arm elevation in subjects with shoulder impingement syndrome (SIS) that is associated with the severity of the disease. Fourteen subjects (7 amateur athletes and 7 students athletes) with SI and 7 controls performed arm elevation in the scapular plane. Scapular kinematics (upward rotation, elevation, tipping, and scapulohumeral rhythm) and muscular activity (upper trapezius (UT), lower trapezius (LT), serratus anterior (SA), and deltoid) were measured by an electromagnetic motion tracking system and surface electromyography (EMG). Subjects with SI had greater elevation of the scapula (11.9 mm, $p < 0.005$) and less peak scapular posterior tipping (10.6°, $p < 0.021$) than controls. In more severe subjects/amateur athletes), the elevation and posterior tipping of the scapula were correlated with an increase in the UT:LT ($R = -0.818$, $p = 0.025$) and a decrease in SA ($R = 0.772$, $p = 0.049$) activity, respectively. Our results identified a characteristic compensatory scapular elevation to reduce impingement during arm elevation in subjects with SI. Assessing scapular elevation during arm elevation may be a useful functional marker for evaluating impingement status and associated muscle function. Additionally, SA and LT muscle strengthening may improve SI. © 2010 Orthopaedic Research Society. Published by Wiley Periodicals, Inc. J Orthop Res 29:653–657, 2011

Keywords: adaptive; shoulder; impingement; kinematics; scapula muscle

Subjects with impingement syndrome often present with pain and a loss of function during arm elevation,[1] represented by painful arc during motion, a positive resisted isometric test, or range of motion limitation.[2,3] Arm elevation performance is frequently used as a measure of the syndrome in this group.[1–4] The ability to elevate the arm is directly related to the function of the scapular muscles. The coordinated scapular muscle function acts as a stabilizer of the scapula to maintain a sufficient subacromial space. Thus, loss of scapular muscle function can be a risk factor in the initiation and progression of impingement syndrome.[2,5–9] Research therapies have been directed at improving scapular muscle strength to reduce progression of the impingement.[8,9] Although the loss of scapular muscle function may have several causes, subjects likely adopt patterns of movement during arm elevation to compensate for the loss of scapular muscle function. Identifying the mechanisms of movement during arm elevation in subjects with impingement could offer useful information on the severity of the syndrome.

The mechanics of arm elevation in the situation of scapular muscle function have been characterized in terms of scapular kinematics, including tipping, upward rotation, elevation, and protraction.[8,9] Specifically, compensatory mechanisms that elevate and upwardly rotate the scapula to increase subacromial space have been related to compromised impaired serratus anterior (SA)/lower trapezius (LT) muscle function due to reduced subacromial space.[2] It has been suggested that these patients elevate and upwardly rotate their scapula to compensate for the reduced subacromial space.[5] Thus, as impingement severity increases, patients may also adopt compensatory strategies associated with elevation and upward rotation of the scapula. Identifying this mechanism would provide a useful method to evaluate scapular muscle function without the need for tests requiring the exertion of maximum effort and could contribute to the development of treatments to improve function in subjects with impingement syndrome.

The purpose of this study was to determine whether subjects with impingement syndrome of varying severity adopt an altered pattern of movement. We hypothesized that: (1) subjects with impingement would have greater scapula elevation and scapula upward rotation during arm elevation than control subjects; (2) scapula kinematics and associated muscular activity of the scapula are significantly correlated; (3) amount of the scapula kinematics and associated muscular activity of the scapula are related to disease severity.

## MATERIALS AND METHODS

The sample included 7 amateur baseball athletes and 7 university student baseball athletes with symptoms, and 7 healthy controls with exercise comprising overhead activities 2–3 times per week (all males, Table 1). All participants signed an approved consent form. These subjects were recruited through advertisements and personal contacts. Inclusion criteria for subjects with symptoms were a positive Neer impingement test, a positive Hawkins impingement test, and pain with palpation of the rotator cuff tendons. To characterize a potential adaptive pattern without confounding pain factor, subjects with a positive painful arc test or pain with isometric resisted abduction were excluded. Subjects were excluded if they had systematic inflammatory arthritis, a torn rotator cuff, a history of surgery on the shoulder, or malignancies in the shoulder region. For the healthy controls, none of them had previously been treated for any clinical upper extremity conditions. A physical

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어깨충돌증후군!!
운동 패턴으로
구별할 수 있을까?

**Adaptive Patterns of Movement during Arm Elevation Test in Patients with Shoulder Impingement Syndrome**

J Orthop Res. 2011 ;29(5):653-7

**어깨충돌증후군**은 흔한 어깨 질환 중 하나이다.

다양한 원인으로 견봉하공간(subacromial space)이 좁아져,

팔을 올리는 동작을 할 때,

견봉(acromion)과 위팔뼈머리(head of humerus)의 부딪힘을

유발하여 **통증, 운동범위 감소** 등의 다양한 증상이 나타나는 질환이다.

