# 116 - IMPACT AND TIME OF IMPACT IN BANDAL TCHAGUI KICK OF THE TAEKWONDO

AUDREY CRISTINE ESTEVES, DIOGO CUNHA DOS REIS, SARAY GIOVANA DOS SANTOS
Laboratory of Biomechanics CDS/UFSC, Florianópolis, SC, Brasil
audrey_cris@yahoo.com.br

**Introduction**

Taekwondo appeared in Korea has 2000 years approximately (LEE, 1978). Since its origin until today, it passed for several transformations leaving of being only martial art to become competition sport.

This art presents more than two thousand techniques being that 70% of these techniques consist of kicks. Amongst the variety of kicks, one of the most used is the Bandal Tchagui, that consists of a lateral kick, with rotation of the hip and projection of the trunk in direction of the adversary using the chest of the foot for the accomplishment of the contact.

The foot is a fragile structure in relation to the impacts and initially it was not made to kick, therefore the majority of the injuries in the Taekwondo happens in the foot. The repetitions of these impacts in sessions of trainings or competitions put the biomateriais to the repetitive traumas.

The Impact conceptually is defined as a simple collision between two masses where the first one is in movements and the second one can be in movement or in rest (HARRIS and CREDE, 1976).

The effect of the impacts, which involves changes in the body speed, in a short period of time, in accordance with MEYDAN (1997), can be measured in terms of displacement and their derivatives. These impacts are composites for shock waves that possess high frequencies and amplitude.

The specific physical requests of each sport modality, as well as the influence of the way in the case of characterized sports of open dexterities (contact sports), generate characteristic injuries, as it is the case of the injuries most frequent in level of inferior members (knee and ankle) in the soccer.

Taekwondo as combat sport demands a preparation of the athlete to support high loads of work, demanding especially power, resistance and effectiveness of the energy systems, therefore this sport is characterized for dependent acyclical loads of the adversary (CASTAÑEDA, 2005). The amount and the frequency of these impacts provoke injuries to the biomaterial.

For the explanation, the objective of this work was to identify to the magnitudes of impact and the times of impact during the execution of the kick Bandal Tchagui of the Taekwondo.

**Materials and Methods**

This study is characterized as being speculation and the only case. The research citizen is of the masculine sex, 24 years, 80 kg of corporal mass, stature of 1,80 m, black band, second dan, practitioner of taekwondo has 11 years and competitor of the modality has 10 years.

The research occurred in the Biomechanics Laboratory of the Center of Sports of the Universidade Federal de Santa Catarina.

A triaxial accelerometer of Type 4321 from Bruel & Kjaer was used for the measurement of the values of impact, connected to a system of acquisition of data. The accelerometer was fixed with adhesive ribbon and prolongated braces in the posterior part of the ankle about two centimeters next to the right lateral ankle, hindering the landslide between the instrument and the faying surface. The target was fixed in the superior member of another participant and consisted of a protective field of training made with latex foam coated with tanned fine skin.

The electric signals generated in the accelerometer (in mV) for the impact had been sent to pre amplifying and for a plate of acquisition of data multicanal CIO-DAS 16/1600 that encloses 16 absolute canals or 8 distinguishing canals, with analogical converter of 12 bites with tension limit of entrance of +/- 10V, from Computer BoardTM, where they had been processed and recorded in software SAD32®. The used values of attenuation in the pre-amplifying indicate the factors of correction of multiplication of the signal. The signals had been still divided by 9,81m/s2 to be normalized for the acceleration of the gravity (g).

The impacts had been measured in the three axles: lateral (z), vertical line (x) and anteroposterior (y). The axles had been defined in accordance with the positioning of the accelerometer in the erect anatomical position of the person.

TABLE 1: Factors of correction of the pre-amplifiers

| | x (mV) | y (mV) | z (mV) |
|---|---|---|---|
| Values of correction | 0,1 | 1 | 0,316 |

The values for the calculations of the largeness of the impacts had been gotten in the peaks of the curves. The adopted criterion was the largeness of the biggest peak.

