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Summary

Background: The humeral torsion angle (HTA) of throwing athletes is known to be greater on the throwing side than on the non-throwing side. However, little information is available regarding detailed changes in HTA and actual shoulder range of motion during the growth period.

Materials and Methods: Subjects comprised 357 male baseball players from elementary school to senior high school (age range, 9-17 years). Age, height, weight, and years of experience playing baseball were elicited as background factors. External rotation in abduction (ABER) and internal rotation in abduction (ABIR) were measured, and HTA was assessed with the support of ultrasonography.

Results: HTA decreased with age on the non-throwing side, but remained unchanged on the throwing side. The difference between sides thus increased with age. A lateral difference in ABER was found in players >11 years old, and a lateral difference in ABIR was found in all players. The lateral difference in HTA was correlated with increased age, greater height and weight, and longer experience playing baseball.

Conclusions: The repetitive load of throwing motions restricts the normal processes acting to decrease HTA and affects shoulder range of motion during the growth period.

Keywords
Humeral torsion angle– Shoulder range of motion– Throwing disability shoulder– Baseball– Juvenile athletes

Das Verhältnis zwischen dem Torsionswinkel des Humeruskopfes und dem Bewegungsbereich des Schultergelenks bei jugendlichen Baseballspielern

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Relationship between humeral torsion angle and shoulder range of motion among juvenile baseball players

Atsushi Yamamoto[1], Tsutomu Kobayashi[2], Tsuyoshi Tajika[1], Hitoshi Shitara[1], Tetsuya Kaneko[3], Tsuyoshi Ichinose[1], Daisuke Shomoyama[4], Toshihisa Osawa[4], Kenji Takagishi[1]
[1]Department of Orthopaedic Surgery, Gunma University Graduate School of Medicine, Gunma, Japan
[2]Department of Physical Therapy, Takasaki University of Health and Welfare, Gunma, Japan
[3]Department of Orthopaedic Surgery, Inoue Hospital, Gunma, Japan
[4]Department of Orthopaedic Surgery, National Hospital Organization Takasaki General Medical Center, Gunma, Japan

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Introduction

Athletes who repeatedly perform throwing motions are known to experience a greater range of external rotation and a decreased range of internal rotation in the shoulder on the throwing side [1,5,6]. This phenomenon is regarded as an adaptation to reduce mechanical stress on the glenohumeral joint that occurs when performing throwing motions, but when and how these changes occur during the growth period remains unclear. At the same time, humeral torsion angle (HTA) is known to increase on the throwing side of athletes who repeatedly carry out throwing motions [2,4]. This change is likely to be a factor contributing to the increased in range of external rotation and decrease in range of internal rotation in the shoulder on the throwing side [2], but few reports have undertaken detailed surveys throughout the growth period. The present study investigated the relationship between HTA and shoulder range of motion among juvenile baseball players to elucidate factors associated with increases in HTA.

Materials and Methods

Subjects

Subjects comprised 357 baseball players, ranging from elementary school to senior high school (age range, 9-17 years), who took part in medical checks for the purpose of preventing sports injuries. All subjects were boys. We divided subjects into four groups according to school year: middle grades of elementary school (9-10 years old), 63 students; upper grades of elementary school (11-12 years old), 102 students; junior high school

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Zusammenfassung

Hintergrund: Es ist bekannt, dass der Torsionswinkel des Humeruskopfes (humeral torsion angle, HTA) bei Sportlern in Wurfsportarten auf der dominanten Seite größer ist als auf der nichtdominanten Seite. Einzelheiten über die Änderungen im HTA und den tatsächlichen Bewegungsbereich der Schulter im Wachstumsalter sind jedoch kaum bekannt.

Material und Methoden: Es wurden 357 männliche Baseballspieler aus Grund- bis Oberschulen im Alter von 9 bis 17 Jahren untersucht. Als Hintergrundfaktoren wurden Alter, Größe, Gewicht und die Anzahl der Jahre als Baseballspieler erfasst. Die Außenrotation bei der Abspreizung (ABER) und die Innenrotation bei der Abspreizung (ABIR) wurden gemessen und der HTA wurde mithilfe von Ultraschall ermittelt.

Ergebnisse: Auf der nicht-dominanten Seite verringerte sich der HTA mit zunehmendem Alter, während er auf der dominanten Seite unverändert blieb. Damit vergrößerten sich die Unterschiede zwischen beiden Seiten mit dem Alter. Bei allen Spielern, die 11 Jahre oder älter waren, wurde eine laterale Differenz im ABIR festgestellt. Die laterale Differenz des HTA stand in Korrelation mit einem höheren Alter, größerer Körperhöhe und Gewicht und längerer Erfahrung im Baseballspielen.

Schlussfolgerung: Die wiederholte Belastung bei der Wurfbewegung hemmt den normalen Prozess der Verringerung des HTA und beeinflusst den Bewegungsbereich der Schulter während des Wachstumsalters.

Schlüsselwörter
Torsionswinkel des Humeruskopfes – Bewegungsbereich des Schultergelenks – Werfen Behinderung Schulter – Baseball – Juvenile Athleten

(13-15 years old), 61 students; and senior high school (16-17 years old), 131 students. This study was approved by the Clinical Study Review Committee of the implementing facility, and written informed consent to participate in the study was received from each individual player and their parents.

Evaluation items

Age, height, weight, and years of experience playing baseball were elicited as background factors. Using an examination table and digital goniometer, external rotation in abduction (ABER) and internal rotation in abduction (ABIR) were measured for both the dominant and non-dominant shoulders in the supine position, with the shoulder at 90° abduction and the elbow at 90° flexion. Posterior force by the thenar eminence and thumb was applied through the coracoid process to stabilize the scapula before the arm was rotated, and the humerus was passively rotated at the end of either ABER or ABIR range of motion with the force of gravity acting on the arm [9]. HTA was then measured as the angle between the forearm and the tangent line of the greater and lesser tubercle as detected by ultrasonography, using the method described by Myers et al. [7].

Statistical analyses

To analyze how HTA, ABER, and ABIR of the throwing and non-throwing sides changed with growth, intergroup comparisons of evaluation items were made by one-way analysis of variance (ANOVA) followed by multiple comparisons using Tukey's honestly significant difference test. In addition, intragroup comparisons for throwing and non-throwing sides were made using paired t-tests. Next, to identify the factors involved in changes in HTA, correlations between lateral differences in HTA and background factors of players and range of motion of the shoulder were examined using the Pearson correlation coefficient. All statistical analyses were performed using SPSS Statistics version 21 software (IBM Japan, Tokyo, Japan), with a $<5\%$ level of significance.

Results

Measured angles for HTA, ABER, and ABIR are shown in Table 1. Comparing HTA by age group, the angle remained constant and no differences due to age were seen on the throwing side, but the angle on the non-throwing side was significantly smaller in junior and senior high school students than in middle grades of elementary school students. Comparing throwing and non-throwing sides, from upper grades of elementary school onward, the angle was significantly smaller on the non-throwing side (Figure 1).

Significant differences in ABER due to age were also found only on the non-throwing side, and the angle was significantly smaller in junior and senior high school students than in middle-grade elementary school students. Comparing throwing and non-throwing sides from upper grades of elementary school onward, the angle was significantly smaller on the non-throwing side (Figure 2).

Furthermore, significant differences in ABIR due to age were also found only on the non-throwing side, and the angle was significantly greater in senior high school students than in middle-grade elementary school students. Comparing throwing and non-throwing sides, the angle was significantly greater on the non-throwing side at all ages (Figure 3).

Examining the correlations between lateral difference in HTA and