어깨충돌증후군을 가진 환자들에게서는

어깨뼈(Scapula)를 조절하는 근육들의 약화를 찾아볼 수 있다.

팔을 올리는 동작을 할 때, 어깨뼈가 적절하게 조절되지 못한다면

견봉하공간이 좁아지게 되어 충돌을 야기할 수 있다.

그래서 어깨충돌증후군을 가진 환자들은 기능적 활동을 할 때,

좁아진 견봉하공간을 보상하기 위해 특징적인 운동패턴을 이용한다.

## 어떤 패턴의 움직임이 발생하게 될까?

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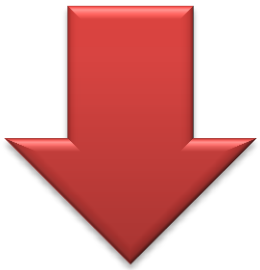
이전의 어깨충돌증후군에 관한 연구를 바탕으로

**세가지 가설**을 세워서 하나씩 알아보기로 하자!

## *가설*

1. 어깨충돌증후군이 있는 사람은 팔을 올릴 때, 어깨뼈 올림(elevation)과 위쪽 돌림(upward rotation)이 많이 일어날 것이다.
2. 어깨뼈의 움직임은 어깨뼈를 조절하는 근육의 활성과 관련이 있을 것이다.
3. 어깨뼈 움직임과 이와 관련된 근육의 활성은 질병의 심각성과 관련이 있을 것이다.



## *결과*

1. 어깨뼈 올림을 이용하여 보상하는 것은 맞으나, 어깨뼈의 뒤쪽경사(posterior tipping)가 충분하지 않다면 올림 동작은 덜 효과적이다.
2. 위등세모근(upper trapezius)의 과도한 사용으로 어깨뼈 올림이 발생하고, 앞톱니근(serratus anterior)의 약화로 뒤쪽 경사가 충분히 발생하지 않게 한다.
3. 증상이 심각할 수록 어깨뼈 올림이 많이 나타나고, 뒤쪽 경사가 불충분하게 발생한다.

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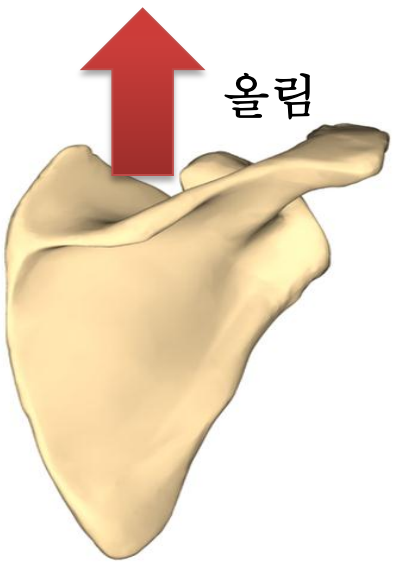
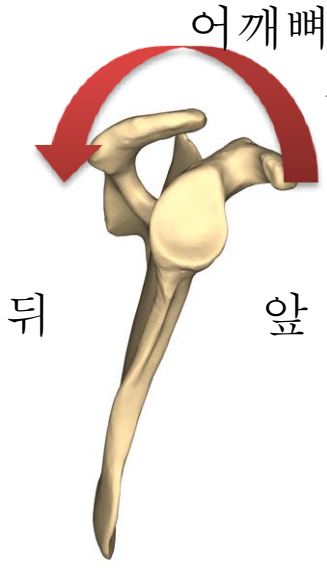
# 어깨충돌증후군에서 어깨뼈는 어떻게 움직일까?

| | 아마추어 운동선수 (어깨충돌증후군 증상 심함) | 학생 운동선수 (어깨충돌증후군 증상 보통) | 정상 (어깨충돌증후군 증상 없음) |
|---|---|---|---|
| 어깨뼈 위쪽돌림 | 40.2 | 37.2 | 43.0 |
| 어깨뼈 뒤쪽경사 | 4.2 | 11.2 | 18.3 |
| 어깨뼈 올림 | 21.6 | 14.1 | 5.1 |

- 위쪽돌림 : 증상과 돌림 각도 사이의 유의한 각도차이는 없다.
- 뒤쪽경사 : 증상이 심해질 수록 팔을 올릴 때의 뒤쪽경사가 적게 발생한다.
- 올림 : 증상이 심해질수록 올라가는 거리가 높아진다.

