P03-5 ID32

ARMWRESTLING EXERCISE AND SHOULDER INTERNAL ROTATION STRENGTH

Kuo-Cheng Lo[1], Hong-Wen Wu[2], Meng-Kai Hong[3], Lin-Hwa Wang[3]

[1]Physical Education Office, Kun Shan University, Tainan, Taiwan
[2]Department of Physical Education, National Taiwan University of Physical Education and Sport, Taichung, Taiwan
[3]Institute of Physical Education, Health & Leisure Studies, National Cheng Kung University, Tainan, Taiwan

The purpose of this study was to investigate the differences in shoulder internal rotation strength between winner and loser during armwrestling. Prior to the armwrestling experiment, subjects would be tested for strength of shoulder internal rotation with 45 °/sec and 60 °/sec by isokinetic dynamometer. The results showed that the strength of shoulder internal rotation at angular velocity of 45°/sec and 60°/sec had significant difference between winner and loser (P <.05). Overall the mean peak torque values of shoulder internal rotation were significantly higher in winner than in loser. However, the participants whose shoulder internal rotators had been trained might be able to reverse the situation.

KEY WORDS: biomechanics, isokinetic, upper arm, recreation.

INTRODUCTION: Arm wrestling (AW) sport is popular in the world, however, studies of sport medicine and sport science on AW were very limited. Possible reasons include technical limitation, the well-established rules, less evident enthusiasm and unknown risk of AW match. Studies of sport medicine and sport science discussing armwrestling (AW) have been limited despite of the popularity of this sport. Fractures sustained during AW competition are rare (Nyska et al., 1992; Low & Lim, 1991), especially in official events (Low & Lim, 1991). Some studies presented that continuously attack received by arm wrestler of defender might result in an intense rotational force with humeral fracture because defender suddenly and passively stretched and changed from their maximally concentric contraction to eccentric compensatory contraction (Ogawa & Ui, 1997). However the timing of most fracture was uncertain. Some literatures reported the timing in even position (Whitaker 1977), in winning phase (Heilbronner et al., 1980) and in losing phase (Whitaker 1977). The timing of fracture occurrence showed 17 times in even position, 9 in the losing phase, and 4 in the winning phase of 30 fracture cases(Ogawa & Ui, 1997). Investigation of the differences in shoulder internal rotation strength between loser and winner during armwrestling was the purpose of this study.

METHODS: Thirty healthy male volunteers (Height: 173.8 ± 7.3 cm; weight: 66.3 ± 8.3 kg) were recruited from National Cheng Kung University. All subjects would be grouped into pairs by similar weight; they reported neither any surgery history on limbs nor any injury on limbs in last six months. None of the participants had neuromuscular system related diseases. Winning or losing a match was determined by the rules of WAF (World Arm Wrestling Competition Federation) and World of Armwrestling. The measurement of the dynamometer of maximum strength was done by Biodex system (Biodex System 4 Pro, New York, USA) and the test of strength of shoulder internal rotation should be applied to all participants. The test position would be set with shoulder flexion 60° to 100° (the angle was chosen by participants), shoulder internal rotation 0°, elbow flexion 90° and wrist angle 0°. Participants would be allowed neither to lean on the back of the chair (nor the seat belt was used) nor to hold the handle at the chair side (as handle of AW). The maximum strength of shoulder internal rotation of all participants would be tested by Biodex at least 2 days prior to AW competition to avoid fatigue. The position of test would be set in shoulder flexion 60 °-100 ° (the angle was chosen by participants), shoulder internal rotation 0 °, elbow flexion 90 ° and wrist angle 0 ° (as AW starting position). The trajectory of exercise started from shoulder

internal rotation 0 ° to 60 °and back to 0 °, three times with two different velocities (45 °/sec and 60 °/sec). Verbal encouragement from researchers would be given to participants.
Paired sample t test (matched sample design) was conducted for the significant difference in the shoulder internal rotation strength between winner (winning position) and loser (losing position). Regression of logistic statistical analysis was used to examine whether strength could forecast the result of match. Statistical analysis was performed using the statistic software SPSS17.0. Significance level was defined as $\alpha < .05$.

RESULTS: The result of Omnibus test did not reach the statistical difference (chi-square: 8.51; p=0.075). Table 1 showed the comparison of detail of strength at different velocities and types of muscle contraction between winner and loser. The strength of eccentric contraction and concentric contraction at 45 °/sec and in 60°/sec was different between winner and loser (p<.05 in all).

Table 1
Detail of strength at different velocities and types of muscle contraction between winner and loser.

