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A Study on the Norm-Referenced Criteria for Isokinetic Functional Strength of the Wrist for Junior Baseball Players

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Abstract

The purpose of this study was to norm-referenced criteria of upper limb for Korean middle school baseball player. Ninety five male middle school students with age ranging 14 to 15 years were participated in this study. They didn't have any medical problem. HUMAC NORM (Stoughton, MA, USA) equipment system was used to obtain the values of peak torque, peak torque to body weight ratio. The results were presented as a norm-referenced criterion value using 5-point scale, by 5 groups (5 percent, 15 percent, 60 percent, 15 percent and 5 percent) and a few suggestions from this study as follows;

- For the evaluation of strength, peak torque % body weights more than peak torque appeared to be more valuable information.
- The provided criterion of peak torque % body weights are very information for baseball coach, athletic trainer, baseball player, sports injury rehabilitation specialists.

Keywords: Baseball, Isokinetic Strength, Norm-Criteria, Peak Torque, People

1. Introduction

Isokinetic exercises were introduced in the late 1960s by Hislop and Perrine and it was[1] that reported through their study that isokinetic exercises had a significantly greater effect than isometric or isotonic exercises in increasing muscle strength[2,3]. Isokinetic exercise refers to muscle contraction exercises at a constant speed. The body movements are formed by the movement of the musculoskeletal structure centering on each joint. The tension that occurs when muscles are contracted accelerates the movement. Therefore the tension that occurs with the increase in movement speed changes with the change in the angle of the joint movement. In order to remove this factor, a machine was used to ensure that muscle contraction will occur at a constant speed and a strong weight will be applied[1,3,4].

Isokinetic exercises can be conducted while receiving the same maximum weight and therefore is more effective in improving muscle strength and has a high reliability for mechanical exercise assessment of the muscle function. Therefore, muscle contraction at a constant speed appears as torque that triggers acceleration and which is the strength that allows the fast movement of the body part. The assessment for the exercise results of isokinetic muscle strength is done for peak torque, muscle power, muscle endurance, and agonist/antagonist ratio, and therefore is very effective[3,5-8].

The objective measurement of the reference muscle strength plays the role of standard data that is valuable of assessing abnormal muscle strength and identifying a decrease in bodily function[9]. As such, objective studies on various muscle groups have been conducted. But there are not sufficient preceding studies on the wrist.

Suggested that the measurement of wrist muscle strength will provide clinical data for rehabilitation treatment[10]. In Korea, the measurement of normal figures of the wrist among normal subjects in their 20s has been

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reported[11], and there were almost no studies on the measurement of flexor or extensor in the wrist except for studies that were conducted on the isokinetic muscle strength of the wrist in athletes of volleyball, basketball and tennis[12] and the study on the correlation between university baseball players' body size, maximum muscle strength in related joints, straight balls and slide speed, along with the measurement of the flexor and extensor of the wrist[13]. The start of baseball can be said to be the pitching of a ball, which makes the ball-throwing part critical and the wrist is an extremely important joint physiologically for the baseball player. In particular, it plays an important role in the hitter and is the pivot point for power that determines the quality of the pitch of a pitcher. The strength of most muscles related to the shoulders, knees, ankles and lower back were measured using baseball players as subjects in most cases, but there is no report on the reference of muscle strength when assessing the wrist. Therefore this study seeks to set this reference point and provide a standard indicator for baseball coaches, trainers and junior baseball players that experience frequent injury.

2. Study Method

2.1 Study Subjects

Randomly selected 95 male baseball students of 21 middle schools located in the Seoul, Gyeonggi area and registered with the Korea Baseball Association, and those who visited the S-hospital in Seoul from October, 2013 to February 2014 for a medical check-up were used as subjects. Athletes with a medical history or physical examination result that revealed medical issues were excluded from the study. The purpose of the study was thoroughly explained to the participants and consent was received that they will do their best. The physical characteristics of the subjects are as shown in Table 1.

