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COACHING & KINESIOLOGY

Paula Avakian[1(ABCD)], Daniel Aloisio Frezza[1(ABCD)],
Belmiro Giordani Pinho[1(ABCD)], Abdallah Achour Junior[1,2(AEF)],
Esteban Aedo-Munoz[3,4,5(EFG)], Diego Ignacio Valenzuela Perez[6(EFG)],
Destter Alacks Antonietto[3(EFG)], Ciro Jose Brito[3(FG)], Bianca Miarka[3,8(ABEF)]

[1] Brazil - National Olympic Committee, Rio de Janeiro (Brazil)
[2] State University of Londrina, Londrina (Brazil)
[3] Physical Education Postgraduate Program, Federal University of Juiz de Fora, Governador Valadares (Brazil)
[4] Physical Education Department, Universidad Metropolitana de Ciencias de la Educacion, Santiago (Chile)
[5] Science of Physical Activity, Sport and Health School, Universidad de Santiago de, Santiago (Chile)
[6] Master in Physical Activity and Sport Sciences, Faculty of Health, Universidad Santo Tomas, Santiago (Chile)
[7] Escuela de Kinesiologia – Facultad de Salud, Universidad Santo Tomas, Santiago (Chile)
[8] Physical Education Postgraduate Program, Federal University Rio de Janeiro, Rio de Janeiro (Brazil)
Corresponding author: Diego Ignacio Valenzuela Perez, Escuela de Kinesiologia – Facultad de Salud, Universidad Santo Tomas, Santiago, Chile, Av. Ejercito Libetador, 146, Centro – Santiago, Chile
e-mail: diegovalenzuela@santotomas.cl

Development and reliability of technical-tactical and time-motion real-time analysis in the World Taekwondo Grand Prix

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Key words: time and motion studies, technology, martial arts, circuit-based exercise, high-intensity interval training, athletic performance

Abstract

Background. Despite its importance, time-motion and technical-tactical analyses are rarely applied in Taekwondo by coaches and in technical assistance because of the lack of technical-tactical protocols for real-time analysis.

Problem and aim. This study aimed to elaborate and validate a new technical-tactical protocol in Taekwondo for real-time analysis, as well as to demonstrate the characterization and practical application of the app for general models of high-level championships.

Methods. The data was constructed

for 7,370 sequential technical-tactical actions – a total of 189 rounds – which were observed during 64 matches. From this number, twenty-four matches from a total of 64 (37.5%), were analyzed twice by one expert with a 24hour interval between them and once by another expert. Frequencies and time (seconds) of the technical-tactical variables selected for the analysis correspond to the following groups: a) Positioning; b) Techniques; c) Clinch; and d) Pause. The Mann-Whitney comparison and Cohen's Kappa coefficient were used, $p \geq 0.05$.

Results. Similar technical-tactical real-time analyses were observed with no significant inter-rater difference in the attack or counterattack variables (P=0.959), in stance variables (P=1.0) or pause time (P=0.959), with agreement between 0.49 (moderate) and 0.75 (strong). There were also no significant intra-rater differences in the attack and counterattack variables (P=1.0), in stance variables (P=1.0) or pause time (P=1.0), with agreement between 0.72 (strong) and 0.87 (almost perfect). Tactical analysis reveals that athletes were more effective in scoring defensive actions than offensive, scoring the most times with 1-point techniques; bandal chagui was the technique with the highest frequency of scoring and ~20% of the scoring came from penalties.

Conclusion. These results represent an advantage, as coaches can use this protocol, showing immediate feedback to your athlete during competitions or training, as the App can be installed on tablets and smartphones.