	Winner	Loser	*P*	Effect size
ECC 45°/sec.	86.02 ± 21.32	71.17 ± 14.60	.001*	0.81
CON 45°/sec.	79.55 ± 19.28	66.32 ± 11.54	.004*	0.83
ECC 60°/sec.	82.40 ± 23.38	70.79 ± 14.41	.032*	0.58
CON 60°/sec.	78.80 ± 23.53	66.86 ± 12.75	.041*	0.63

Data are mean newton meter ± SD. * *P* <.05. Abbreviations: ECC, eccentric contraction; CON, concentric contraction.

DISCUSSION: Different from other studies in which participants' bodies were fixed to the dynamometer (Komi et al., 2000; Walmsley & Szybbo, 1987), this study tried to simulate actual AW situation as much as possible without fixing subjects to the dynamometer, so participants were able to exert their strength of both internal rotator and whole body. It has been confirmed that arm strength is the greatest contributor to the victory of an AW match (Hong et al., 2011). Maximum strength in eccentric contraction and at slower angular velocity suggested maximum strength on the dynamometer by participants, and the specific characteristics of AW could possibly explain the training subjects' greater strength in larger angular velocity (Bompa 1999). The observed strength of shoulder internal rotation might indicate greater torque values (Newton meter; N.m) of winner.
Training on shoulder internal rotator is necessary for AW competition. However AW athletes should strengthen the specific range of motion of shoulder internal rotation at about 30°. From the results of elbow pattern, strengthening the elbow flexor seems to be the most important idea because winner needs to flex elbow to acquire an advantaged posture. On the other hand, loser tends to extend elbow to allow back of hand to touch pad in this study; therefore, strengthening the elbow flexor can increase not only offensive capabilities but also defensive capabilities. The particular muscle training section is important, especially in range of motion of winning phase by concentric contraction and losing phase by eccentric contraction. It is suggested that coaches and fitness instructors could use the isokinetic dynamometer to estimate chance of winning by peak torque.

CONCLUSION: The strength of shoulder internal rotation at angular velocity of 45°/sec and 60°/sec had significant difference between winner and loser. Overall the mean peak torque values of shoulder internal rotation were significantly higher in winner than in loser. However, the participants whose shoulder internal rotators had been trained might be able to reverse the situation. It is concluded that shoulder internal rotator may determine the result of an AW match, and injury risk may become higher when strength becomes weaker.

REFERENCES:

Bompa, T. O. (1999). *Periodization: theory and methodology of training* (4th ed.). Champaign, IL: Human Kinetics.

Heilbronner, D. M., Manoli, A., 2nd, & Morawa, L. G. (1980). Fractures of the humerus in arm wrestlers. *Clinical Orthopaedics & Related Research,* 149, 169-171.

Hong, M. K., Lin, C. Y., Liao, Y. S., Hong, C. K., & Wang, L. H. (2011). *Kinematic and electromyographic analysis of upper extremity in arm wrestling*. Paper presented at the ISBS 2011.

Komi, P. V., Linnamo, V., Silventoinen, P., & Sillanpää, M. (2000). Force and EMG power spectrum during eccentric and concentric actions. *Medicine & Science in Sports & Exercise, 32*(10), 1757-1762.

Low, B. Y., & Lim, J. (1991). Fracture of humerus during armwrestling: report of 5 cases. *Singapore medical journal, 32*, 47-49.

Nyska, M., Peiser, J., Lukiec, F., Katz, T., & Liberman, N. (1992). Avulsion fracture of the medial epicondyle caused by arm wrestling. *American Journal of Sports Medicine, 20*(3), 347-350.

Ogawa, K., & Ui, M. (1997). Humeral Shaft Fracture Sustained during Arm Wrestling: Report on 30 Cases and Review of the Literature. *Journal of Trauma: Injury, Infection, and Critical Care, 42*(2), 243-246

Walmsley, R. P., & Szybbo, C. (1987). A comparative study of the torque generated by the shoulder internal and external rotator muscles in different positions and at varying speeds. *Journal of Orthopaedic and Sports Physical Therapy, 9*(6), 217-222.

Whitaker, J. H. (1977). Arm wrestling fractures-a humerus twist. *American Journal of Sports Medicine, 5*(2), 67-77.

Acknowledgement

This study was supported by the Aim for the Top University Project grant D100-34B06 and partly supported by grant NSC 100-2410-H-006-076-MY2, from the National Science Council, Taiwan. The authors acknowledge Dr. Fong-Chin Su for the assistance and the application of the Motion analysis laboratory at Institute of Biomedical Engineering of NCKU.