The calculations of the impact time had been taken off following the criterion of the beginning of the decline and end of the curve, as explained in the figure below. The value of the impact time is resultant of the subtraction of the final time for the initial.

Four series of 10 lateral kicks had been carried through to average height against the target, with a frequency of acquisition of 5.000 Hz, and total time of acquisition of 5 seconds with interval of 30 minutes between the series to rest of the athlete.

The project of this research, when submitted, it got approval of the committee of ethics of the Federal University of Santa Catarina in the year of 2005.

The data had been worked using statistics descriptive and analyzed with ANOVA to $p<0,05$.



**Figure 1**: Circular kick the half height.

**Results and Discussion**

Following the objectives established in the work, the allusive results to the impacts in the ankle are presented in table 2.

TABLE 2: Importance of impact in the axles (x, y, z) in the ankle during the execution of the kick.

| | X | σ | minimum | maximum | CV% |
|---|---|---|---|---|---|
| x | 71,81 | 15,30 | 45,65 | 98,35 | 21,31 |
| y | 334,88 | 64,66 | 231,91 | 461,88 | 19,31 |
| z | 166,98 | 18,80 | 138,74 | 191,56 | 11,26 |

TABLE 3: Analysis statistics of the impacts in the three axles.

ANOVA

| *variation source* | *gl* | *MQ* | *F* | *p* |
|---|---|---|---|---|
| between groups | 2 | 301618,5 | 189,7506 | 1,61E-23 |
| inside of the groups | 48 | 1589,553 | | |
| Total | 50 | | | |

At the moment of the kick, the anteroposterior axle presented greaters values of impact, exactly for this to be in the direction of the biggest propagation of the force. Mathematically the angulação of execution of the kick is evidenced that cause influence in the largeness of the other components of force, verifying that the values of impact found in the lateral axle (z) present bigger values that in the vertical axle (x). It is verified that all the groups had presented significant differences, for the fact of the decomposition of the forces in the execution of kick, as displayed previously.

In accordance with Sidthilaw (1997), the impacts could easily cause breakings the bones, displaying the biomaterial to the continuous application of stress. Santos (2003) affirm that the impacts proceeding from the falls in the Judo present high values in the corporal segments, indicating that periodic practical leads the cumulative injuries. McKenzie et al (1985) designates that the problem most frequent in running athletes are pains in the joint of the knee and can be attributed the amount of impacts suffered in the landing during the race.

It is to believe that these values of impacts are associates with the percentage of injuries of inferior members that they attack the athletes of Taekwondo (56% of the cases), being that 21% of these occur in the structure of the feet, the values of impacts are considered high, aggravating still more in function of the great number of repetitions in short space of time.

TABLE 4: Times of impact in the axles (x, y, z) in the ankle during the execution of the kick.

| | X | σ | Minimum | Maximum | CV (%) |
|---|---|---|---|---|---|
| x (s) | 0,11 | 0,02 | 0,09 | 0,15 | 15,25 |
| y (s) | 0,02 | 0,01 | 0,01 | 0,03 | 34,83 |
| z (s) | 0,02 | 0,01 | 0,01 | 0,04 | 31,77 |

TABLE 5: Analysis statistics of the times of impact in the three axles..

ANOVA

| *variation source* | *gl* | *MQ* | *F* | *p* |
|---|---|---|---|---|
| between groups | 2 | 0,066929 | 538,7459 | 1,33E-41 |
| inside of the groups | 66 | 0,000124 | | |
| Total | 68 | | | |

The interval of duration of these impacts that occur in a relatively short time, becomes very important.

In the results analysis of table 4 it is verified average minors of impact periods had been presented in axle x. Significant differences between the times in relation to the other groups had been found in axle x.

For that variability of the data, according to Gomes (1990), can be verified that present high levels (21%).

This high variability in axles y and z can be associated to the fact of the executions series of the kicks to be done of sucessive way, making difficult the reproduction of the kick with the same intensities.

Sidthilaw (1997), in dynamic analysis of kicks verified that the biggest peaks of force and impulse had been gotten in kicks of average height. The kicks analyzed here present the same characteristics, resulting in high values of force and impulse and impact.

