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## **MMA fighters' technical-tactical preparation – fight analysis: a case study**

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**Brief running head:** MMA Polish fighting

### **Summary**

**Introduction.** An MMA fight gives the participating athletes an opportunity to show a wide range of tactical and technical skills from a variety of martial arts. To be successful in it, one must impose his own fighting style on the opponent and confirm its effectiveness.

**Materials and methods.** The research material consisted of a hundred and eighty-seven technical attacks performed during a 13-minute fight of two MMA fighters (referred to in the paper as Athlete #1 and Athlete #2) belonging to the elite of the Polish KSW organization (Mixed Martial Arts Confrontation). The collected material allowed assessing the time structure of the fight as well as individual characteristics of tactical and technical preparation of the involved athletes.

**Results.** Athlete #1 limited the technical elements in stand-up fighting to striking; Athlete #2 showed a considerably greater versatility of techniques in stand-up fighting. While fighting on the ground Athlete #2 limited his techniques to striking and more often won a dominant position on the ground obtaining a clear advantage in values of all the measured indices of tactical and technical preparation. An increase in the frequency of applied techniques (A) during the analyzed fight was also associated with an increase in the range of their use (W).

**Conclusions.** During the analyzed fight the athletes showed a narrow range of techniques. The collected results allow developing an individual characteristic of athletes' technical and tactical preparation enabling corrections to their training and preparation for the next fight.

**Key words:** time structure of a fight, MMA techniques, characteristics of attack

## **Introduction**

Nowadays mixed martial arts (MMA) are one of the most popular and the fastest developing fight presentation in the world, enjoying increasing coverage in mass media MMA includes sophisticated combat strategies, among others from such martial arts as judo or ju-jitsu, karate, kung-fu, kickboxing, wrestling or boxing. Such a combination is not a sum of them all, but it creates a new quality, which simultaneously deviates from the classic models of the disciplines constituting the core of MMA. In turn, the above mentioned martial arts, so far functioning independently and basing on traditional models, now struggle for supporters, fans and sponsors in their environments so as not to be pushed aside. To do that, they implement new, more attractive in reception forms of rivalry and tradition.

MMA, although such a popular but still new fight discipline, has not been scientifically studied in the training areas to enable coaches to prepare an athlete for participation in a tournament [1].

The fight in mixed martial arts (MMA) confront athletes with a need to master multiple techniques used in different styles of combat. Depending on the preferred techniques used during a fight, athletes can be divided into the so-called *strikers* (who prefer strikes) and *grapplers* (who prefer grappling techniques). There is also a group of athletes whose fight is to take the opponent to the ground and strike there (*ground and pound*).

Owing to their usefulness, observations and analyses indicating the currently most effective and the most frequently used techniques during competitions, are constantly being developed [2,3].

In MMA there is a definitely greater variety of applied techniques and interdependent factors determining the success in a bout.

Many of the top MMA fighters, with spectacular victories in prestigious tournaments, represent championship skills both in the striking and in grappling techniques. Their successes

during fights relies on a simultaneous application of the dominant techniques and neutralizing the opponent's dangerous actions. Victory during these encounters should be guaranteed by a detailed analysis of the potential rival's fights and adapting one's own skills to his way of fighting [4,5,6]

The authors of this article together with another scientists believe that the physiological endurance in MMA brings very various results and is not well studied [7].

For example - in authors opinion the training 4-5 per week can not result in very high aerobic and anaerobic level as presented in Australian study [8]. Even more difficult to explain are the results of aerobic capacity at very high level of MMA fighters which declared training 2 times a week since 2 years - obtained in american studies [9]

The aim of the study was to determine the structure of an MMA fight, and an individual characteristic of technical-tactical preparation of the fighting athletes.

### **Material and methods.**

The fight was conducted during KSW 29 in 2014 in Krakow, enjoying a great interest of the audience, and it was broadcast by TVP (Polish National Public Broadcaster). The fight was registered by audio-video means and then each executed technique was recorded with the help of graphic marks for each executed attack.

The written record of the contests was made separately by two combat sport trainers. Both people worked separately using the same standard computer equipment to read the video record (stop frame, magnifying, slow motion, reversing, 32" screen, screen resolution - 1280/960).

The statistical reliability of the information record made by both experts was calculated using PQStat. v.1.4.4 program. The Cohen's- kappa index was calculated at 85%.

The research material consisted of 187 attacks carried out by two athletes from the national elite of the KSW organization (Mixed Martial Arts Confrontation) (referred to in the paper as *Athlete #1* and *Athlete #2*). The total time of the fight was 13 minutes. The athletes competed in a 2-round fight, five minutes each, and additional 3-minute extra time. There was a 1.5-min break between the first and the second round, and between the second round of the fight and the extra time the break was two minutes and twenty seconds.

