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외상력이 없는 주관절에서 활차 내측 골극과 주관절 굴곡 제한과의 관계

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Relationship of Trochlear Medial Facet Osteophyte to Elbow Flexion in Elbow Joint without Trauma History

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Purpose: The purpose of this study is to evaluate the relationship between trochlear medial facet osteophyte (TMFO) and elbow flexion in the elbow joints without trauma history.

Materials and Methods: Twenty five patients, who underwent computed tomography without elbow trauma history, were reviewed. Patients were checked for osteophyte or loose bodies in the coronoid and olecranon sides. The height and length of TMFO were measured.

Results: The average elbow flexion contracture was 18.6°, and further flexion was 112.1°. The TMFO height and length was 2.2 mm and 4.7 mm, respectively. The average elbow further flexion was 105.1° in the coronoid block group (n=14) and 119.1° (p=0.011) in the coronoid free group (n=11). The relationship between further elbow flexion and TMFO was significant with a partial correlation coefficient of 0.687(p<0.000) in the TMFO length.

Conclusion: Elbow joints with longer TMFO length decrease further flexion.

Key Words: Trochlear medial facet, Coronoid, Osteophyte, Elbow further flexion, Computed tomography

Introduction

The elbow stiffness is caused by various diseases or trauma, which impedes the daily activities. The intraarticular causes of elbow stiffness include diseases, such as a osteophyte associated with degenerative arthritis or rheumatoid

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arthritis and posttraumatic conditions, such as intraarticular fractures and dislocation of the elbow. On the other hand, the extraarticular causes of elbow stiffness include anterior or posterior capsular contracture, medial collateral ligament (MCL) contracture, muscle contracture or ectopic ossification.[1] The MCL becomes tense in the posterior band at maximum flexion and tense in the anterior band at full extension because of the cam effect to provide reciprocal tightening through the entire elbow motion.[2] If the tension on the ligament is excessive, it may limit the elbow motion arc. There is little information regarding the trochlear medial facet osteophyte (TMFO) associated with MCL tension.

The etiology of a locked metacarpophalangeal joint of the index finger was known as catching of the accessory collateral ligament on the osseous prominence on the radial condyle of the metacarpal. We believe TMFO has similar anatomy to osseous prominence on the radial condyle of the metacarpal.[3]

The hypothesis tested was that the TMFO size affects the elbow motion arc because it is in constant contact with the MCL.

The purpose of this study was to determine how the TMFO affects the elbow motion arc.

Materials and methods

Patient Selection

Between November 2001 and December 2009, all patients who underwent computed tomography (CT) of the elbow joint at our institution were enrolled in this study if they met the following criteria: (1) osteoarthritis of the ulnohumeral joint, (2) elbow stiffness without trauma history. Also we checked CT of the elbow joint for age matched normal volunteers after obtaining informed consent.

Patients with radial head deformity or radiocapitellar arthritis or previous trauma history, such as an elbow fracture, dislocation or ligament injury, were excluded. Patients with an acute painful elbow stiffness associated with bursitis around the elbow, septic arthritis, rheumatoid arthritis, epicondylitis or loose bodies were also excluded. This study was approved by the Institutional Review Board of our hospital.

Twenty five cases who met the inclusion criteria were enrolled in this study. Of these 25 cases, 24 were male and one was female. The mean age was 33 years (range, 16~61 years), and they were followed up for a mean of 18 months (range, 12~20 months). The right and left elbow was involved in 13 and 12 cases, respectively. The diagnosis was osteoarthritis in 9 cases, valgus overload syndrome in 11 cases and normal volunteers in 5 cases. All cases underwent CT (Multi Slice CT, Siemens Medical Systems, Somatom sensation; Forchheim, Germany) of the elbow joint. CT scan protocol was 1 mm slice thickness with elbow flexion 90 degrees. Of these 25 cases, 9 patients underwent CT arthrography (CTA) to identify the loose body. The surgical procedures for these patients included arthroscopic debridement in 10 cases, arthroscopic anterior capsular release in 9 cases and open anterior capsulectomy in 4 cases. The elbow motion was measured using a goniometer preoperatively under general anesthesia.

