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A COMPARISON OF KINETICS, KINEMATICS AND STABILITY OF ROUNDHOUSE KICK AMONG CAPOEIRA, KARATE, MUAY THAI AND TAEKWONDO

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INTRODUCTION

Roundhouse kick is one of the most researched kicks that can be performed with both back and front leg [1]. This kick can be divided in different phases such as Chamber, Preparation, Extension and Recoil [2]. Rapid pelvic axial rotation, linear foot velocity, hip abduction velocity, hip flexion velocity, knee extension velocity and Centre of Mass (COM) velocity towards the target appear to be key variables to perform this kick [2]. There is also a study that suggested that kicking at 110º in Taekwondo produced more power and kicking duration that kicking at 90º [1]. Two studies highlighted the difference between Karate, Muay Thai and Taekwondo and suggested that major differences occur between Muay Thai and Karate in the hip [2,3] but no study compared more than three Martial Arts (MA). Due to the lack of research at 110º angle, the aim of this study was to compare the kinetics, kinematics, and stability of Roundhouse kick with the back leg at 90º and 110º at both chest and head level in Capoeira, Karate, Muay Thai and Taekwondo since in training/competitions they are performed at different heights and angles.

METHODS

Six athletes with more than 18 years old, at least three years of experience in the MA and no record of injury in the previous 2 months participated in this study, Capoeira (n=2), Karate (n=2), Muay Thai (n=1) and Taekwondo (n=1). For assessing kinematics 14 Vicon Vantage Cameras were used at a frequency of acquisition of 250Hz, one Kistler force platform to measure stability and one Passport force platform to record kicking force at 1000Hz. Participants kicked at each height and level until 3 valid trials were recorded, participants had unlimited rest time between trials and kicked with reflective markers according to IOR Gait Model without the second metatarsal head markers. Stability was assessed via Centre Of Pressure (COP) velocity equation (1). The kicking phases analysed in this study were Preparation, Toe-Off (TO), Chamber and Impact. Due to the sample size only descriptive statistics were conducted.

RESULTS

Muay Thai exhibited the highest kicking power relative to body mass at 90º to chest, while Capoeira outperformed other angles and heights, with 90º to chest also yielding the most power. Taekwondo and Muay Thai were the fastest MA, with Capoeira being the slowest, particularly at 110º. Karate was the most stable, and participants were less stable in sagittal plane. Supporting limb plantarflexion and knee flexion were greater in Capoeira and Muay Thai than in Karate and Taekwondo, with all MA plantarflexing at impact. Muay Thai presented the lowest peak knee

flexion and Taekwondo the highest whereas Muay Thai and Karate presented the highest knee extension velocity. Trunk angles varied across MA except trunk lateral flexion at Impact and trunk extension at TO. Supporting limb hip flexion and abduction was higher in Capoeira and lower in Muay Thai. Muay Thai had the lowest peak knee flexion, Taekwondo the highest, whereas Muay Thai and Karate the highest knee extension velocity. Capoeira showed the least kicking limb hip abduction and external rotation, while Muay Thai had the highest hip flexion and abduction velocity. Stability was highest at 90º to chest, which also resulted in higher linear foot velocities, peak knee extension velocities, supporting limb plantarflexion and hip flexion at TO. Capoeira and Karate had higher standard deviation values. At 110º, higher kicking limb and supporting limb plantarflexion at Impact, higher trunk angles except in the sagittal plane, kicking limb abduction and hip flexion/abduction velocities values were recorded. Chest level kicks showed greater kicking foot plantarflexion at preparation, as well as increased knee flexion and hip abduction at TO. Head level suggested higher trunk extension at TO and supporting limb hip flexion and abduction.

CONCLUSION

This study in comparison to the limited existing literature, found similar results in terms of stability, supporting limb, trunk angles, and kicking angles in Muay Thai and Taekwondo [2,3] except [1] that kicking at 90º produced more power and was slower than 110º. The findings of this study suggests that Karate is the most stable MA, athletes should focus improving the stability in sagittal plane, 90º to chest is the most powerful angle and height to kick, Capoeira is the most powerful in relation to body mass, Muay Thai and Taekwondo the fastest, Muay Thai and Capoeira flex more the supporting limb than other MA, Muay Thai kick more “round” and less knee dominant when compared to other MA, trunk presents high variability between MA, Muay Thai was hip dominant, standard deviations were higher in MA than more than one participant as expected and differences appear to be more evident between kicking angles than heights. The main limitation of this study was the small sample size that lead to not conducting more advanced statistical analysis. Further research is needed to address this limitation.

FORMULA

$$\sum_{i=1}^{n-1} \frac{|t_i - t_{i+1}|}{1/f} \qquad (1)$$

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(1) Centre Of Pressure velocity (COP velocity) formula