Table 1. Physical characteristics of the subjects

Position	N	Age(yrs)	Height (cm)	Weight (kg)	Career (yrs)
Picher	31	14.74±0.45	175.84±5.44	73.77±10.51	4.29±1.64
Position Player	64	14.61±0.92	170.98±5.79	66.98±12.37	5.06±1.57
Total	95	14.65±0.48	172.57±6.09	69.20±12.17	4.81±1.63

Value are Mean±SD

2.2 Test Method and Variables

2.2.1 Test Method for Extensor/Flexor of the Wrist

HUMAC NORM (Stoughton, MA, USA), equipment for measuring isokinetic muscle strength was used to measure the muscles of the wrist. The test was conducted three times and 20 times respectively at 30 deg/sec and 120 deg/sec. For accurate measurement, a practice of 3 times was done at maximum muscle strength before the test, a rest was taken, and then the test was conducted. The rotation axis of the subject's wrist was aligned with the rotation axis of the Dynamometer, the legs were fixed using a supporting system and the Dynamometer arm pad was fixed. Set anatomical zero was established and the range of movement was set at 70 degrees for extension and 80 degrees for flexing. In order to minimize the involvement of other muscle groups or unnecessary movement, a belt was used to fix the chair Figure 1. During the test, verbal encouragement was given to the subject to exert maximum muscle strength.

2.2.2 Measurement of Variables

The assessment reference for measurement variables were set as follows for the extensor and flexor movements during isokinetic exercises.

2.2.3 Peak Torque

The muscle strength measured without consideration given to body weight. The torque of the extensor and flexor after 3 repeats and 20 repeats was measured at 30 deg/sec and 120 deg/sec. The unit is Nm.

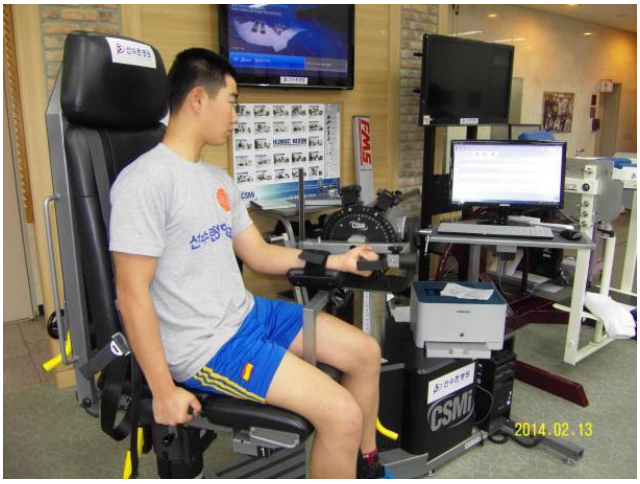

Figure 1. Measurement of the isokinetic muscle strength in the wrist.

2.2.4 *Peak Torque % Body Weight*

The muscle strength measured with consideration given to body weight. The maximum torque of the extensor and flexor after 3 repeats and 20 repeats is divided by the body weight. This figure represents relative muscle strength and the unit used is %.

2.3 Analysis of Data

The measured values from the HUMAC NORM data recording computer were analyzed using SPSS/PC 18.0 program for Windows to calculate the mean and standard deviation for each measurement variable. In order to set an assessment reference for the isokinetic muscle strength in the flexor and extensor of junior baseball players' wrists, the measured results were applied as a percentage and categorized into 5 groups (5 percent, 15 percent, 60 percent, 15 percent and 5 percent). This is because there is a small change in the ratio between categories not only when it is a normal distribution but when it is an abnormal distribution. It also has the advantage of allowing the application of normal distribution theories.

3. Results

The analysis of measured variables using the HUMAC NORM (Stoughton, MA, USA) is as follows.

3.1 Peak Torque at Angular Velocities of 30 deg/sec and 120 deg/sec

The mean and standard deviation of the measured values for the muscle strength of the extensor and flexor are as seen in Table 2.

The mean for the right extensor strength and flexor strength at an angular velocity of 30 dig/sec was 9.44 ± 3.48 and 12.98 ± 3.06 Nm, with the mean of the left extensor and flexor 10.57 ± 4.14 and 12.06 ± 3.93 Nm, respectively. At an angular velocity of 120 deg/sec, the mean for the right extensor and flexor was 8.13 ± 3.08 and 12.32 ± 2.92 Nm, respectively, and for the left extensor and flexor the mean values were 8.98 ± 3.40 and 11.04 ± 3.23 Nm, respectively.

Table 2. Measured values of peak torque in the extensor and flexor of the wrist (Unit:Nm)

	30 deg/sec				120 deg/sec			
	Right		Left		Right		Left	
	Ext	Fle	Ext	Fle	Ext	Fle	Ext	Fle
Mean± SD	9.44± 3.48	12.98± 3.06	10.57± 4.14	12.06± 3.93	8.13± 3.08	12.32± 2.92	8.98± 3.40	11.04± 3.23

Ext: Extension, Fle: Flexion

3.2 Peak Torque/Body Weight Ratio at an Angular Velocity of 30 deg/sec and 120 deg/sec

The mean and standard deviation of the measured muscle strength for the extensor and flexor on the left and right wrists at an angular velocity of 30 deg/sec and 120 deg/sec are as presented in Table 3.

