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A KINEMATIC ANALYSIS OF THE HIP MOTION IN THAI BOXING CLINCH

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The purpose of the study was to investigate the kinematics of the hip joint between the double collar-tie and double underhook Thai Boxing clinching positions. Ten amateur mixed martial arts athletes executed six knee strikes for both clinching positions. A standard two-dimensional video motion analysis captured at 60 Hz was conducted. The results showed a statistical significant difference at the hip joint angle between two clinching positions. In addition, there was a statistically significant correlation found at the hip joint angular velocity and acceleration. This study demonstrates the importance of the hip joint movement in both clinching positions, which implies the importance of strength training and flexibility at the hip. Future studies are warranted to examine the lower leg kinematic chain to fully understand the Thai Boxing clinch.

KEY WORDS: lower extremity, martial arts, Muay Thai,

INTRODUCTION: Thai Boxing is a national sport of the Kingdom of Thailand. Sidthilaw (1997) examined the kinetic and kinematic characteristics of Thai Boxing roundhouse kicks at different height with ten male Thai Boxing athletes. These athletes had eight to forty eight months of training experience. From this study, the results showed the middle-level kick generated the greatest peak force and impulse while the high-level kick involved the least amount of force and impulse. The amount of peak force and impulse were directly related to the final velocity of the ankle (r = .86 and r = .79), but they were not significantly related to leg strength. Sidthilaw (1997) further indicated that the Thai Boxing roundhouse kick could generate sufficient force to cause neurological impairment, skull fractures, facial bone fractures, and rib fractures. Other research studies have analyzed lower-limb kinematic variables in similar martial arts (Hwang, 1987; Pozo et al, 2011). Hwang (1987) conducted a preliminary kinematical analysis of the Taekwondo front kick with three amateur Taekwondo athletes who were instructed to execute kicks at a target and without it. Hwang (1987) determined that the absolute linear foot velocities were between 10.3 m/s and 11.7 m/s for with a target condition and between 0.8 m/s and 1.0 m/s for without a target condition, and the maximum foot velocities of both conditions were between 11.6 m/s and 13.4 m/s. In regards to the angular velocity, Pozo, Bastein, and Dierick (2011) determined that there were significant differences in several lower-limb joint angles with angular velocity peaks occurring earlier in the kick for the Shotokan karate kick Mae-Geri. However, there are no research studies that have investigated the Thai boxing clinch. There are two types of Thai boxing clinch: double collar-tie and double underhook. The double collar-tie requires a martial artist to lock and secure the opponent's neck while the double underhook focuses on securing the opponent's shoulders and upper body. Both of these clinch positions possess a striking motion that is initiated by the hip joint to attack the opponent, but the exact mechanics of hip movement in both clinching positions was still unclear. Therefore, the purpose of this study was to examine the hip kinematics between the double collar-tie and double underhook Thai Boxing clinching positions.

METHODS: Ten amateur martial arts athletes were recruited to participate in the study. The mean age, height, weight and experience in mixed martial arts were 23 ± 5 yrs., 1.8 ± 0.1 m, 73.3 ± 11.4 kg, and 5.9 ± 5.4 yrs., respectively. Written informed consent was obtained from the participants before participation in the study and the institutional research ethics review board approved the study. The study took place at the Biomechanics Laboratory. Two Thai Boxing cotton hand wraps (4.6 m) and two standard Thai Boxing gloves (.34 kg) were provided to each participant for wrist protection while simulating both double collar-tie and double underhook clinching positions. The participants performed a dynamic warm up to increase core muscular temperature and muscular force production to prevent against potential injuries. Joint reflective markers were placed on the right side of the following joint locations: lateral epicondyle of the femur (knee), greater trochanter (hip), and greater tubercle (shoulder). Each participant wore a tight-fitting black shirt and shorts to provide better contrast between the markers and clothes for video analysis. Participants executed six continuous knee strikes with the dominant leg (right) in each of the two clinching positions; for a total of twelve knee strikes. Since the knee strikes were performed in a continuous motion, the participants attempted to simulate real fight-like movement. Each participant had three minutes break between both two clinching positions to avoid the influence of fatigue. For each knee strike, the participant directed the kick towards an experienced Thai Boxing athlete whom was equipped with a belly pad, two standard Thai Boxing pads, a groin protector, and a mouth guard to insure safety of the athlete. Since the target was well protected, the risk of injury was minimal. Lastly, the order of the clinching positions was randomized to reduce any order effect. Following all twelve knee strikes, the participant performed five minutes of static stretching for cool down and recovery. A standard two-dimensional video analysis was conducted with a JVC video camera (model: GR-D371V) captured sagittal motion at 60 Hz with 650W artificial lighting. Data collection was conducted in one hour over the duration of one day. Data was recorded on all twelve knee strikes, and a total of 120 trials were collected and analyzed in the study. The video was transferred onto a computer in the Biomechanics Lab and analyzed with Ariel Performance Analysis System (APAS). Digital filter was applied at 8 Hz to filter the data. Dependent sample t-tests ($\alpha = 0.05$) and Pearson's product-moment correlations were conducted with SPSS (version 18) software.

