THE STUDY OF SHOULDER INTERNAL AND EXTERNAL ROTATION STRENGTH IN COLLEGE BASEBALL PLAYERS

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The purpose of this study was to investigate the different of dominant arm shoulder rotation torque between the baseball pitchers, infielders, and outfielders. Participants were 27 first-level collegiate baseball players, including 9 pitchers, 10 infielders, 8 outfielders. A Biodex Isokinetic Dynamometer was used for estimation of shoulder muscle strength. This system's test velocity was set at 60 °/s and the range of motion of dominant arm shoulder in flexion, abduction, 90° of abduction with external rotation, and 90° abduction with internal rotation. The results indicated that there was no significant different in internal rotation peak torque and ER/IR ratio between pitchers, infielders, and outfielders. There was significantly different in external rotation peak torque. The infielders and outfielders possess greater external rotation peak torque than pitchers.

KEY WORDS: isokinetic, rotators, rotation toque.

INTRODUCTION: The shoulder rotation was one of the most important performances of throwing athletes, especially baseball players no matter pitchers, infielders, or outfielders. Many studies researched isokinetic muscular performance characteristics of the shoulder internal and external rotation of baseball players. Dauty et al (2003) found the balance in the strength of the internal rotators and the external rotators of shoulder joint was an important factor in shoulder dysfunction. Shoulder injuries are the modern occurrence in baseball players, because they perform internal arm rotation with very fast angular velocity during throwing (Dillman ea al.,1993). The main agonists are the internal rotators being contracted concentrically in the acceleration phase, meanwhile the external rotators have to stabilize the shoulder joint. It is important to evaluate the external and internal rotation strength to prevent injury and design training programs for baseball players(Lin et al., 2015). In addition to shoulder rotation strength studies, the analysis of the external / internal rotation strength ratios also has revealed characteristic strength patterns(Ellenbecker et al.,1997). The external / internal ratio, the agonist-antagonist strength balance, has been used to estimate the risk factors for shoulder pathology, such as the suitable strength of external and internal rotation torque(Edouard et al., 2009; Ellenbecker et al., 2000). In addition, the throwing skills and demands were different between pitcher, infielder,and outfielder. Because there were individual characteritics of different position players, such as outfielders need to throw long distance; infielders throw short distance and need quick motion; pitchers need high speed swing and numberous pitches. We believe there were different of shoulder rotation, include internal and external. Therefore, the purpose of this study was to investigate the different of dominant arm shoulder rotation torque between different position baseball players. The participates were divided into three groups, pitchers, infielders, outfielders. The various were include the external rotation peak torque, internal rotation peak torque, ER: IR ratio. We want to reveal the characteristic performance of shoulder rotation in different position baseball players. It could be helpful to design the effective training programs and decrease the risk of injury.

METHODS: Participants were 27 male first-level collegiate baseball players, including 9 pitchers, 10 infielders, 8 outfielders. All of these participates had no recent history of the shoulder injury (within the past 6 months), or any shoulder discomfort during activity. The average height and weight of pitchers was 176.5± 4.3cm and 69.9±8.5kg. The average height and weight of infielders was 172.3± 6.3cm and 74.5±10.3kg. The average height and weight of outfielders was 177.3± 5.5cm and 71.4±8.8kg. Participates knew the procedures of the study and possible risks. They all wrote consent voluntarily before experimentation.

A Biodex Isokinetic Dynamometer (system 3, Biodex Medical Systems, NY, USA) was used for estimation of shoulder muscle strength. This system's test velocity was set at 60 °/s and the range of motion of dominant arm shoulder in flexion, abduction, 90° of abduction with external rotation, and 90° abduction with internal rotation. The test speed and position were chosen because they has been presented by Lin et al.(2015).

Before undergoing isokinetic testing, each participates performed 5-minute warm-up and stretched their shoulders. During testing, the participates were sat, the trunk was stabilized with anterior strap stretched diagonally from just above shoulder level to the opposite pelvic side. The pelvis was stabilized with an additional strap. The axis of the dynamometer arm was aligned with the glenohumeral joint. The elbow was maintained at 90° of flexion by the device. After test procedure was ready, they performed five submaximal trials to familiarize the testing condition. A 2-minute interval was given between each trial.