For a better description of the fight, the terminology used in MMA and other martial arts was adopted, e.g. "*stand-up*" fighting (while standing) – a fight during which athletes have contact with the ground only through their feet, *fight on "the ground"* – a fight during which athletes have at least three points of contact with the ground, "*a dominant position on the ground*" is

defined as one in which the opponent is turned with the back or the front of his trunk to the ground, and the attacking athlete is positioned above him. Also the technique aimed at implementing a throw or bringing the fight to the ground was often called with the jargon term "*takedown*" (www.mma.pl). During the fight in stand-up three groups of applied techniques were distinguished: striking with hands, striking with legs and grapplings performed in order to bring the fight to the ground. Also in a ground position three groups of techniques were distinguished: striking with hands, grapplings to subdue the opponent and immobilizations - positioning the opponent.

Indicators allowing for an objective assessment of the applied attacks: versatility of attack index and activity in attack index [10], were also determined, according to the formulas:

- activity in attack index -

Aa1 = Athlete's #1 sum of attacks/min

Aa2 = Athlete's #2 sum of attacks/min

A1 = Athlete's #1 attack activity

A2 = Athlete's #2 attack activity

A1 = Aa1 – Aa2 or A2 = Aa2 – Aa1

- the versatility of attack index (range of applied techniques) -

$W = X/M$

W – versatility of attack

X – the number of performed technical groups

M – the number of registered (applied) technical groups marked with a fixed denominator – 100 techniques – for the purposes of analysis in the paper.

## **Results**

The time structure of the entire fight is presented in Figure 1. The fight was conducted in full 13 minutes, two rounds 5 minutes each and an extra time round of 3 minutes. In total the athletes fought 5 minutes in stand-up and 8 minutes on the ground. In the first round, the athletes fought for 75 seconds in stand-up, then by striking with his leg Athlete #2 brought the fight to the ground and maintained the dominant position for 165 seconds. Then due to declining activity in this position, the referee stopped the fight on the ground and resumed it in stand-up, in which it continued for 60 seconds until the break between rounds. The second

round of fighting started in stand-up, and after 69 seconds again Athlete #2 brought the fight to the ground by grappling the opponent's feet with his hands and took a dominant position for 66 seconds. Then the referee conducting the fight found lack of fighters' activity and resumed fighting in stand-up. For a period of 25 seconds the athletes struggled in stand-up, then Athlete #1 brought the fight to the ground and maintained his dominant position for 92 seconds, then he gave the initiative to Athlete #2 for 8 seconds, regaining it for 5 seconds, and again lost dominance on the ground, which Athlete #2 kept until the end of the second round, i.e. for 35 seconds. After two rounds, referees did not decide to explicitly appoint the winner; therefore, after a break of 140 seconds they decided that additional 3-minute extra time would decide about the final victory. The first 49 seconds of fighting took place in stand-up, then Athlete #2 brought the fight to the ground and maintained the dominant position there for 71 seconds. After this time referee stopped the fight on the ground, resuming it in stand-up. Athletes fought for 22 seconds in stand-up, then again Athlete #2 brought the fight to the ground and ran it for the next 38 seconds in the dominant position until the end of the meeting.

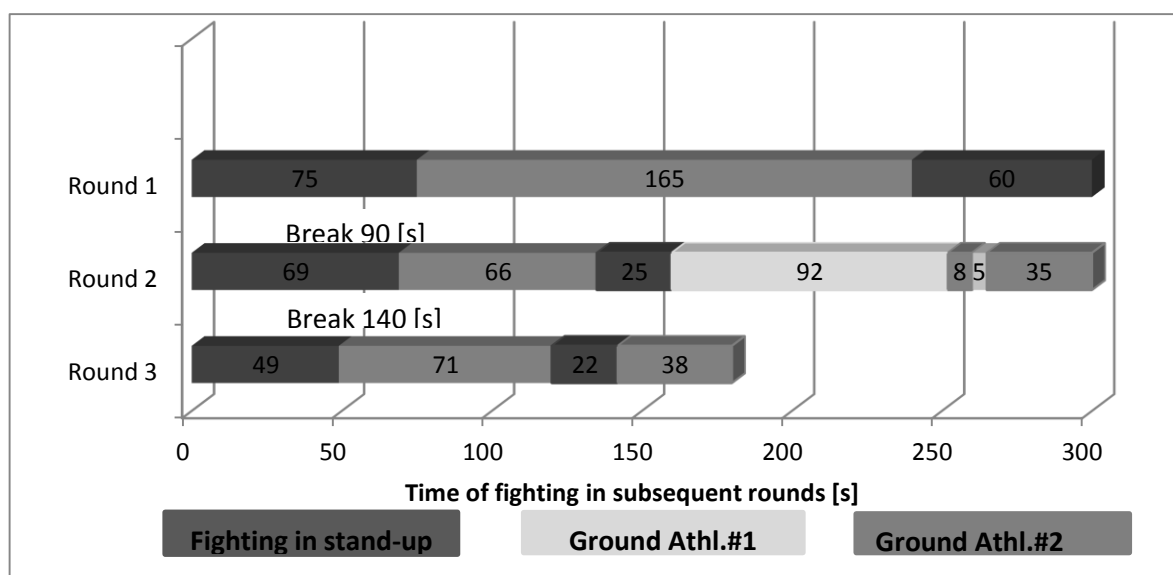


Figure 1. Time structure of the fight taking account of the athletes' dominant position on the ground.