At an angular velocity of 30 deg/sec the mean for the muscle strength for the right extensor and flexor per unit body weight were 14.09 ± 4.68 and 18.81 ± 3.90 %, respectively, and for the left they were 15.34 ± 5.38 and 17.44 ± 4.76 %, respectively. At an angular velocity of 120 deg/sec the mean for the muscle strength of the right extensor and flexor per unit body weight were 11.97 ± 4.05 and 18.44 ± 5.07 %, respectively, and for the left side they were 13.06 ± 4.46 and 16.27 ± 3.74 %, respectively.

3.3 The Assessment Norm-Referenced Value of the Wrist Muscle Strength through an Extensor and Flexor Test of Junior Baseball Players

3.3.1 *Assessment Norm-Referenced Value of Peak Torque at Angular Velocities of 30 deg/sec and 120 deg/sec*

The assessment reference value of the peak torque for the flexor and extensor at angular velocities of 30 deg/sec and 120 deg/sec are as shown in Table 4.

Table 3. Measured values of peak torque in the extensor and flexor of the wrist (Unit:%)

	30 deg/sec				120 deg/sec			
	Right		Left		Right		Left	
	Ext	Fle	Ext	Fle	Ext	Fle	Ext	Fle
Mean ±SD	14.09 ±4.68	18.81 ±3.90	15.34 ±5.38	17.44 ±4.76	11.97 ±4.05	18.44 ±5.07	13.06 ±4.46	16.27 ±3.74

Ext: Extension, Fle: Flexion

Table 4. Assessment Norm-referenced value of peak torque in the extensor and flexor of the wrist (Unit:Nm)

	Assessment		Very weak	Weak	Average	Good	Excellent
30deg/sec	Ext	R	4.22 or less	4.23-7.69	7.7-11.18	11.19-18.87	18.88 or more
		L	4.36 or less	4.35-8.49	8.5-12.64	12.65-16.77	16.78 or more
	Fle	R	8.39 or less	8.38-11.44	11.45-14.51	14.52-17.56	17.57 or more
		L	6.16 or less	6.17-10.8	10.09-14.03	14.04-17.95	17.96 or more
120deg/sec	Ext	R	3.51 or less	3.52-6.58	6.59-9.67	9.68-12.74	12.75 or more
		L	3.88 or less	3.87-7.27	7.28-10.68	10.69-14.07	14.08 or more
	Fle	R	7.94 or less	9.95-10.85	10.86-13.78	13.79-16.6	16.7 or more
		L	6.19 or less	6.20-9.41	9.42-12.86	12.87-15.88	15.89 or more

Ext: Extension, Fle: Flexion, R: right, L: Left

3.3.2 The Assessment Norm-Referenced Value of Peak Torque per unit Body Weight at Angular Velocities of 30 deg/sec and 120 deg/sec

The assessment reference value for the muscle strength of the extensor and flexor per body weight at angular velocities of 30 deg/sec and 120 deg/sec, which show muscle strength in relation to body weight, are as shown in Table 5.

4. Discussion

This paper proposes an accurate wrist strength criterion of junior baseball player. The purpose of this study was to evaluate the training plan, training results leader for baseball players and trainers and to provide evidence that could be a reference. Using isokinetic equipment were 95 patients wrist flexion strength tests and god power

Despite the growing popularity of isokinetic testing[14], knee represents the most common joint assessed. Nevertheless, clinicians and researchers are becoming increasingly interested in isokinetic assessment and exercise of upper extremity joints as the shoulder and the elbow[15-19]. Recent studies have investigated distal muscles of the upper limb, particularly forearm and wrist muscles[15,17,19-21]. Some pathology which results from sport activities and specific professional occupations involve these muscles[3,12,13,32].

Recent studies have investigated concentric muscle of wrist joint was in flexion, 18 (±12) % to 22.5 (± 10) % and in extension, 13 (± 6) % to 14 (± 9) %[22]. Just as studies have demonstrated above 20 wrist muscle strength and

Table 5. Assessment Norm-referenced value of peak torque per unit body weight at angular velocities of 30 deg/sec and 120 deg/sec (Unit:Nm)