The osteophyte or loose body was checked on the coronoid process and coronoid fossa as well as the olecranon process and olecranon fossa in the sagittal plane of the reformatted CT image. The loose body in this study was defined as solitary nonossified mass not connected to the coronoid or olecranon process, which size was 1~3 mm. The relationship between the elbow range of motion and TMFO was analyzed with partial correlation coefficient to exclude confounding factor using SPSS version 11.0 for Windows (SPSS Inc.; Chicago, IL, USA).

The TMFO was measured at the largest part of the TMFO in the coronal plane of the reformat-

ted CT image. The osteophyte height is defined as the distance between the bases of the osteophyte, which is measured from the deepest portion of the medial epicondyle to the medial facet articular margin, and the medially most prominent portion of the osteophyte (Fig. 1A). The osteophyte length is defined as the distance between the medial facet articular margin and the most proximal portion of the osteophyte (Fig. 1B). We also checked osteophyte height of coronoid and olecranon in the sagittal plane of the reformatted CT image. The coronoid osteophyte height is defined as the distance from the tip of the coronoid articular margin to the anteriorly most prominent portion of the osteophyte. The olecranon osteophyte height is defined as the distance from the tip of the olecranon articular margin to the posteriorly most prominent portion of the osteophyte.

Results

The average elbow flexion contracture was 18.6 ±12.7° and further flexion was 112.1±14.2°. There were 20 TMFOs. There were 18 osteophytes and 7 loose bodies on the olecranon fossa or olecranon process, which was defined as the olecranon block group. There were 14 osteophytes, 7 loose bodies at the coronoid fossa or coronoid process, which was defined as the coronoid block group (Table 1). Because osteophytes or loose bodies of olecranon or coronoid can affect the elbow motion, the cases were divided into the olecranon block group (n=18) and ole-

