The Immediate Effect of Humerus Anatomical Neck-shaft Rotation on Glenohumeral Joint Contracture

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Abstract. [Purpose] Elderly female patients with glenohumeral joint (GHJ) contracture, forced into prolonged immobility were examined. Range of motion exercises using humerus anatomical neck-shaft rotation were performed, and the immediate effect and adaptation were investigated. [Subjects and Methods] A total of ten individuals with a mean age of 79.4 ± 11.0 years were included in this study. The controlled intervention involved conventional range of motion exercises, and the experimental intervention involved humerus anatomical neck-shaft rotation. Each exercise was performed 30 times. Shoulder joint flexion and abduction and external rotation of the GHJ range of motion were measured with the scapula fixed. Each change in range of motion was compared using ANOVA; less than 5% was considered significant. [Results] After the experimental intervention, significant increases were seen in shoulder joint flexion, abduction, and external rotation ranges of motion. [Conclusion] Therefore, this method was effective as a means of improving the range of motion of the GHJ.

Key words: Shoulder joint, Contracture, Humerus anatomical neck-shaft rotation

INTRODUCTION

Contracture is the state in which joint motion is constrained as a result of prolonged immobility or the fixation of joints at rest. The skin, connective tissue, skeletal muscles, and nerves1, 2) are intertwined and complexly involved in range of motion (ROM) restrictions, and physical assessment of these elements is not an easy task. Contracture with ROM restrictions adversely affects posture and movement in daily life3). For example, being forced into prolonged immobility is a factor that restricts quality of life. Many reports have claimed that if the ROM restrictive factors mainly originate from muscle spasms, then suppressing the muscle spasms through massage and stretching can immediately improve ROM4). However, if the ROM restrictive factor is mainly tissue degeneration and shortening of collagen fibers in the joint capsules or ligaments, improvement is reportedly difficult3, 4). Even if conservative therapy is performed for 3–4 months for the contractured shoulder after shoulder periarthritis, if no remission of symptoms is seen, aggressive surgical treatment is encouraged5). However, if no surgical treatment is performed for shoulder joint contracture in the elderly caused by prolonged immobility, ROM exercises are the first choice.

ROM restrictions of the shoulder joint in elderly people forced into prolonged immobility are essentially the result of problems with the glenohumeral joint (GHJ) in most cases, which are currently dealt with using ROM exercises and stretching. A colleague and I previously performed joint capsule and ligament stretching using humerus anatomical neck-shaft rotation for frozen shoulders, and reported on the usefulness. The humerus anatomical neck-shaft is a perpendicular shaft on the surface of the anatomical neck of the humerus, and the rotation of this shaft is called humerus anatomical neck-shaft rotation6). The humerus moves in a cone-shape with a 90-degree apex angle that vertically touches the scapula and acetabulum6). In this rotation, the acetabular surface and anatomical neck surface always run parallel to each other. In other words, since the surfaces run parallel to the coracoacromial arch of the greater tubercle without passing under the arch, stretching of the joint capsules and ligament tissue around the shoulder joint is possible without causing pain in the suprathumeral joint. Clinically applying these exercises for shoulder joint contracture in elderly people who are forced into prolonged immobility and presenting the results may be significant.

The objective of this study was to perform conventional ROM exercises and humerus anatomical neck-shaft rotation for shoulder joint contracture in a total ten elderly people who were forced into prolonged immobility, and to examine the immediate changes and adaptation.
SUBJECTS AND METHODS

A Total of ten elderly females patients forced into prolonged immobility at our institution were included in this study. The mean ± standard deviation values of the age and weight of the subjects were 79.4 ± 11.0 years, and 40.4 ± 6.5 kg respectively. The underlying disease causing prolonged immobility was disuse syndrome as a result of the progression of cerebrovascular disease and Alzheimer’s. This represented 0 points on the Barthel Index.

Shoulder joint contracture was defined as meeting the following two conditions: 1) feeling soft tissue restrictions in the end feel after transversely moving the shoulder joint in all directions and 2) feeling shortening of the joint capsules and ligaments after maintaining abduction of the shoulder joint at a 45° angle and then transversely moving the bone head in all directions. In principle, the examined shoulder joints were on the non-paralyzed side. Four cases including cases where transitive 45° flexion and abduction movement was not possible, cases of bone fractures or other past histories, and cases that also involved degenerative diseases such as Parkinson’s disease were excluded.

Humerus anatomical neck-shaft rotation exercises were always performed with the anatomical neck surface and acetalabural surface parallel to each other. Since the anatomical neck of the humerus faces 135 degrees and 30 degrees, movement on these surfaces, represented by movement of the humerus, forms a conical 90° apex angle at a right angle to the acetalabural surface, and since forearm abduction is always 30° in regard to this circular tangent, the position of the shoulder joint was defined as 45° above the scapular surface of the GHJ, with an external rotation of 30°. Humerus anatomical neck-shaft rotation exercises were performed 30 times until final ROM. Typical transitive shoulder joint ROM exercises including flexion, abduction, adduction, internal rotation, and external rotation, which were the control intervention, were performed 30 times until final ROM. There was one day was placed between the experimental intervention and control intervention. In addition, sufficient consideration was given to the development of pain during both the experimental intervention and control intervention. For the evaluation, external rotation, flexion, abduction, and the initial position depending on the scapula were fixed. Measurements were done in the supine position. Shoulder joint ROM with the scapula fixed was defined as the GHJ angle. Measurement was performed by two individuals. Measurement of the movement angle and basic angle was performed 3 times in 5° increments using a goniometer in accordance with the Japanese Association of Rehabilitation Medicine guidelines, and the mean value of the 3 was used. The control intervention and experimental intervention were compared by analysis of variance (ANOVA) with one repeated measures factor α = 0.05 as the using a level of significance. 