Introduction

Studies addressing the creation and reliability evaluation of new technologies were developed in combat sports [Coswig *et al.* 2019; Cular *et al.* 2018; Miarka *et al.* 2014; Morales *et al.* 2016]. Such tools contribute to list and systematize the main elements of the combat, whether for displacements, attacks, defenses or intervals in order to outline possible physiological parameters in effort-to-pause ratio and quantify technical-tactical actions for further interventions in training or strategy during taekwondo competition [Tornello *et al.* 2013; Formalioni *et al.* 2017]. Despite the importance, time-motion and technical-tactical analyses are rarely applied in Taekwondo by coaches and in technical assistance; a fact which arises from the lack of practical technical-tactical protocols for dynamic analysis in real time which provide crucial knowledge about matches, and which are still performed by generalist cursive methods [Menescardi *et al.* 2019; Menescardi *et al.* 2015; Tornello *et al.* 2013]. On the other hand, much more complex analyzes already exist [Casolino *et al.* 2012], but they require a lot of time for recording, editing and analysis using impractical software [Casolino *et al.* 2012]. Therefore, a real-time technical-tactical analysis tool for high- performance training and competitions would have higher applicability for coaches who wish to control combat actions in order to identify attacks and counterattacks at each moment of the round.

An official Taekwondo combat has eight minutes' total duration, spread across three rounds of two minutes each, with a one-minute break between rounds. Regarding scoring, athletes obtain one point for a hit to the trunk protector (kick or punch), three points for a valid turning kick to the trunk protector or a valid kick to the head, and four points when a turning kick reaches the opponent's head [O'Sullivan, Fife 2016]. Victory can be achieved through knockout, a sum of points, by the difference of points (when one of the athletes shows superiority with 12 points of difference at the end of the second round or during the third round), sudden death, withdrawal, disqualification of the opponent or victory by a punitive declaration by the referee [Falco *et al.* 2016; Menescardi *et al.* 2015; O'Sullivan, Fife 2016].

The sport's technical and tactical demands are high, and this kind of analysis makes it possible to increase coaches' knowledge on how to train athletes more effectively for competitive situations [Menescardi *et al.* 2015]. Furthermore, many coaches seek a technical-tactical model aiming the high-level performance [Cerda-Kohler *et al.* 2015; Formalioni *et al.* 2017; Menescardi *et al.* 2019]. In addition, performance analysis is an objective method which aims to provide quantitative and qualitative feedback on the actions performed during competitions in order to assist coaches and athletes in creating strategies that are capable of countering opponent's actions [Tornello *et al.* 2014]. Based on the assumption that performance analysis in Taekwondo provides crucial information for athletes' success, developing a specific protocol to provide time-motion and technical-tactical information in real time is a *sine qua non* condition in high-performance competitions and training. The analysis of such variables can generate different results depending on gender [Casolino *et al.* 2012], weight division [Casolino *et al.* 2012] and the tournament phase [Tornello *et al.* 2013].

In turn, observing these variables in the world's best-ranked athletes can add knowledge for technical-tactical modeling of the sport and its rules [Jae-Ok, Voaklander 2016; Jeong *et al.* 2019], as well as providing information on the physiological and technical-tactical demand for intervention in physical preparation, assessments and training with similar actions to those of combat [Avakian *et al.* 2016; Seo *et al.* 2019; Tibana *et al.* 2019; Vasconcelos *et al.* 2020]. Present hypothesis expected that when analyzing the best athletes in the world, more uniformity and reduction in effort-to-pause ratios and greater variability in technical-tactical actions, as well as greater usage frequency in most of the actions performed by the front leg style have been accentuated since the introduction of the electronic protector, along with more actions towards the opponent's face. In addition, it is possible to develop a practical app model for applicability with reliability tests and, improving technical-tactical analysis in real time, understanding how athletes perform in taekwondo. Thus, in this study we propose to elaborate and validate a new technical-tactical app analysis in Taekwondo for real time application, as well as demonstrate the characterization and practical application of the app model in a high-level championship.