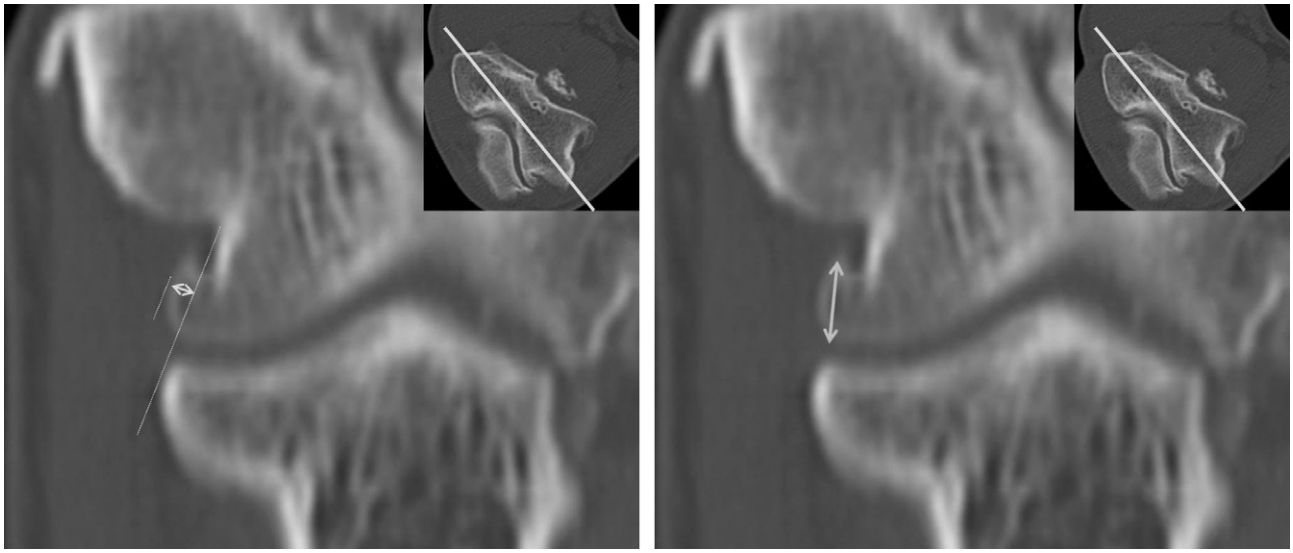

Fig. 1. (**A**) The osteophyte height is defined as the distance between the bases of the osteophyte, which is measured from deepest portion of the medial epicondyle to the medial facet articular margin, and medially the most prominent portion of the osteophyte (small transverse arrow). (**B**) The osteophyte length is defined by distance between the medial facet articular margin and the most proximal portion of the osteophyte (longitudinal arrow).

Table 1. Location of Elbow Osteophyte or Loose Body

	Cases
Trochlear medial facet osteophyte	20
Olecranon process or fossa osteophyte	18
Olecranon process or fossa loose body	7
Coronoid process or fossa osteophyte	14
Coronoid process or fossa loose body	7

cranon free group (n=7). In the same way, they were also divided into the coronoid block group (n=14) and coronoid free group (n=11). The average height and length of TMFO were 2.2±1.4 mm and 4.7±3.1 mm, respectively (Table 2). The average height of coronoid osteophytes and olecranon osteophytes were 1.0±1.5 mm and 1.0±1.2 mm, respectively. The average height of coronoid osteophytes between the coronoid block group (n=14) and coronoid free group (n=11) were 0.6±0.6 mm and 1.5±2.0 mm, respectively (p=0.01). The average height of olecranon osteophytes between the olecranon block group (n=18) and olecranon free group (n=7) were 0.6±1.0 mm and 1.5±1.1 mm, respectively (p=0.27). The average elbow further flexion was 105.1±12.7° in the coronoid block group (n=14), 119.1±13.2° (p=0.011) in the coronoid free group (n=11), 111.2±14.3° in the olecranon block group (n=18), 113.1±13.6° (p=0.748) in the olecranon free group (n=7). The average elbow flexion contracture was 19.1±11.8° in the olecranon block group (n=18), 16.8±14.5° (p=0.632) in the olecranon free group (n=7), 20.1±13.2° in the coronoid block group (n=14) and 16.2±13.5° (p=0.433) in the coronoid free group (n=11) (Table 3).

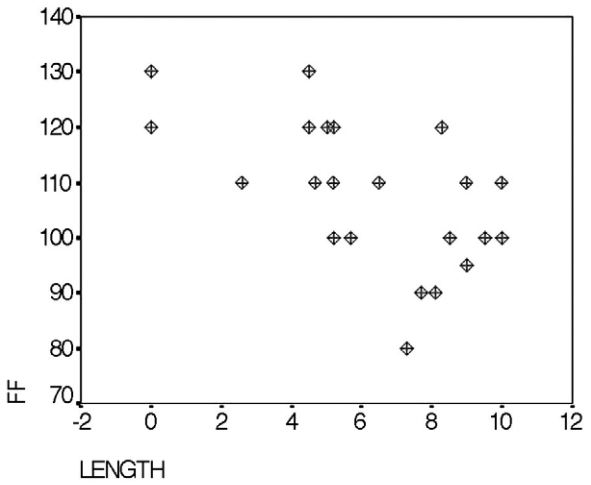

Fig. 2. Scatterplot shows the relationship between the osteophyte length and further flexion of the elbow and partial correlation coefficient (r=0.687, p<0.001) adjusted by the coronoid block.