Descriptive statistics (mean and standard deviation) including height, weight, peak torque of ER and IR, and ER:IR ratio of participates were presented. A one-way ANOVA test was used to analyze the different of peak torque of ER and IR, and ER: IR ratio between pitchers, fielders, and outfielders. Statistical significance was set at the level of $\alpha < .05$.

RESULTS: Table 1 shows the variance of shoulder rotation at shoulder abduction 90°, include the peak torque of external and internal rotation and ER: IR ratio in the three groups. The results indicated that there was statistically significant difference ($p < .05$) in peak torque of external rotation, and outfielders group were greater than the pitchers group. There was no significant difference in peak torque of internal rotation and ER: IR ratio, although the infielders and outfielders groups had higher value(Table 2).

Table 1
Analysis of variance results for peak torques of shoulder rotation between the three groups

	pitchers	infielders	outfielders
ER peak torque	32.3 ± 6.9	39.2 ± 6.5	41.6 ± 5.6
IR peak torque	45.9 ± 12.3	55.1 ± 11.9	50.8 ± 14.1
ER:IR(%)	71.6 ± 7.3	72.3 ± 9.9	88.2 ± 30.1

Table 2
Analysis of variance results for comparisons of test between the three groups

	F-value	*P*	Remarks
ER peak torque	4.859	.017*	outfielders > pitchers
IR peak torque	1.238	.308	
ER:IR(%)	2.326	.119	

*$p < .05$

DISCUSSION: The peak torque of internal rotation of pitchers, infielders, and outfielders were 45.9, 55.1, and 50.8. The peak torque of internal rotation of pitchers, infielders, and outfielders were 32.3, 39.2, and 41.6. The results of this study were similar to several previous studies presented (Lin et al., 2015; Ellenbecker et al., 1997). In our study, outfielders had greater than pitchers, while the internal rotation peak torque was no significant difference. The reasonable explanation for outfielders had greater external rotation peak torque because of the outfielders need to throw long distance concomitant more

extension of the arm when throwing the ball. Furthermore, the pitchers showed the lowest internal rotation and external rotation peak torque was different with some previous studies. It means the muscle strength of internal rotators and external rotators in these pitchers were not enough. The results of ER: IR strength ratios as between 71.6% to 88.2% were in agreement with the results showed in those previous investigations(Lin et al., 2015; Noffal, 2003). Noffal (2003) indicated the lower ratio is due to a greater IR strength without a concomitant increase in ER strength. But, some previous studies suggested that we should try to increase the ER: IR ratio by training(Alderink & Kuck, 1986).The external rotators play an important role during deceleration of the pitching in the follow-throw phase. Ellenbecker et al (2000) implicated that increasing the ER: IR ratio to 76% would be better. As we know it is a better way to increase ER: IR ratio by increasing the external rotation strength, because it could effectively increase the ratio and add more stability to shoulder in baseball pitching. It also could possibly prevent the shoulder injury. The results of this study showed the similar consequence with those investigations. This was a useful information for coaches to arrange the effective training program. In my opinions, these pitchers should design more effective training programs to enhance their shoulder muscle strength, especially in external rotators. However, the rotate cuff are the main external rotators. The rotate cuff consist of supraspinatus, infraspinatus, subscapularis, and teres minor. Although the rotate cuff are not the agonist for pitching, but they play very important roles for stabilization the glenohumeral joint when players throwing. Moreover, the rotate cuff are small muscles, so it has little effect by weight training. If they make eccentric isokinetic training for the rotate cuff, such as elastic cord or elastic belt, it will have better effect for external rotators strenght training. Therefore, we could decrease the ER: IR ratio by increasing the strength of rotate cuff, and the shoulder will become more stable after stronger the strength of rotate cuff. Such consequence will improve the effciency of pitching, and further reduce the risk of shoulder injoury.

CONCLUSION: There was little investigation to research the shoulder rotation strength of different positions in baseball players. The pitchers, infielders, and outfielders have the different type of performance to use their arm, and it could show some different components of shoulder rotation strength. In our study, it was revealed the characteristics of shoulder rotation strength in different position baseball players. The results were also implicated that these pitchers need to design more muscular training to enhance their shoulder muscle strength, espacially in external rotators. We suggest that eccentric isokinetic training for the rotate cuff will be effective to enhance the muscle strenght. And it is a good way to use elastic cord or elastic belt.

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