Methods

Experimental approach

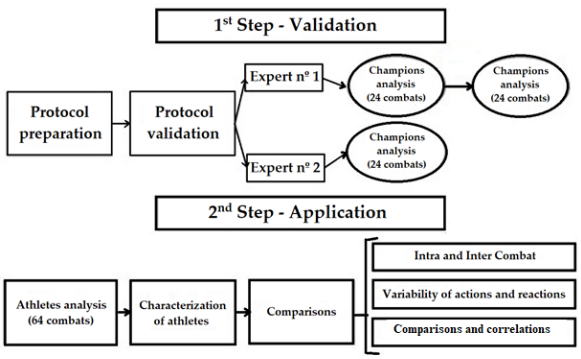


Figure 1. Study Design

This applied research is characterized as a descriptive technological development and innovation addressing the basic aspects of creation, validation, description, correlation and comparison of the elements of technical

and tactical interactions. First, a focal group observed the main technical-tactical actions of taekwondo, testing the construction of the protocol. After that, official videos of the matches for each weight category were collected to assess the techniques performed. Parts of these videos were used to realize the creation, tests and reliability test of the technical-tactical real-time protocol. Figure 1 illustrates the study design, with an outline divided into two stages: protocol development, reliability and validation and application.

Subjects

The data was composed for 7,370 sequential technical-tactical actions a total of 189 rounds they were observed during 64 matches, in which 43 were completed by summing points, 7 by a 12-point difference, 4 by withdrawal, and 10 decided on sudden death, or golden point. Twenty-four matches out of a total of 64 (37.5%) were used to validate the intra and inter-subject protocol. The study population consisted of Taekwondo combats of the 2014 Grand Prix Final in Querétaro, Mexico, which was a competition in which only WTF guests participate having up to the eighth place in the international ranking in the month prior to the event. The athletes were aged between 18-28 years in all male and female divisions. All participants had previous experience with professional Taekwondo events, rules and procedures used during the championship. No interferences were made in the training, nutritional or hydration status of participants. All combats occurred in air-conditioned arenas at a range temperature between 24.5-27.0ºC. In addition, this study was submitted to and approved by the We ensured anonymity and confidentiality by replacing the athletes' personal ID, there are no ethical issues in analyzing or interpreting data obtained at public events. The present research was earlier approved by the local Ethics and Research Committee, following WMA Declaration of Helsinki.

Protocol for the analysis of technical and tactical indicators

Video capture, as well the protocol development and validation, were carried out at the official WTF channel. The set of the necessary equipment to do this was composed of an Inspiron N4050 computer, (Dell®, Brazil) and a Galaxy Tab III (Samsung®, Brazil). The technical-tactical variables selected for the analysis correspond to the following groups: a) Positioning; b) Techniques; c) Clinch; and d) Pause, in addition to the score established for effective actions.

a. *Positioning*: defined from the back leg adopted in the stance during the match. In addition to the right or left, the stance was also characterized as closed and open, with the closed stance is the situation in which the two athletes have the same leg positioned behind (and thus their front leg would hit the front of the opponent's protector); and open stance being the situation in which an athlete has one leg behind, for example, the right leg, and the other left leg in front (and thus, it would be the back leg which would hit the front of the opponent's protector more easily). Therefore, four basic possibilities for combat were defined: Right Open Stance (ROS), Left Open Stance (LOS), Right Closed Stance (RCS), Left Closed Stance (LCS).
b. *Techniques*: the component of Taekwondo was classified into attack and counterattack actions. For kicking, the moment when the athlete takes their foot off the ground until they return to it is considered. Punching starts with the elbow extension movement until contact of the wrist with the opponent. These actions can be performed with the right or left limb, being positioned in front or behind. The following techniques were selected in this protocol: 1. *Bandal cha*gui (BAN); 2. *Dolyo chagui* (DOL); 3. *Dubal chagui* (DUB) - or *Nare chagui*; 4. *Furyo chagui* (FUR); 5. *Chagui Yop* (YOP) - or prop technique; 6. *Bitro chagui* (BIT); 7. *Titchagui* (TIT); 8. *Torgue chagui* (TOR); 9. *Mondolyo chagui* (MD). 10. Coverage kicks (COV), constituting a category which groups *Anchagui*, *Bakatchagui*, *Tigo chagui* and *Neryo chagui*; 11. Frontal Kicks (FRO), constituting a category which groups *Ap chagui* and *Miro chagui*; 12. Punch (PUN); and 13. Feints (FEIN), mostly characterized by a knee lift without the intention of completing a specific kicking technique.
c. *Clinching:* clinching is a combat situation used by athletes in the hand-to-hand moment. It starts from the moment when the athletes shorten the distance until they touch and ends with the technical execution of one or both parties, mutual separation or with the intervention of the main referee.
d. *Pausing*: pausing in the match can be recurrent due to several factors: technical request, video replay, falling, leaving the court, penalty, medical assistance or at the request of the referee. Both the start and the end of the break time are signaled by the main referee.