RESULTS: A dependent sample t-test ($p < 0.05$) was conducted between the double collar and double underhook clinching positions at the hip joint. The joint angular displacements, velocities, and acceleration were calculated and compared between the two positions, Table 1. The results showed a statistical significant difference at the hip joint angular displacement between both clinching positions. However, there were no statistical differences in the joint angular velocity and joint angular acceleration between both clinching positions. Further, to better understand the relationship between two clinching positions, a two-tailed Pearson's product-moment correlation was conducted for the hip in both clinching positions, Table 2. Between both clinching positions, there was a significant strong correlation in the angular velocity and acceleration but no significant correlation in the hip joint angular displacement.

Table 1

Kinematical Variables between Clinching Positions

Kinematical Variables	Double Collar	Double Underhook	*p*
Angular Displacement (°)	103.2 ± 13.4	88.4 ± 12.4	0.00*
Angular Velocity (°/sec)	-9.4 ± 86.8	-10.1 ± 76.9	0.94
Angular Acceleration (°/sec^2)	8790 ± 3603	8691 ± 4284	0.90

* Statistical significant at $p < 0.05$

Table 2

Correlation between Clinching Positions

Kinematical Variables	*p*
Angular Displacement (°)	0.55
Angular Velocity (°/sec)	0.94*
Angular Acceleration (°/sec^2)	0.85*

* Significant correlation at $p < 0.05$

DISCUSSION: The results revealed a statistical significant difference at the hip joint angle between both clinching positions. In a previous Taekwondo research study, Kim et al. (2010) observed a significant difference in the peak hip flexion for the roundhouse kicking leg. In this study, the hip flexion for the double collar-tie and double underhook clinching positions were 103.2˚ ± 13.4˚ and 88.4 ˚± 12.4˚, respectively. One of the main factors that may explain a statistical significant difference for the joint angular difference at the hip between both clinching positions was the hip's linear distance from the target. This interpretation corresponds with Kim et al. (2010) who determined that the target distance had an influence on hip flexion and pelvic rotation. From qualitative video analysis, the hip was farther away from the target for the double collar-tie position than for the double underhook position. This factor might have allowed the athlete to achieve a greater hip flexion in this research study. For the joint angular velocity, there was a high standard deviation observed, which indicates that participants executed the hip striking motion with different velocities. Some of the reasons why each participant performed the hip striking motion at different angular velocities could be attributed to recruitment of fast-twitch muscle fibers, muscle fiber composition, muscular strength, and technique. When comparing this study to other martial arts studies, Pozo et al. (2010) also did not find significant difference at the hip joint for the peak angular velocities for the Shotokan Karate Mae-Geri kick with reported values of 721˚/s and 605˚/s for international and national athletes, respectively. Further, in this study both clinching positions reached their peak angular velocities approximately 0.1 s before the contact which supports Sorensen, Zacho and Simonsen (1996)'s finding that motion-dependant moments from lower leg angular velocity may cause thigh deceleration during the martial arts front kick before the contact. From the Pearson product-moment correlation coefficient, it was revealed that a statistical significant strong correlation was found in the hip joint angular velocity and acceleration between two clinching positions. The correlation results may suggest that there is a high transferability of skill and that by training one clinching technique may be beneficial for another clinching technique. More research studies are required to validate the ability of skill transfer between two clinching positions.

CONCLUSION: This study provides an important understanding on the hip kinematics of the Thai boxing clinching positions in the dominant (right) leg for both double collar-tie and double underhook techniques. This study indicates that the double collar-tie clinching position technique has a lesser hip flexion angle than the double underhook clinching technique. Thus, the double collar clinching technique may be more suitable for striking a lower target in relation to the striker's knee position. Finally, this study suggests the importance of strength training and flexibility at the hip joint for injury prevention and performance improvement. Future studies are warranted to analyze joints on the lower kinematic chain to further understand the Thai Boxing clinch.

REFERENCES:

Hwang, I. (1987). Analysis of the kicking leg in taekwondo. *Proceedings of the 4th International Conference of Biomechanics in Sports (Del Mar, California).*

Kim, J., Kwon, M., Kwon, Y., & Yenuga, S. (2010). The effects of target distance on pivot hip, trunk, pelvis, and kicking leg kinematics in taekwondo roundhouse kicks. *Journal of Sports Biomechanics*, *9*(2), 98-114.

Pozo, J., Bastein, G., & Dierick, F. (2011). Execution time, kinetics, and kinematics of the mae-geri kick: comparision of national and international standard karate athletes [Electronic version]. *Journal of Sports Sciences, 29*(14), 1553-1561.

Sidthilaw, S. (1996) Kinetic and kinematic analysis of thai boxing roundhouse kicks (Unpublished doctoral dissertation). *Oregon State University, Oregon.*

Sorensen, H., Zacho, M., Simonsen, E. B., Dyhre-Poulsen, P., & Klausen, K. (1996). Dynamics of the martial arts high front kick. *Journal of Sports Sciences, 14*(6), 483-495.

Wasik, J. (2011). Kinematics and kinetics of taekwon-do side kick. *Journal of Human Kinetics, 30*, 13-19.

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