43 - REACTION TIME AND PUNCH SPEED IN GRADUATED KARATECA

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INTRODUCTION

The initiation of karate and their learning process training is intended to prepare the practitioner to respond as quickly possible to the stimuli coming from the opponent during the fight. The reaction time through visual stimulus is one of the most important and used in the literature to evaluate the psychophysical integration on these individuals (CARNEIRO, ET AL, 2011),.and it's the ability of a fighter to respond to specific more fast as possible. In this case the speed becomes crucial along with Shotokan's technique (LAYTON, 1993a). Karate is a good example of a competitive sport with high temporal-spatial needs that requires fast reactions and precise blows (MORI ET AL, 2002). During the fighting (Kumite) in karate athlete is required to watch the direction of the opponent's, speed and position to make attack or defense decisions quickly (KIM, AND PETRAKIS, 1998). The Kumite literature reports that the most points happen through the punch with minimal involvement of kicks (MARQUES-JUNIOR, 2011). The karate straight punch (Gyaku Tsuki) is one of the acts early learned on this sport during the initiation, the initial position of the hand that make this blow, can present some variations with reference by belt that is around the hip. There is no consensus among instructors and masters over which hand initial position (into, above or below the belt) would be the most appropriate technique to improve the execution of the Gyaku tsuki. Several studies have been evaluated the kinematic variables of the karate punch: speed (CESARI AND BERTUCO, 2008), (LAYTON, 1993b), reaction time (NETO et al, 2009) and the angular velocity of elbow (VENCESBRITO ET AL, 2011) on the attempt to describe and understand the kinematic factors of straight punch to improve its performance. Thus, the objective of this study was to determine which of the three positions are better at performing Gyaku tsuki in graduate karate athletes.

MATERIALS AND METHOD

Ten male athletes with Age of 22 (± 3.2) years and practice time of 9,8 (± 3.1) years, with a black belt graduation. All participants provided informed consent.

For the reaction time evaluation, a lamp was positioned in the field of vision of the athlete, which when triggered by the evaluator, was command corresponded to the athlete perform the punch. In our study, it was agreed that the reaction time is the time interval between the lamp lights turned on and the first effective wrist athlete movement. The reaction time was video based determined by counting frames per second (fps) video, divided by the number of frames in standard playback (30 fps), the value of time was divided by 8 (eight) to adjust the speed of capture camera (figure 1). Because the camera shoots at 240 fps and plays at the standard speed:

$$TR = \frac{Nq/30}{8}$$

Figure -1: Calculation to determine the reaction time: Where: Nq is the number of selected frames.

The punches were recorded with a Samsung WB2000 camera, the laterally positioned at three a meters and about a meter from the ground supported by a leveling tripod.

Kinematic data

The evaluation of elbow angular velocity (ω) and wrist velocity (Wvel), three points was chosen, followed anthropometric model proposed by Zatsiorsky, (1998): (1) the wrist joint, (2) edge foreign head of proximal ulna, (3) horizontal axis of the gleno-humeral joint. Each point was fixed with passive markers (which have reflective material) into the skin to be scanned later. Each athlete performed three (3) punches in each three positions: a) hand over the belt EFx b) above the belt at the ribs AFX, and below the belt on the femur greater trochanter BFX (Figure 1). Athletes performed the punches without hip rotation and only arm action. The punches hits a target positioned at a distance proportional to the athletes range. Between each punch was obeyed an interval of about 30 seconds. Two dimensions calibration was with a one meter stack, subsequently, the images were edited and analyzed by Vicon Peak Motus Software and graphics smoothed by a Butterworth linear filter with cutoff frequency at 6Hz



Figure 1: The initial position of the athlete the Gyaku tsuki. At left to right hand over the belt EFx b) above the belt AFX, and below the belt.

For statistical descriptive analysis was performed mean and standard deviation, to observe the distribution and normality of the data, and to verify were significant means differences of each group in the three types of execution carried out analysis of variance (ANOVA) for repeated measures and between groups was performed to test post-hoc Bonferroni.