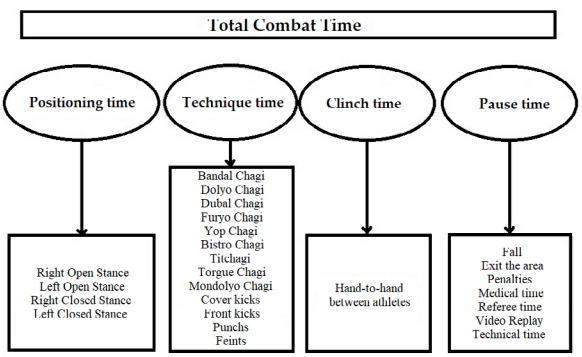


Figure 2. Time-motion and technical-tactical real-time factors.

Procedures for validating real-time analysis

Performance analyzes were performed in the first stage of this work using combat modeling by two experts to validate the technical-tactical modeling of the match for use in the applications and observation in real continuous time, and to realize intra and inter expert comparisons [Chaabene *et al.* 2018; Coswig *et al.* 2019; Tabben *et al.* 2014]. Following the criteria of previous authors [Menescardi *et al.* 2019; Miarka *et al.* 2014], the experts were Physical Education professors with more than ten years of practice in the sport, with competitive experiences both as coaches and as Taekwondo referees. Each evaluator performed 24 analyzes of paired fights, with the first evaluator analyzing the same 24 twice in a row (1st expert, n=48; 2nd expert, n=24) [Antonietto *et al.* 2019; Dos Santos *et al.* 2019]. In the first case, the evaluator performed the two measurements on different days, with a minimum interval of 24 hours between analyzes due to the need to verify the absolute reliability, as defined and suggested by preceding reports [Coswig *et al.* 2018; Formalioni *et al.* 2017; López Díaz-de-Durana *et al.* 2018]. These procedures enabled verifying if there was objectivity in the model in inter-rater; in other words, if there were significant differences in the accuracy of analysis with the model and if there was a systematic error [Benson *et al.* 2015; Purves *et al.* 2019]. The experts were already familiar with the Easytag® program (Dartfish, Brazil) used in analyzes with the new combat model. The total number of videos made available for the draw was 189 international rounds, including all weight divisions, and both genders. Randomization and selection followed the protocol described by a previous study [Aquino *et al.* 2019; Ortega-Toro *et al.* 2019].

Procedures for model application and data collection

The study was conducted by analyzing videos collected from the Internet on the official WTF channel. All the matches held in the event edition were counted in order to analyze each weight division from the preliminary matches to the medal disputes. Each competitor in the tournament was analyzed individually by combat and by round exactly how illustrated in Figure 3.

Data processing and statistical analyses

The Statistical Package for Social Sciences 20.0 (SPSS) was used to validate the model based on the correlation between the performed analyzes. The data are presented in mean ± standard deviation or median (first quartile; third quartile). The Mann-Whitney test was used for comparisons between the evaluators, and the Cohen's Kappa coefficient was used to check the correlation between the measurements obtained from each model, which is a statistical measure of agreement between two observations for qualitative categorical variables. Thus, the results are classified into: i) values <0, there is no agreement; ii) values between 0-0.2, weak agreement; iii) values between 0.21-0.4, distant agreement; iv) values between 0.41-0.6, moderate agreement; v) values between 0.61-0.8, strong agreement; and vi) 0.81-1.0, with almost perfect agreement. A significance level of 5% was adopted in all analyzes.