	Assessment		Very weak	Weak	Average	Good	Excellent
30 deg/sec	Ext	R	7.07 or less	7.08-11.74	11.75-16.43	16.44-21.10	21.11 or more
		L	7.27 or less	7.28-12.64	12.65-18.03	18.04-23.40	23.41 or more
	Fle	R	12.96 or less	12.97-16.85	16.86-20.76	20.77-30.50	30.51 or more
		L	10.3 or less	10.4-15.05	15.06-19.82	19.83-24.57	24.58 or more
120 deg/sec	Ext	R	5.89 or less	5.90-9.93	9.94-14	14.1-18.04	18.05 or more
		L	6.37 or less	6.38-10.82	10.83-15.29	15.30-19.74	19.75 or more
	Fle	R	10.83 or less	10.84-15.8	15.9-20.98	20.99-26.04	26.05 or more
		L	10.66 or less	10.67-14.3	14.4-18.14	18.15-21.87	21.88 or more

Ext: Extension, Fle: Flexion, R: right, L: Left

muscle power of the middle school baseball player in each of the men had similar levels.

This shows that the wrist is used mainly on the nature of the sport of baseball player campaign.

However, most studies have measured the strength of 20 adult data and the data for the wrist strength of middle school students is nonexistent situation

In the conduct of research, the absolute and relative muscle strength was that the difference is so accurate that assessment to evaluate and prescribe muscle strength per unit weight of Relative Strength.

In this study, we use relative strength as a tool for evaluation, during training or when, but based on the absolute strength prescription has considered relevant to assess the relative strength consideration.

5. References

1. Thistle HG, Hislop HJ, Moffroid M. Isokinetic contraction: a new concepts of resistive exercise. Arch Phys Med Rehabil. 1967; 48:279–82.
2. Hislop HJ, Perrine JJ. The isokinetic concept of exercise. Physi Ther. 1967; 49:114–7.
3. Perrine HD. Isokinetic Exercise and Assessment. Human Kinetics Publisher; 1994.
4. Moffroid, Whipple. Physiological Assessment of Human Fitness. Human Kinetics Publisher; 1970.
5. Adams MG. Exercise Physiology Laboratory Manual. Wm. C. Brown Publishers; 1990. p. 178–83.
6. Beam WC, Bartels RL, Ward RW. Multiple comparison of isokinetic leg strength in male and female collegiate atheletic teams. Medicine and Science in Sports and Exercise. 1985; 17(2):269.
7. Daniel NK. The Injuries Athletes. J. B. Lippincott Company; 1982. p. 146–50.
8. Davies GJ. Controlling anterior shear during isokinetic Knee extension exercise. The Journal of Orthopaedic and Sports Physical Theraphy. 1984; 4(1):26–32.
9. Thorstensson A, Grimby G, Karlsson J. Force-velocity relations and fiber composition in human muscles. J Appl Phy. 1976; 40:12–6.
10. Vanswearingen JM. Mearsuring wrist muscles strength. JOSPT. 1983; 4:277–87.
11. KimD-Y. Isokinetic measures of forearm muscle strength in young normal adults. J KAUTP. 1994; 1:47–54.
12. Choi M-J, Lee K-W. A study regarding isokinetic training for wrist strengthening of volleyball, basketball and tennis players. KJPE. 1997; 36(2):283–91.
13. Kim Y-B. The correlation fast ball and slider speed physique related isokinetic muscular peak torque of university baseball pitchers. J KJSP. 2014; 23(1):1123–33.
14. Calmels P, Abeillon G, Domenach M. et al. Bilanisocinetique du coudeet dupoignet. Isocinetisme et medecine de reeducation; Masson, Paris; 1991. p. 66–74.
15. Jorgensen K, Bankov S. Maximum strength of elbow flexors with pronated and supinated forearm. Med Sport. 1971; 6:174–80.
16. Mandalidis DG, O'Brien M. Isokinetic strength of the elbow flexors with the forearm in supination and in the neutral position. Isokinetics Exerc Sci. 2001; 9:111–7.
17. Mayer F, Horstmann T, Kranenbert U et al. Reproducibility of isokinetic peak torque and angle at peak torque in the shoulder joint. Int J Sports Med. 1994; 15:26–31.
18. Cooney WP. Sports injuries to the upper extremity. How to recognize and deal with some common problems. Postgrad Med. 1984; 76:45–50.
19. Field LD, Altchek DW. Elbow injuries. Clin Sports Med. 1995; 14:59–78.
20. Field LD, Savoie FH. Common elbow injuries in sport. Sports Med. 1998; 26:193–205.
21. Rettig AC, Patel DV. Epidemiology of elbow, forearm, and wrist injuries in the athlete. Clin Sports Med. 1995; 14:289–97.
22. Forthomme B, Croisier JL, Foidart-Dessalle M, Crielaard JM. Isokinetic assessment of the forearm and wrist muscles. Isokinetics & Exercise Science. 2002; 10:121–8.