We use partial correlation coefficient rather than correlation coefficient to reduce confounding variable because coronoid block affect elbow further flexion. The partial correlation coefficient adjusted by the coronoid block between elbow further flexion and TMFO was −0.456 (p=0.021) and 0.687 (p<0.000) in the osteophyte height and osteophyte length, respectively (Table 4). Also the partial correlation coefficient adjusted by the olecranon block between elbow further flexion and TMFO was −0.528 (p=0.006) and 0.761 (p<0.000) in the TMFO height and length, respectively. These suggest that the TMFO

Table 2. Average Height and Length of Trochlear Medial Facet Osteophyte (TMFO)

Osteophyte height	2.2 mm±1.4
Osteophyte length	4.7 mm±3.1

Table 3. Elbow Motion

	Elbow flexion contracture	Elbow further flexion
Coronoid block* (+) (n = 14)	20.1±13.2° (p=0.433)	105.1±12.7° (p=0.011)
Coronoid block (-) (n =11)	16.2±13.5°	119.1±13.2°
Olecranon block (+) (n = 18)	19.1±11.8° (p=0.632)	111.2±14.3° (p=0.748)
Olecranon block (-) (n = 7)	16.8±14.5°	113.1±13.6°

* Block means osteophyte or loose body at fossa or process

length have a medium positive correlation (0.6~0.8) and the TMFO height have a weak negative correlation (−0.4~−0.6) with further elbow flexion (Fig. 2).

Discussion

This is the first study which proves that TMFO size has a relationship with the elbow flexion from the radiological measurements in the coronal plane of the reformatted CT image. Both MCL and coronoid osteophyte have known to be related elbow stiffness, but the TMFO is not studied yet for our literature review. Our study based on the question that another intra-articular factor may have a role for the elbow stiffness.

We believe that TMFO is another etiology for elbow stiffness, besides the already known intra-articular factors, such as coronoid process osteophyte or coronoid fossa loose body.

TMFO length has medium correlation with elbow stiffness based on this study. A further biomechanical study will be needed if these parameters can reproducibly represent the osteophyte volume, which would increase the MCL tension.

Even though we cannot isolate coronoid osteophyte effect completely, elbow joints with longer TMFO length decrease further flexion. The osteophyte at coronoid or olecranon side seems to be inevitably associated with TMFO, which surely is natural progress of degenerative arthritis. The height difference of coronoid osteophyte between the coronoid block group and coronoid free group was only 0.9 mm. We think that this height is not enough to explain the etiology for elbow stiffness with coronoid osteophyte only.

Extrinsic elbow stiffness is attributable to the capsule and periarticular soft tissue.[4,5] Periarticular ossification has been treated recently with satisfactory results.[6-8] Ectopic ossification at the MCL itself should be removed to achieve sufficient elbow flexion.[9] Although MCL itself is not shortened, elbow stiffness may occur. If the TMFO is large, MCL tension may be increased because it contacts with the protruding surface of the TMFO. To determine the clinical implications of TMFO excision while preserving the MCL, more study will be needed to validate the minimal invasive surgery for a selective excision of the osteophyte using cadavers.[10]

There are some limitations of this study. First, the osteophyte is a three dimensional structure. But our measurement depend two dimensional coronal image even though the image of TMFO was checked at the most prominent portion of the CT image.[11-13] The part of the TMFO affects limitation of flexion or extension. In posterior situation, posterior band is extended and further flexion should be limited. In anterior location, anterior band is extended and further extension should be limited. Fortunately our cases have TMFO throughout entire facet, not particular location. Also we had no cases of kissing lesions, which have both trochlea and olecranon osteophyte. In addition we exclude severe osteoarthritis with cartilage defect to focus on TMFO effect of motion. Second, static image cannot accurately measure the ligament tension because the tension may change while the elbow flexion increases. Third, we did not consider individual

Table 4. Partial Correlations Coefficient Between Elbow Further Flexion and Trochlear Medial Facet Osteophyte (TMFO)

	Adjusted by coronoid block	Adjusted by olecranon block
Osteophyte height	-0.456 (p=0.021)	-0.528 (p=0.0064)
Osteophyte length	0.687 (p<0.000)	0.761 (p<0.000)

variation of ligament tension exist. Last, we checked coronoid or olecranon osteophyte at the most prominent part in sagittal reformatted image but medial or lateral side osteophytes of coronoid or olecranon process may contact more closely with medial side osteophytes of coronoid or olecranon fossa than the most prominent part.

Conclusion

Elbow joints with longer TMFO length decrease further flexion.