Results

Regarding the protocol validation process, the Mann-Whitney test did not show any significant inter-rater difference in the attack or counterattack variables (P=0.959), in stance variables (P=1.0) or pause time (P=0.959), with Kappa agreement between 0.489 (moderate) and 0.749 (strong). There were also no significant intra-rater differences in the attack and counterattack variables (P=1.0), in stance variables (P=1.0) or pause time (P=1.0), with Kappa agreement between 0.721 (strong) and 0.875 (almost perfect).

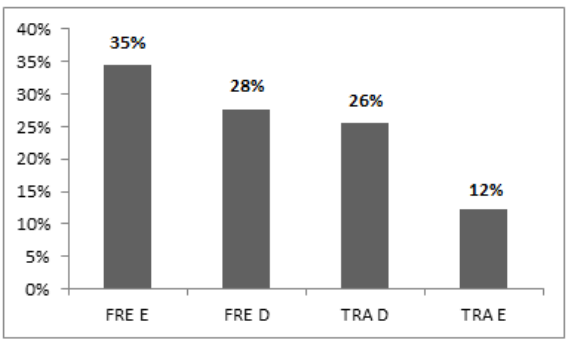
BAN	YOP	FIN	BAD	CLI
DOL	DUB	1 PT	BAE	QUE
COB	FUR	3 PT	BFD	PRV QUE
TIT	FRO	4 PT	BFE	PAU
MD	TOR	ATA	FRE	PEN
SOC	BIT	C ATA	TRA	FIM

Note. BAN = *Bandal chagui*; DOL = *Dolyo chagui*; COB = *Coverage kicks*; TIT = *Titchagui*; MD = *Mondolyo*; SOC = *Punch*; Yop = *Yop chagui*; DUB = *Dubal chagui*; FUR = *Furyo cha*gui; FRO = *Front kick*; TOR = *Torgue chagui*; BIT = *Bitro chagui*; FIN = Feint; 1 PT = 1 point; 3 PT = 3 points; 4 PT = 4 points; ATA = Attack; C ATA = Counterattack; BAD = Right Foot Forward Open Stance; BAE = Left Foot Forward Open Stance; BFD = Right Foot Forward Closed Stance; BFE = Left Foot Forward Closed Stance; FRE = Frontal Stance; TRA = Backward Stance; CLI = Clinch; QUE = Fall; PRV QUE = Cause a fall; PEN = Penalty; END = end of the round.

Figure 3. App Model of Technical-tactical and time-motion real-time analysis for Taekwondo.

Regarding the combat aspects, it was noted that most of the scores were achieved in the third round (39.4%), followed by the second round (31.5%), the first round (27.5%), and the golden point (1.3%). Among the scores, 45.0% were from defensive actions or counterattack; 36.9% were caused by offensive actions or attacks

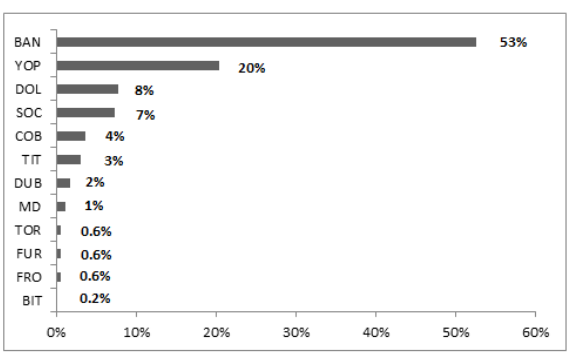
and 18.1% of the scores resulted from penalties. The actions which scored the most were kicks of 1 point (85.2%), followed by strikes worth 3 points (13.8%) and 4 points (1.0%). Strikes delivered with the right limb (53.2%) scored more than the left side (46.8%), and more scores were achieved from actions performed with the front leg (62.1%) than the back leg (37.9%). However, we obtain a higher number of points made with the left leg in front (34.5%), as shown in Figure 4.