Results and Discussion

Table 1 shows the values of reaction time, the wrist linear velocity and the elbow angular velocity at three positions.

Table 1. Descriptive Statistical of this study

Variable	Over (EFx)			Above (AFx)			Below BFx		
	RT (sec)	ω (°/s)	Wvel ($m.s^{-1}$)	RT (sec)	ω (°/s)	Wvel ($m.s^{-1}$)	RT (sec)	ω (°/s)	Wvel ($m.s^{-1}$)
Mean	0,19	1408,7	6,0	0,2	1483	5,87	0,18	1412	6,17
Standard deviation	0,04	116,9	0,3	0,04	172,9	0,38	0,04	113,1	0,2

No significant differences were found for reaction time, elbow angular velocity and the wrist linear velocity on three types of Gyaku tsuki execution ($p \leqslant 0.05$). The values of reaction time showed lower values of standard deviation indicating the possibility of a high repeatability in graduated athletes, which also has been found in studies by Sforza et al, (2000). The reaction time values showed lower compared to Neto, et al (2009) studies for Kung Fu Palm Strike and karate straight punch. Layton's (1993b) showed superior values for RT = 0.45 this may happen probably by the different methodology used to measure RT, these studies evaluated the complete movement execution and not the time between the visual stimulus and the first motor response. Figure 2 shows the RT mean values for each attempt of one athlete.

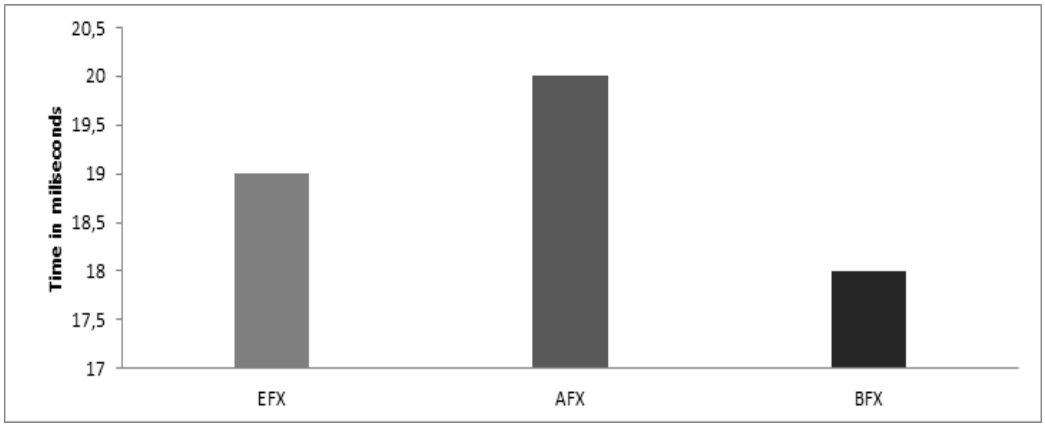

Figure 2: Mean reaction time of one athlete at three positions.

Wrist Speed values showed accordance with studies of Wilk et al, (1983), Gulledge and Dapena (2008), but in our study was smaller compared to the study of Cesari and Bertucco (2008) this happen probably due recording methodology that was via photo-cells and the athletes use the hip movement that accelerates the final wrist movement. The figure 3 shows the curves of velocity of one athlete in three executions of Gyaku tsuki. The curves shown have different values but with similar behavior. The BFX attempt was more fast and large than others, but when we talk about speed in a fight this is not a real advantage. The curves shown have different values, but with similar behavior. By reading the graph below, the total punch execution time EFX was the lowest among the three forms of execution, not necessarily implying a real advantage.

