Factors Involved in the Onset of Symptoms Associated with Rotator Cuff Tears
-A Comparison of Asymptomatic and Symptomatic Rotator Cuff Tears in the General Population-

INTRODUCTION:
A rotator cuff tear is one of the most common disorders affecting the shoulder. Traditionally, the tear itself has been believed to be a direct cause of these symptoms, but recent reports revealed that some individuals have asymptomatic rotator cuff tears. In our previous study, 20.7% of 1,366 shoulders had full-thickness rotator cuff tears regardless of the presence or absence of symptoms. Moreover, 36.0% of the subjects with current symptoms had rotator cuff tears, while 16.9% of the subjects without symptoms also had rotator cuff tears. However, little is known about either the mechanism of symptom onset or what factors render some tears asymptomatic and others symptomatic.

The purpose of this study was to characterize the nature of asymptomatic rotator cuff tears in comparison to symptomatic tears and to determine the factors involved in the onset of symptoms of rotator cuff tears in the general population.

METHODS:
Cancer screening and a preventive health medical checkup was conducted for the residents of a mountain village, where agroforestry and tourism are the main industries. Among the residents, we randomly picked 683 people and performed ultrasonography on both shoulders to diagnose rotator cuff tears. The subjects of this study included 211 cases with 283 shoulders in which a full-thickness rotator cuff tear was observed through ultrasonography. The subjects comprised 81 males with 114 affected shoulders and 130 females with 169 affected shoulders, and the mean age was 65.5 years old. All of the subjects filled out a questionnaire regarding their age, gender, dominant arm, heaviness of labor, a history of shoulder trauma, and whether they had any current symptoms involving their shoulders. They subsequently underwent physical examinations that evaluated the presence of the impingement sign, the active range of motion, and the loss of muscle strength.

The subjects were divided into two groups according to their current symptoms involving the shoulders -- those with a symptomatic rotator cuff tear (“Group S”) and those with an asymptomatic tear (“Group A”). We determined the prevalence of Group A and the percentage of subjects in Group A in each generation. In addition, the differences between the two groups in terms of age, gender, dominant arm, heaviness of labor, history of trauma, impingement sign, active forward elevation, and weakness in abduction and external rotation were evaluated. Finally, a stepwise forward logistic regression analysis was used to identify the factors involved in the onset of symptoms of rotator cuff tears using the aforementioned factors as explanatory variables. All statistical analyses were conducted using the Statistical Package of Social Science (SPSS) version 13.0J software program and the critical values for significance were set at p<0.05.

RESULTS:
Group A accounted for 65.4% (185/283 shoulders) and Group S for 34.6% (98/283 shoulders) of the subjects and the percentage of subjects in Group A in each generation was 33.3% of subjects in their 30s (1/3 shoulders), 62.5% in their 40s (10/16 shoulders), 72.9% in the 50s (35/48 shoulders), 67.8% in the 60s (59/87 shoulders), 60.9% in their 70s (67/110 shoulders) and 68.4% in their 80s (13/19 shoulders), without any tendency in the proportions of the two groups.

There were no differences between the two groups in terms of age, gender, or heaviness of labor; however, there were significant differences between the two groups regarding the presence of a tear in the dominant arm (dominant: 51.9% in Group A and 72.4% in Group S, p=0.001), presence of the impingement sign (positive: 5.9% in Group A and 41.8% in Group S, p<0.001), the angle of active forward elevation (150.7 degrees in Group A and 146.1 degrees in Group S, p=0.013), weakness in abduction (presence: 16.8% in Group A and 40.8% in Group S, p<0.001), and weakness in external rotation (presence: 12.4% in Group A and 36.7% in Group S, p<0.001).

A logistic regression analysis revealed that the impingement sign, weakness in external rotation, and the presence of a tear in the dominant arm were significantly associated with the onset of symptoms of rotator cuff tears. The odds ratios for the impingement sign, weakness in external rotation, and the presence of a tear in the dominant arm were 10.18 (95% CI 4.57-22.69), 3.10 (95% CI 1.21-7.95), and 2.99 (95% CI 1.57-5.71), respectively.

DISCUSSION:
Because there is a high prevalence of asymptomatic rotator cuff tears in the general population, the tear itself has been regarded as one type of normal degenerative change. Some studies have evaluated the prevalence of asymptomatic rotator cuff tears using diagnostic imaging in asymptomatic healthy volunteers. The prevalence of asymptomatic full-thickness rotator cuff tear was 0-15% in studies using magnetic resonance imaging and 6-23% in studies using ultrasonography, and most of those reports revealed that the prevalence of tears increases with age. However, these studies limited the subjects to volunteers without any symptoms in their shoulders, so the prevalence of symptoms in whole rotator cuff tears in the general population remains unclear.

Furthermore, the relationship between age and the presence of symptoms was ambiguous due to the limitations of research design. According to the results of the current study, 65.4% of 283 rotator cuff tears displayed no symptoms. There was no significant association between age and the percentage of asymptomatic tears. These results are the first to demonstrate the prevalence of the appearance of symptoms in whole rotator cuff tears in the general population and the relationship between age and the appearance of symptoms.

There are several reports comparing asymptomatic and symptomatic rotator cuff tears, but there is no consensus as to what factors are involved in the onset of symptoms. The current study demonstrates that in comparison to symptomatic tears, asymptomatic rotator cuff tears showed a greater association with a negative impingement sign, preserved strength in external rotation, and tear in the non-dominant arm. Furthermore, in 283 shoulders with rotator cuff tears, 93.8% of the above described shoulders with all three of the aforementioned conditions had no symptoms involving the shoulders. Consequently, these factors were determined to be strongly associated with the onset of symptoms.

The current study compared the nature of asymptomatic rotator cuff tears with that of symptomatic tears and elucidated the factors involved in the onset of symptoms of the tear. However, this study is a cross sectional study, so diachronic change in regard to the symptoms is not evaluated. In a continuous follow-up of the subjects of the current study, we are now investigating whether asymptomatic rotator cuff tears remain asymptomatic, and, in the cases of symptom onset, what factors render these tears symptomatic. We believe that the mechanism of symptom development in rotator cuff tears will eventually be revealed by these investigations.

In conclusion, 65.4% of rotator cuff tears had no symptoms involving the shoulders in the general population, and these asymptomatic tears showed no correlation with age. The factors involved in the onset of symptoms associated with rotator cuff tears were revealed to be a positive impingement sign, weakness in external rotation, and an affected dominant arm. Asymptomatic rotator cuff tears could be considered to be a condition in which the body adapts to the rotator cuff tear through compensatory mechanisms, and this condition should thus be the goal of conservative medical management for rotator cuff tears. We believe that the mechanisms behind the development of symptoms will therefore be revealed through a better understanding of asymptomatic rotator cuff tears and this knowledge will thereby positively influence the treatment strategies for rotator cuff tears.