In accordance with the data informed by the athlete, the average of execution of kicks in the training sessions varies of 60 the 80 repetitions, being able this number vary as the period of training.

This repetition put the inferior members, mainly the foot to an intense process of fatigue hindering his complete recovery.

**Conclusion**

In view of the objectives of the study and respecting its limitations it could be arrived at the following conclusions:

- the size of impact in the anteroposterior axle (y) presented high average values of impact, being in the direction of propagation of the force in the execution of the kick.

- in function of the great amount of repetitions and the high average values of impact in the kicks, the structure of the foot can be susceptible to the attack of injuries.

- the impact times had presented higher in the vertical axle (x) due the rotation of the hip at the moment of the kick, having deduced that the contact time is bigger

Ahead of the scarcity of studies measuring the impact and period of duration of the impacts proceeding from the sport practical and specifically in martial arts, exists the necessity to know the forces involved, in function of the presence of resultant blows of movements in high speed and short intervals of time.

**References**

Castañeda, P. E. G. Perspectivas del taekwondo del continente americano rumbo a Beijing 2008. Disponivel em: http://www.efdeportes.com/ Revista Digital - Buenos Aires 10 - n° 88, 2005.

Gomes, F. P. Curso de estatística experimental. 13 ed. Piracicaba: Nobel AS. 1990. 468 p.

Harris, C. M.; Crede, C. E.: Introducion to the handbook. HARRIS, C. M.; CREDE, C. E. (Orgs). Shock & Vibration Handbook. 2 th ed. New York: McGraw Hill Book Company, 1976. Cap. 1. p. 1-25.

Lee, W. J.. Aprenda Tae kwon-Do. Editora Brasil-America (EBAL) S. A. Rio de Janeiro 1978.

Meydan, T. Recent trends in linear and angular accelerometers. Sensors and Actuators. N. 59, p. 43-50, 1997.
Santos S. G. dos. Estudo das características de impacto e da percepção humana de conforto na prática de "Ukemis" em diferentes "tatamis". Florianópolis: UFSC. 2003. 169P. Tese (Doutorado em Engenharia de Produção e Sistemas). Centro Tecnológico, Universidade Federal de Santa Catarina, Florianópolis.
Sidthilaw, S. Kinetic and kinematic analysis of Thai boxing roundhouse kicks. Ph. D. University of Oregon, 1997. Abstract. Disponível em: http://www.cev.org/biblioteca/index.html Acesso em: agosto de 2005.

AUDREY CRISTINE ESTEVES
Laboratório de Biomecânica CDS/UFSC, Florianópolis, SC, Brasil
Rua: Felipe Neves, 410, bl.B3, ap. 03
Estreito, Florianópolis, SC Brasil
CEP: 88090-750
Tel: (48)32489987 / 88150991
e-mail: audrey_cris@yahoo.com.br

**IMPACT AND TIME OF IMPACT IN BANDAL TCHAGUI KICK OF THE TAEKWONDO**

**Abstract**

This study is characterized as being of speculation and the one case, having as purpose to identify to the magnitude of impact during the execution of the bandal thagui kick of Taekwondo. The citizen of the research was an individual of the sex masculine with 24 years, corporal mass 80 kilograms, stature of 1,80m, black belt 2° Dan, 11 years practising Taekwondo and competing 10 years in the modality. For measurement of the impact magnitude was used one triaxial accelerometer connected to a system of data acquisition. Four series of 10 lateral kicks had been carried through to average height against the target, with a frequency of acquisition of 5.000 Hz, and total time of acquisition of 5 seconds with interval of 30 minutes between the series to rest of the athlete. The impact results had presented in average the values for x=71,81g±15,30g, y=334,88g±64,66g and z=166,98±18,80g in the foot at the moment of the kick. The times had presented in x=0,11s±0,02s, y=0,02s±0,01s and z=0,02s±0,01s. Thus, it concludes that in function of the great amount of repetition and the high values of impact in the kicks, the structure of the foot becomes more susceptible the injuries.

Key-words: impact, kicking, Taekwondo.