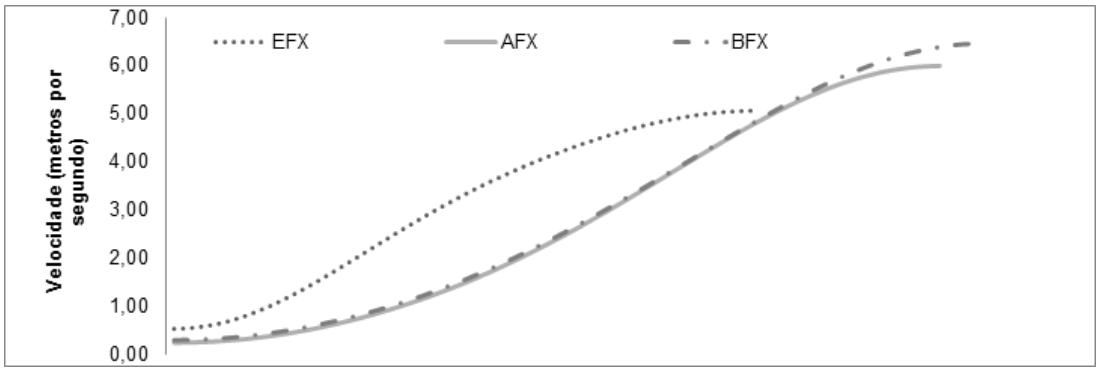

Figure 3: Linear speed of the wrist in X axis of one athlete on three attempts.

The values of elbow´s angular velocity showed values above the Vencesbrito et. al (2011) study. Probably, this difference was by technical execution of the punch analyzed (Choku Zuki). The figure 4 shows curves angular velocity of one athlete in three executions of Gyaku tsuki. The curves also show similar behavior, with an increase of an elbow flexion before the extension in AFX and BFX. In BFX attempts a peak of angular velocity was delayed.

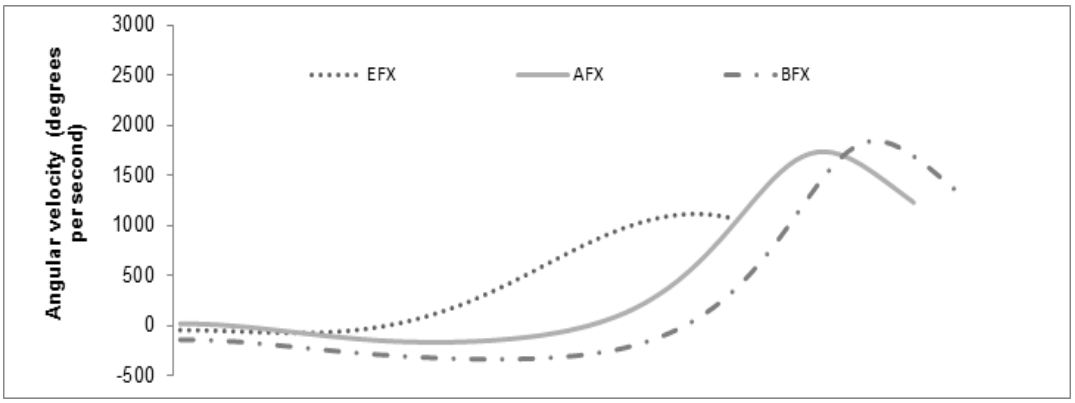

Figure 3: Elbow Angular velocity of an athlete in three attempts. Negative values indicate the action of flexion and positive values are extension.

CONCLUSION

The use of low cost cameras with high speed features demonstrated good accuracy in kinematic data calculation and must become a good alternative to trainers and coaches in martial arts. In a combat situation there is no advantageous position more effective the application of Gyaku tsuki. It seems that the high level of training, time practice and technical accuracy movements that athletes make use compensatory actions to maintain the same performance. Further researches applying other biomechanics methods together do necessary for a better understand Karate motor actions.