In addition, the purpose of this study was explained in writing to the families, and their consent was obtained. The investigation conformed to principles outlined in the Declaration of Helsinki and was approved by Human Research Ethics Committee.

Table 1. Changes in shoulder joint ROM

|                  | Flexion | Abduction | External rotation |
|------------------|---------|-----------|-------------------|
| Base line        | 40.5±9.5| 38.5±9.1  | 10.5±6.4          |
| Control intervention | 40.5±9.5| 38.5±9.1  | 10.5±6.4          |
| Experiment intervention | 66.0±12.8| 67.0±13.1| 23±7.5            |

Mean ± SD, Repeated measures ANOVA was performed. *p<0.05

RESULTS

Table 1 shows a comparison of the ROM values. In the experimental intervention, significant increases were seen in flexion, abduction, and external rotation with the scapula fixed (Table 1).

DISCUSSION

The pathology of shoulder joint contracture can be mainly divided into extra-articular factors and intra-articular factors. Tension of the muscles surrounding the shoulder joint is the main extra-articular factor, and is thought to heal in response to conservative therapy centered on exercise therapy. While contracture of the joint capsules is the main intra-articular factor, many reversible cases of this pathology centered on ROM exercise conservative therapy have been reported. In previous studies on conservative therapy for shoulder joint contracture, a reduction in pain and an increase in flexion and abduction could be seen; however, significant increases in medial rotation and external rotation were often reported to be difficult to achieve. The factors that affect the degree of improvement such as age, shoulder joint flexion at time of diagnosis, and reduced lateral rotation, are considered poor result factors in conservative therapy. The results of the present study show that significant increases were seen not only in flexion and abduction, but also in external rotation (Table 1). Since the patients’ age group, ROM values at the time of diagnosis, number of conservative therapies undergone, and pathologies leading to contracture differed between this study and previous studies, the results cannot be easily compared. However, a significant increase was seen in ROM when the experimental intervention and control intervention were compared; if the ROM for performing humerus anatomical neck-shaft rotation remains, then this may be clue to the significance of introducing this method and improving ROM.

To easily measure the ROM of the GHJ, there is a method that measures flexion and abduction with the scapula fixed. Magnetic resonance imaging is also necessary to perform proper measurements, but the above conventional method was adopted in the present study because its reproducibility and validity have been confirmed. When the scapula is fixed, a maximum of 120° of abduction is possible. There are many cases in which there are problems with the GHJ due to extremely restricted ROM. In this study, the non-fixed shoulder joint could be flexed to an average angle of about 120°. In a normal shoulder, the GHJ moves about 80°. Flexion and abduction of the fixed scapula in this
study, however, were less than 80°; therefore, there may be a problem with the GHJ in this study’s ROM restrictions. It has been reported that the ROM restrictions occurring in the GHJ are mainly due to shortening of the joint capsules. From the surgical findings of 17 cases of intractable shoulder contracture, the coracohumeral ligament (CHL) and scarring of the loose part of the rotator cuff were significant, and contracture was reported to 3-dimensionally disappear through isolation and removal of this tissue. In addition, the CHL tenses in shoulder joint lateral rotation, and the loose part of the rotator cuff narrows in the longitudinal direction and has a function that increases stability, but a reduction in extensibility due to scarring in the same area is one of the major factors that significantly restrict shoulder joint motion. Furthermore, the GHJ is very narrow when contracture is strong, narrowing of the joint capsules is also observed, and inflammation and swelling of the tissue surrounding the suprhumeral joint often causes adhesion. The same pathology was presumed to be occurring in the shoulder joints examined in this study. The shoulder joints of elderly people forced into prolonged immobility are more vulnerable than expected, and acute inflammation around the suprhumeral joint may even be the result of simple ROM exercises. In conventional exercise therapy with stretching through transitive articulation in an elevating direction, pain may occur around the suprhumeral joint before the sensation of stretching the muscles is felt. The conventional ROM exercise resulted in to changes at all. In the conventional ROM exercise, it was very difficult to improve the shortened joint capsule or the CHL. Therefore, shoulder ROM was not 3-dimensionally improved by the conventional ROM exercise.

In addition, when language and cognitive functions decline due to progression of Alzheimer’s dementia, as with the subjects in this study, it may be difficult to accurately convey complaints of pain. In humerus anatomical neck-shaft rotation, there may be adaptation not only in cases where there is a possibility of causing pain in the suprhumeral joint during stretching in an elevating direction and cases where shortening can be seen in the joint capsules and ligaments, but also in cases where a reduction in language and cognitive functions is seen in those forced into prolonged immobility.

Problems and issues, such as the validity of the stringency and therapeutic effect of this study not being verified, remain. Future comparisons with more conventional methods and examinations through a single-case design are necessary.

However, this study suggests this method is an effective means of improving muscle shortening, centered on the joint capsules and CHL, which directly affect GHJ ROM.

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