**Abstrait**

Cette étude est caractérisée en tant qu'étant de la spéculation et de l'un cas, ayant comme but d'identifier à l'importance d'impact pendant l'exécution du coup-de-pied bandal de thagui de Taekwondo. Le citoyen de la recherche était un individu du sexe masculin avec 24 ans, la masse corporelle 80 kilogrammes, stature de 1,80m, ceinture noire 2° Dan, 11 ans pratiquant Taekwondo et concurrençant 10 ans dans la modalité. Pour la mesure de l'impact la grandeur a été employée un accéléromètre à trois axes relié à un système d'acquisition de données. Quatre séries de 10 éruptions latérales avaient été exécutée taille moyenne contre la cible, avec une fréquence de l'acquisition de 5.000 hertz, et de temps de total de l'acquisition de 5 secondes avec l'intervalle de 30 minutes entre la série au reste de l'athlète. Les résultats d'impact avaient présenté à la moyenne les valeurs pour x=71,81g±15,30g, y=334,88g±64,66g et z=166,98±18,80g en pied à l'heure actuelle du coup-de-pied. Les temps avaient présenté dans x=0,11s±0,02s, y=0,02s±0,01s et z=0,02s±0,01s. Ainsi, il conclut qu'en fonction de la grande quantité de répétition et des valeurs élevées de l'impact dans les éruptions, la structure du pied devient plus susceptible les dommages.

Mots clés: coup-de-pied, impact, Taekwondo

**Resumen**

Este estudio se caracteriza como estando de la especulación y del un caso, teniendo como propósito de identificar al magnitud del impacto durante la ejecución del retroceso bandal tchagui de Taekwondo. El ciudadano de la investigación era un individuo del sexo masculino con 24 años, masa corporal 80 kilogramos, estatura de el 1,80m, cinta negra 2° Dan, 11 años que practicaba Taekwondo y que competía 10 años en la modalidad. Para la medida del impacto del magnitud fue utilizado un acelerómetro triaxial conectado con un sistema de la adquisición de datos. Cuatro series de 10 retrocesos laterales habían sido a través llevada altura media contra la blanco, con una frecuencia de la adquisición de 5.000 hertzios, y del tiempo del total de la adquisición de 5 segundos con el intervalo de 30 minutos entre la serie al resto del atleta. Los resultados del impacto habían presentado en promedio los valores para x=71,81g±15,30g, y=334,88g±64,66g y z=166,98±18,80g en el pie en el momento del retroceso. Los tiempos habían presentado en x=0,11s±0,02s, y=0,02s±0,01s y z=0,02s±0,01s. Así, concluye que en la función de la gran cantidad de repetición y de los altos valores del impacto en los retrocesos, la estructura del pie llega a ser más susceptible a lesiones.

Palabras claves: retroceso, impacto, Taekwondo

**Resumo**

Este estudo é caracterizado como sendo exploratório e de caso único, tendo como objetivo identificar as magnitudes de impacto no tornozelo durante a execução do chute *Bandal Tchagui* do Taekwondo. O sujeito da pesquisa foi um indivíduo do sexo masculino com 24 anos, massa corporal de 80kg, estatura de 1,80m, faixa preta 2 Dan, praticante de Taekwondo a 11 anos e competidor da modalidade a 10 anos. Para a mensuração das magnitudes de impacto foi utilizado um acelerômetro triaxial, acoplado a um sistema de aquisição de dados. Foram realizadas 4 séries de dez chutes laterais à média altura contra o alvo, com uma freqüência de aquisição de 5000Hz e tempo total de aquisição de 5*s,* com intervalo entre as séries de 30min para descanso do atleta. Os resultados de impacto apresentaram em média os valores para x=71,81g15,30g, y=334,88g64,66g e z=166,9818,80g no pé no momento do chute. Os tempos apresentaram em x=0,11s0,02s, y=0,02s0,01s e z=0,02s0,01s. Assim, conclui-se que em função da grande repetibilidade e dos altos valores de impacto nos chutes, a estrutura do pé torna-se mais suscetível a lesões.

Palavras-chave: impacto, chute, Taekwondo.