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REACTION TIME AND PUNCH SPEED IN GRADUATED KARATECAS

ABSTRACT

The aim of this study was to analyze the straight punch (Gyaku tsuki) in karate and evaluate if there are differences in three starting positions. The sample consisted of 10 (ten) karatekas black belt, with an age 22 (± 3.2) years, practice activity time 9.8 (± 3.1) years; The variables of this study were: reaction time (RT), wrist speed (Vp) and elbow angular velocity (ωcot). The three starting positions were: a) hand over the belt (EFx) b) above the belt (AFX) below the belt (BFX). The punches were recorded with a high speed camera (240Hz). The assessment of reaction time was measured by the image and was the time between a visual stimulus and the first movement of the athlete. For elbow angular velocity and the wrist speed evaluation, markers were placed into skin in the shoulder joints, elbow and wrist. Data were analyzed using Peak Motus Software by Vicon ®. For statistical analysis was of variance (ANOVA) for repeated measures and between groups was performed to test post-hoc Bonferroni. The results showed no significant differences on values of TR, and Vp ωcot in three positions. The wrist speed values were similar to other studies. The values of reaction time showed lower values compared to other studies with martial arts and karate. The wrist velocities showed accordance with studies that evaluated the same technique. The elbow angular velocity showed values above studies of similar techniques (Choku Zuki). It can be concluded that in a combat situation does not exist a more advantageous position in which to become more efficient implementation of Gyaku tsuki. It seems that the high level of training, practice time and accuracy of the technical gesture makes the athletes use of compensatory actions to maintain the same performance. Further researches using other methods of biomechanics are necessary for a better motor actions understanding in Karate.

KEYWORDS: Karate, Reaction - time, Kinematics.

TEMPS DE REACTION ET VITESSE PUNCH IN GRADUEE KARATÉKA
RÉSUMÉ

Le but de cette étude était d'analyser le coup de poing (Gyaku tsuki) dans le karaté et vérifier s'il ya des différences dans trois positions de départ. L'échantillon se composait de 10 karatékas, avec un âge de 22 (± 3,2) ans, la durée de l'activité de 9,8 (± 3,1), les variables de cette étude étaient: le temps de réaction (RT), la vitesse poing (Vp) et la vitesse angulaire du coude (ωcot). Les trois positions de départ étaient les suivantes: une main) sur la piste (EFX) b) sur toute la gamme (AFX) et sous la plage (BFX). Les actions ont été enregistrées avec une caméra à haute vitesse (240 Hz). L'évaluation du temps de réaction a été mesurée par l'image enregistrée de l'individu entre un stimulus visuel et le premier mouvement de l'athlète. Pour l'évaluation de la vitesse angulaire du coude et du poignet linéaire, les marqueurs ont été placés sur la peau de l'épaule articulations de l', du coude et du poignet. Les données ont été analysées à l'aide de Peak Motus Vicon ® Software. Pour l'analyse statistique a été réalisée de la variance (ANOVA) pour mesures répétées et entre les groupes a été réalisée pour tester post-hoc de Bonferroni. Les résultats n'ont montré aucune différence significative dans les valeurs de TR, et Vp ωcot dans trois positions. Les valeurs de vitesse de poing étaient semblables à d'autres études. Les valeurs des temps de réaction a montré des valeurs plus faibles par rapport à d'autres études sur les arts martiaux et le karaté et le. Les vitesses du poignet a montré accord avec des études qui ont évalué la même technique. Les valeurs de vitesse angulaire du coude ont montré des valeurs supérieures à celle mesurée études techniques similaires (Choku Zuki). On peut en conclure que, dans une situation de combat n'existe pas une position plus avantageuse dans laquelle pour devenir plus efficace la mise en œuvre de Gyaku tsuki. Il semble que le niveau élevé de formation, la pratique du temps et la précision du geste technique rend les athlètes utilisent des mesures compensatoires pour maintenir les mêmes performances. Des recherches plus poussées en utilisant d'autres méthodes de biomécanique ainsi sont nécessaires pour une meilleure compréhension des actions motrices en karaté.