Note. FRE E = Frontal Stance + Attack with the left foot; FRE D = Frontal Stance + Attack with the right foot; TRA D = Backward Stance + Attack with the right foot; TRA E = Backward Stance + Attack with the left foot.

Figure 4. Frequency of occurrence (%) of laterality in the scores performed.

In relation to stances, 32.3% of strikes were performed on the right open base behind, 25.8% on the left open base behind, 23.6% on the right closed base behind, 12.1% on the left closed base behind, and 6.2% in clinching actions. Of the 7681 strikes performed, only 504 (6.6%) resulted in scores, and from these, 86.3% were attributed to strikes executed in the torso region and 13.7% in the head. Figure 5 illustrates the strikes used for scoring.



BAN = *bandal chagui*; FIN = *feint*; YOP = *yop chagui*; COB = *coverage kicks*; DOL = *dolyo chagui*; SOC = *punch*; TIT = *titchagui*; DUB = *dubal chagui*; MD = *mondolyo chagui*; FUR = *furyo chagui*; FRO = *frontal kicks*; TOR = *torgue chagui*; BIT = *bitro chagui*.

Figure 5. Frequency of occurrence (%) of attacks in the scores performed.

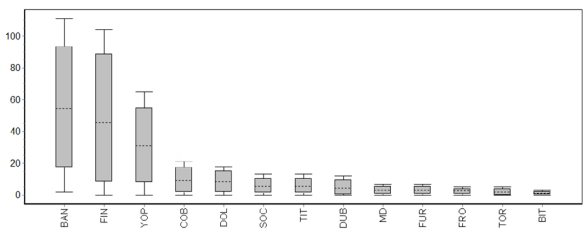
Table 1 shows the total time spent in a fight for each technical-tactical variable in Taekwondo matches.

Table 1: Descriptive time-motion analysis by taekwondo action and phase during a match, presented in seconds by mean ± SD.

Time-motion analysis	Action	Total Action-time	Total phase-time
Approach	BAD	116 ± 415	389 ± 521
	BAE	114 ± 470	
	BFD	99 ± 340	
	BFE	60 ± 309	
Attack	BAN	20.3 ± 47	51 ± 78
	YOP	9 ± 30	
	BIT	0.1 ± 2	
	DOL	3 ± 15	
	DUB	0.6 ± 4	
	COB	2 ± 8	
	FUR	0.5 ± 6	
	TIT	1 ± 7.07	
	FRO	0.5 ± 4	
	MD	0.4 ± 4	
	TOR	0.3 ± 5	
	SOC	5 ± 25	
	FIN	8 ± 22	
Clinch	CLI	37 ± 98	37 ± 98
Pause	QUE	2 ± 16	168 ± 365
	PAU	15 ± 78	
	PEN	150 ± 358	
Total			**646 ± 454**

Note. BAD = Right Foot Forward Open Stance; BAE = Left Foot Forward Open Stance; BFD = Right Foot Forward Closed Stance; BFE Left Foot Forward Closed Stance; BAN = *bandal chagui*; YOP = *yop chagui*; BIT = *bitro chagui*; DOL = *dolyo chagui*; DUB = *dubal chagui*; COB = coverage kicks; FUR = *furyo chagui*; TIT = *titchagui*; FRO = front kick; MD = *mondolyo chagui*; TOR = *torgue chagui*; SOC = punch; FIN = feint; CLI = clinch; QUE = fall; PAU = pause; PEN = penalty.

Figure 6 presents the frequency of attacks during each combat.