REFERENCES

1) **Song HS, Yoon HM.** *Pathophysiology of stiff elbow. Clin Shoulder Elbow Soc. 2010;13:286-92.*
2) **Zimmerman NB.** *Clinical application of advances in elbow and forearm anatomy and biomechanics. Hand Clin. 2002;18:1-19.*
3) **Yagi M, Yamanaka K, Yoshida K, Sato N, Inoue A.** *Successful manual reduction of locked metacarpophalangeal joints in fingers. J Bone Joint Surg Am. 2000;82:366-71.*
4) **Morrey BF.** *Surgical treatment of extraarticular elbow contracture. Clin Orthop Relat Res. 200;370: 57-64.*
5) **Viola RW, Hastings H 2nd.** *Treatment of ectopic ossification about the elbow. Clin Orthop Relat Res. 200;370:65-86.*
6) **Brouwer KM, Lindenhovius AL, de Witte PB, Jupiter JB, Ring D.** *Resection of heterotopic ossification of the elbow: a comparison of ankylosis and partial restriction. J Hand Surg Am. 2010;35:1115-9.*
7) **Lindenhovius AL, Linzel DS, Doornberg JN, Ring DC, Jupiter JB.** *Comparison of elbow contracture release in elbows with and without heterotopic ossification restricting motion. J Shoulder Elbow Surg. 2007;16:621-5.*
8) **SJ Cheon, DH Lee, SH Cha, HT Kim, JT Suh.** *Debridement arthroplasty using posteromedial approach in elbow joint with pain and bony limitation of motion. J Korean Shoulder Elbow Soc. 2009; 12:67-75.*
9) **MJ Park, MJ Chang, YB Lee, HJ Kang.** *Surgical release for posttraumatic loss of elbow flexion. J Bone Joint Surg Am. 2010;92:2692-9.*
10) **Waldt S, Bruegel M, Ganter K, et al.** *Comparison of multislice CT arthrography and MR arthrography for the detection of articular cartilage lesions of the elbow. Eur Radiol. 2005;15:784-91.*
11) **Dubberley JH, Faber KJ, Patterson SD, et al.** *The detection of loose bodies in the elbow: the value of MRI and CT arthrography. J Bone Joint Surg Br. 2005;87:684-86.*
12) **Fritz RC, Breidahl WH.** *Radiographic and special studies: recent advances in imaging of the elbow. Clin Sports Med. 2004;23:567-80.*
13) **Libicher M, Freyschmidt J.** *Radiological diagnosis in contracted elbow joint. Value of CT and MRI. Orthopade. 2001;30:593-601.*

초 록

목적: 외상력이 없는 주관절에서 척골 근위부 활차 내측 관절면 골극의 크기가 주관절 굴곡에 미치는 영향을 분석하고자 한다.

대상 및 방법: 주관절부 컴퓨터 단층촬영을 시행한 외상력이 없는 환자 25예를 대상으로 연구를 시행하였다. 컴퓨터 단층촬영상 구상돌기 및 구상와, 주두 돌기 및 주두와 골극의 유무와 크기를 측정하였고, 그리고 활차 내측 관절면의 골극의 높이와 길이를 측정하였다.

결과: 주관절 굴곡 구축은 평균 18.6°, 후속 굴곡은 평균 112.1°였다. 활차 내측 관절면 골극의 높이는 평균 2.2 mm, 길이는 평균 4.7 mm이었다. 후속 굴곡 각도는 구상 돌기나 구상와에 골극 또는 유리체가 있었던 경우(n=14)가 105.1°, 없었던 경우(n=11)가 119.1° (p=0.011)로 통계적으로 유의한 차이가 있었다. 후속 굴곡 각도와 활차 내측 관절면 골극의 평균 길이와의 편상관계수는 0.687 (p<0.000)이었다.

결론: 활차 내측 관절면 골극의 길이가 긴 주관절에서 후속 굴곡 각도가 줄어들었다.

색인 단어: 활차, 구상 돌기, 골극, 주관절 후속 굴곡, 컴퓨터 단층촬영