MOTS-CLÉS: Karaté, réaction - temps, Cinématique

TIEMPO DE REACCIÓN Y VELOCIDAD EN SOCO DE KARATEKAS GRADUADOS
RESUMEN

El objetivo de este estudio fue analizar lo directo ponche (Gyaku tsuki) en karate y comprobar si existen diferencias en las tres posiciones de partida de la mano. 10 diez karatecas cinturón negro, con edad de 22 (± 3,2) años, tiempo de actividad de 9,8 (± 3,1) años; las variables de este estudio fueron: tiempo de reacción (RT), velocidad Puño (Vp) y la velocidad angular del codo (ωcot). Las tres posiciones de partida fueron: en lo cinturón (EFX) b) arriba del cinturón (AFX) y abajo del cinturón (BFX). Las acciones fueron grabadas con una cámara de alta velocidad (240Hz). La evaluación del tiempo de reacción se midió por la imagen grabada de la persona entre un estímulo visual y el primer movimiento del atleta. Para la evaluación de la velocidad angular del codo y la velocidad de la muñeca, los marcadores se colocan en la piel en hombro, el codo y la muñeca. Los datos se analizaron usando el software Vicon Peak Motus ®. La análisis estadístico se realizó de la varianza (ANOVA) para medidas repetidas y entre los grupos e post-hoc de Bonferroni. Los resultados no mostraron diferencias significativas en los valores de TR, ωcot y Vp en tres posiciones. Los valores de velocidad de muñeca fueron similares a otros estudios. Los valores de tiempo de reacción mostraron los valores más bajos en comparación con estudios con otros artes marciales y karate. Las velocidades de la muñeca mostraron conformidad con los estudios que evaluaron la misma técnica. Los valores de la velocidad angular del codo mostraron valores superiores a los estudios que con técnicas similares (Choku Zuki). Se puede concluir que, en una situación de combate no existe una posición mejor que convertirse en una aplicación más eficaz de Gyaku tsuki. Parece que el alto nivel, tiempo de práctica de formación, y la precisión del gesto técnico hace que los atletas utilicen acciones compensatorias para mantener el mismo rendimiento. La investigación adicional utilizando otros métodos de la biomecánica en conjunto son necesarios para una mejor comprensión de las acciones motrices en Karate.

PALABRAS CLAVE: Carate, Tiempo de reacción, Cinemática

TEMPO DE REAÇÃO E VELOCIDADE DO SOCO EM CARATECAS GRADUADOS
RESUMO

O objetivo deste estudo foi analisar o soco direto (Gyaku tsuki) no caratê e verificar se existem diferenças em três posições iniciais. A amostra constituiu-se de 10 caratecas, com idade média de 22 (±3,2) anos, tempo de prática de 9,8 (±3,1); as variáveis desse estudo foram: tempo de reação (TR), velocidade do punho (Vp) e velocidade angular do cotovelo (ωcot). As em três posições iniciais foram: a) mão em cima da faixa (EFx); b) acima da faixa (AFx); e abaixo da faixa (BFx). As ações foram gravadas com uma câmera de alta velocidade (240hz). A avaliação do tempo de reação foi medida através da imagem gravada do individuo entre um estimulo visual e o primeiro movimento do atleta. Para a avaliação da velocidade angular do cotovelo e linear do punho, foram colocados marcadores na pele nas articulações do ombro, cotovelo e punho. Os dados foram analisados através do Software Peak Motus da Vicon®. Para o tratamento estatístico foi realizada a análise de variância (ANOVA) para medidas repetidas e entre os grupos foi realizado o teste Post-Hoc de Bonferroni. Os resultados mostraram não haver diferenças significativas nos valores de TR, ωcot e Vp nas tres posições. Os valores de velocidade do punho foram similares a outros estudos. Os valores de tempo de reação apresentaram valores mais baixos comparados a estudos com outras artes e marciais e com o caratê. As velocidades do punho apresentaram conformidade com estudos que avaliaram a mesma técnica. Os valores de velocidade angular do cotovelo apresentaram valores superiores a estudos que mediram técnicas semelhantes (Choku Zuki). Pode-se concluir que em uma situação de combate não existiria uma posição mais vantajosa na qual tornaria mais eficiente à execução do Gyaku tsuki. Parece que o alto nível de treino, o tempo de prática e a precisão do gesto técnico faz com que os atletas utilizem de ações compensatórias para manter o mesmo desempenho. Novas pesquisas utilizando outros métodos da biomecânica em conjunto são necessárias para uma maior compreensão das ações motoras em caratecas.

PALAVRAS CHAVE: Caratê, Tempo de reação, Cinemática