Note. BAN = *bandal chagui*; FIN = *feint*; YOP = *yop chagui*; COB = *coverage kicks*; DOL = *dolyo chagui*; SOC = *punch*; TIT = *titchagui*; DUB = *dubal chagui*; MD = *mondolyo chagui*; FUR = *furyo chagui*; FRO = *front kick*; TOR = *torgue chagui*; BIT = *bitro chagui*.

Figure 6. Frequency of technical actions during combat

Discussion

The present study aimed to develop a protocol and validate the use of Easytag for real-time analysis of technical-tactical actions in Taekwondo, verifying the reliability intra and inter-expert. In addition, we compared the relative total temporal structure and the frequency of actions and reactions between medalists and non-medalists in

the same match. The main findings indicate that: (a) the athletes were more effective in scoring defensive actions than offensive; (b) they scored the most times with 1-point techniques; (c) *bandal chagui* was the technique with the highest frequency of scoring; (d) the speed was the biggest differential between medalists and non-medalists; (e) there were increased punching and *yop chagui* (strut) actions compared to previous studies; (f) about 18% of the scoring came from fouls and penalties; (g) most of the scoring occurred in the 3rd round. In comparing the results with previous studies, it is noted that despite the changes in rules and equipment (conventional protector for the electronic system), some characteristics of Taekwondo were maintained. It was found that athletes were more effective in scoring counterattack actions in the present study, which corroborates the data presented in preceding studies [Avakian *et al.* 2016; Menescardi *et al.* 2019; Menescardi *et al.* 2015; Milazzo *et al.* 2016; Tabben *et al.* 2018; Tornello *et al.* 2013; Tornello *et al.* 2014].

Another characteristic which remained was the predominance of points with techniques at the trunk (86.3%) and only 13.7% for techniques at the head, with *bandal chagui* being the most frequent technique and with the highest incidence of points, performed 2270 times and scored in 265 different moments. The study carried out by De Prado *et al.* [2011], found that the most used technique in the editions of the 2000, 2004 and 2008 Olympic Games was *bandal tchagui*. Authors observed the incidence of kicks at the torso was 93% in matches with the conventional protector, while these values decreased to 79% with the electronic system [Pyciarz 2011]; likewise, the techniques performed at the height of the protector are still prevalent throughout the match, with a main impact of the protector color between wearing red and the victory in the female featherweight division [Falco *et al.* 2016].

We observed that most of the scoring occurred in the third round, and these results were corroborated by previous papers [Bridge *et al.* 2011; Santos *et al.* 2011]. Despite there being characteristics, which remained the same when comparing studies carried out with conventional protectors to the electronic system, it is noted that several characteristics have changed. The first which deserves mention is the high incidence of using the *yop tchagui* technique (strut), which was not mentioned in previous studies among the most frequent techniques. In addition, the speed of this technique was significantly higher in the group of medalists when compared to non-medalists; this means it seems that executing this technique with higher speed seems to be one of the determining factors for competitive success.

The punching incidence was also another aspect that showed a large difference. This technique was responsible for 7.3% of the points, which was not mentioned with great relevance in previous studies [Falco *et al.* 2016; Menescardi *et al.* 2015; Pyciarz 2011]. In addition to punching, the *dolyo chagui* technique had a high incidence, being the third most used technique. These results are in line with the data presented by Pyciarz [2011], who observed a 600% increase in the use of this technique when comparing matches with the conventional vest and the electronic system.

The scores from fouls and penalties constituted 18.1%, which is a relatively high incidence, being almost one-fifth of the total match scoring. Based on these data, it seems important for the coach to place situations in their training programs which force the opponent to suffer penalties such as falls and outings, and try to prevent their athlete from performing this type of situation. Regarding the match temporality, the present study points out values of 1:8, showing that despite the changes in the fighting style, its temporality remains very similar to the other studies [Menescardi *et al.* 2019; Menescardi *et al.* 2015]. As limitations, there were no time divisions in the first minute and second minute of the round, since there may be differences in the actions at the beginning and end of each round and this is something which should be investigated. Another limitation was the actions were not divided by weight division and gender, which can generate specific data.