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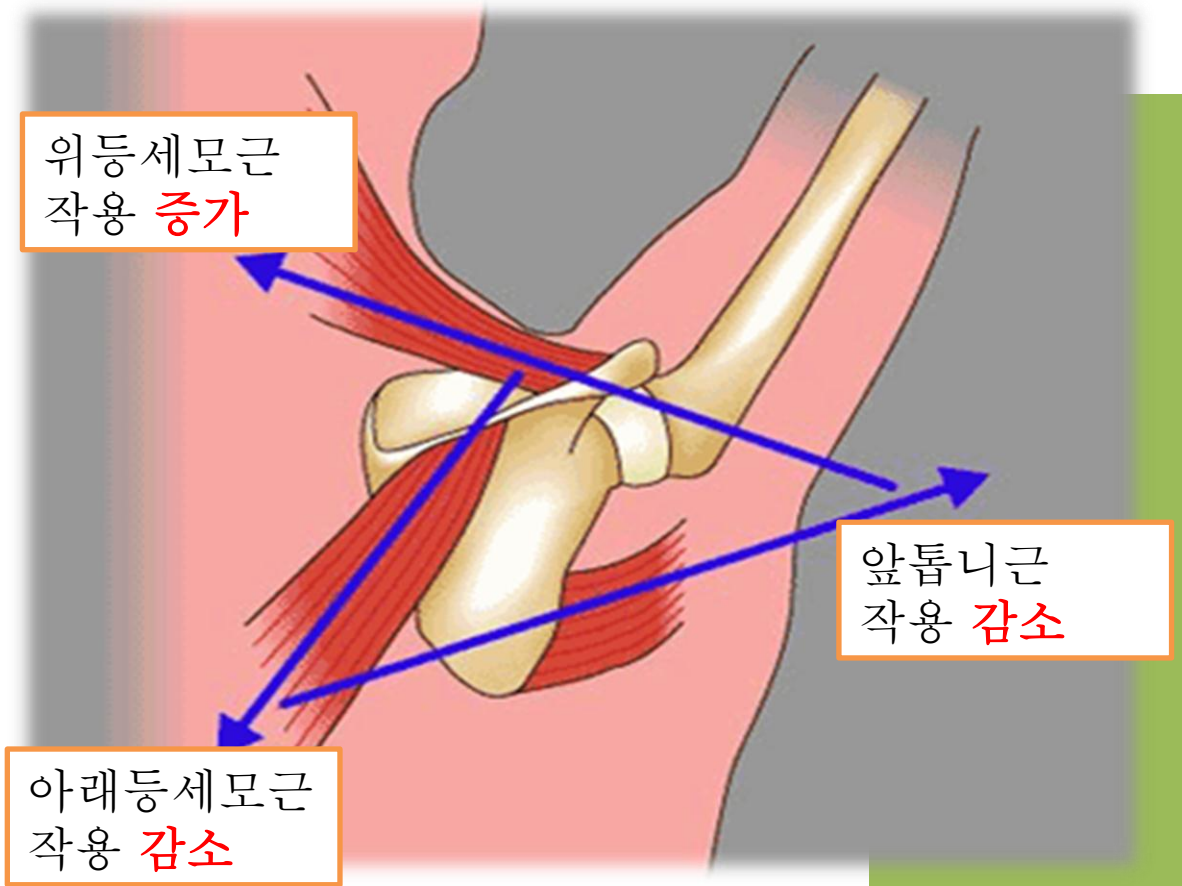
# 어깨충돌증후군에서 어깨 주변 근육은 어떻게 작용할까?

| | 아마추어 운동선수 (어깨충돌증후군 증상 심함) | 학생 운동선수 (어깨충돌증후군 증상 보통) | 정상 (어깨충돌증후군 증상 없음) |
|---|---|---|---|
| 위등세모근 | 0.81 | 0.69 | 0.56 |
| 아래등세모근 | 0.20 | 0.24 | 0.40 |
| 앞톱니근 | 0.10 | 0.16 | 0.28 |

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어깨충돌증후군을 가진 사람들에게서 보상 패턴으로 어깨뼈 올림이 나타난다.

팔을 올리는 동작을 할 동안에 어깨뼈 올림을 측정한다면 근육의 기능,

기능적 상태, 어깨충돌증후군의 심각도를 평가하는데 유용할 것이다.

또한 치료를 위해 아래등세모근과 앞톱니근의 강화 운동을 동반한다면

더욱 효과적인 치료를 할 수 있을 것이다.

**어깨충돌증후군이 있는 사람들은**

**팔을 들어올리는 동작시 어깨뼈의 올림이 증가하고, 뒤쪽경사가 감소한다.**

**또한 위등세모근의 작용이 증가하고,**

**아래등세모근과 앞톱니근의 작용이 감소한다.**

**이러한 결과를 바탕으로 어깨충돌증후군의 평가와 치료에 적용한다면**

**더욱 효과적인 치료가 될 것이다.**

**라고 이 논문을 근거로 이야기 할 수 있을 것이다.**

**-KEMA 책임 연구원 안선희-**

**-문의사항은 KEMA 홈페이지 기사에 댓글로 남겨주세요-**

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