Conclusion

Based on our aims, methods, results and limitations, we concluded that the Easytag developed presented reliability in intra and inter-comparisons, indicating this App could be used to realize technical-tactical and time-motion real-time analysis in Taekwondo. These results represent an advantage, as coaches can show immediate feedback to your athlete during the competition, as the software can be installed on tablets and smartphones.

In the second aim, we compared the actions of world championship medalist and non-medalist. The medalists were more effective in scoring defensive actions than offensive; *bandal chagui* was the technique with the highest frequency; and the speed was the differential between medalists and non-medalists. It is noted that Taekwondo goes through great changes and that its combat style has been significantly changing since implementing rule changes and the electronic system. Techniques which were practically not used such as *Yop chagui* are much more frequent today and determinant for success in the modality; punching points which were practically non-existent now add up to almost 10% of the match score. Therefore, it is essential that coaches follow these changes and adapt their training to the current reality.

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Rozwój i wiarygodność analizy techniczno-taktycznej i czasowo-ruchowej w czasie rzeczywistym w World Taekwondo Grand Prix

Słowa kluczowe: badania czasu i ruchu, technika, sztuki walki, ćwiczenia obwodowe, trening interwałowy o wysokiej intensywności, wydolność sportowa

Streszczenie

Wprowadzenie. Pomimo dużego znaczenia, analiza czasowo-ruchowa i techniczno-taktyczna jest rzadko stosowana w Taekwondo przez trenerów i w pomocy technicznej, co wynika z braku protokołów techniczno-taktycznych do analizy w czasie rzeczywistym.

Problem i cel. Celem pracy było opracowanie i walidacja nowego protokołu techniczno-taktycznego w Taekwondo do analizy w czasie rzeczywistym, jak również przedstawienie charakterystyki i praktycznego zastosowania aplikacji do ogólnych modeli mistrzostw najwyżej rangi.

Metody. Dane zostały skomponowane dla 7,370 sekwencyjnych działań techniczno-taktycznych, łącznie 189 rund, które były obserwowane podczas 64 spotkań. Z tej liczby, dwadzieścia cztery walki z 64 (37.5%) były analizowane dwa razy dla jednego eksperta z 24-godzinną przerwą między nimi i jeden raz dla innego eksperta. Częstości i czas (sekundy) zmiennych techniczno-taktycznych wybranych do analizy odpowiadają następującym grupom: a) Pozycjonowanie; b) Techniki; c) Klincz; i d) Przerwa. Zastosowano metodę porównawczą Manna-Whitneya i współczynnik Kappa Cohena, p≥0,05.

Wyniki. Zaobserwowano podobną techniczno-taktyczną analizę w czasie rzeczywistym, bez istotnych różnic międzyosobniczych w zmiennych dotyczących ataku i kontrataku (P=0,959), zmiennych dotyczących postawy (P=1,0) lub czasu pauzy (P=0,959), przy zgodności między 0,49 (umiarkowana) i 0,75 (silna). Nie było również znaczących różnic między zawodnikami w zmiennych dotyczących ataku i kontrataku (P=1,0), zmiennych dotyczących postawy (P=1,0) lub czasu pauzy (P=1,0), przy zgodności między 0,72 (silna) i 0,87 (prawie doskonała). Analiza taktyczna ujawnia, że zawodnicy byli bardziej skuteczni w zdobywaniu punktów w akcjach defensywnych niż ofensywnych, zdobywając najwięcej razy punkty techniką 1-punktową. Bandal chagui był techniką o największej częstotliwości zdobywania punktów, a ~20% punktów pochodziło z kar.

Wnioski. Wyniki te stanowią zaletę, ponieważ trenerzy mogą korzystać z tego protokołu, pokazując natychmiastową informację zwrotną dla swojego zawodnika podczas zawodów lub treningu, ponieważ aplikacja może być zainstalowana na tabletach i smartfonach.