In subsequent rounds of the fight, athletes attempted to perform groups of techniques depicted in Figures 2-7. During the first round of fighting in stand-up Athlete #1 mostly attacked by striking with hands, whereas Athlete #2 equally performed attacks from the three analyzed

groups of techniques (Fig. 2). During this round, while fighting on the ground, both fighters performed strikes with their hands the most frequently, and Athlete #1 also tried to grapple (Fig. 3)

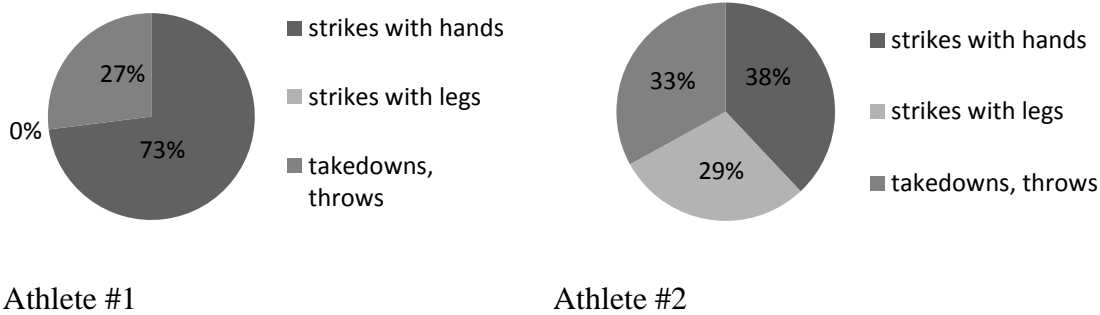


Figure 2. Groups of techniques performed in the first round while fighting in stand-up.

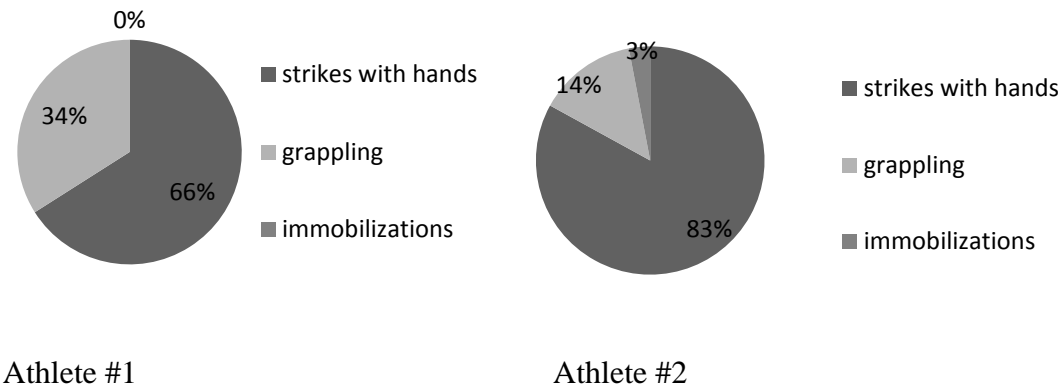


Figure 3. Groups of techniques performed in the first round while fighting on the ground.

During the second round, Athlete #1 again most commonly used technique of striking with hands, whereas Athlete #2 evenly applied techniques from all three analyzed groups (Fig. 4). While fighting on the ground in the second round, half of Athlete’s #1 techniques were striking with hands and the other half of the used techniques were the immobilizations and grapplings.

By contrast, Athlete #2 limited himself to striking with his hands (Fig. 5).

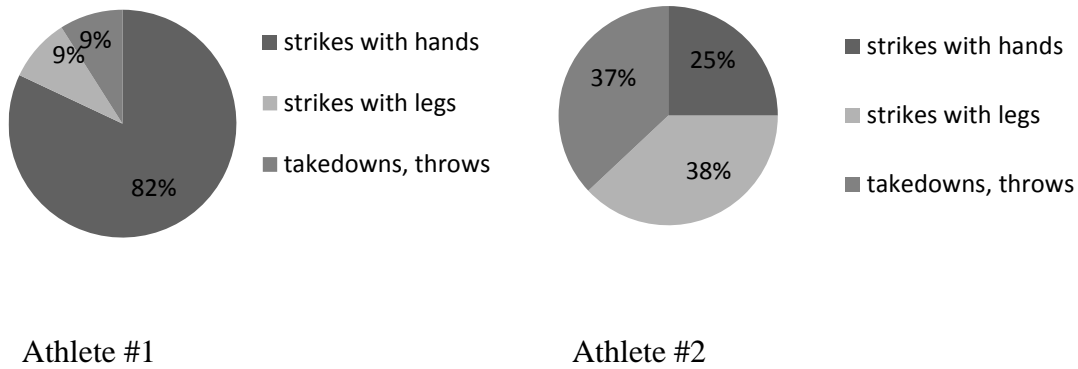


Figure 4. Groups of techniques performed in the second round while fighting in stand-up.

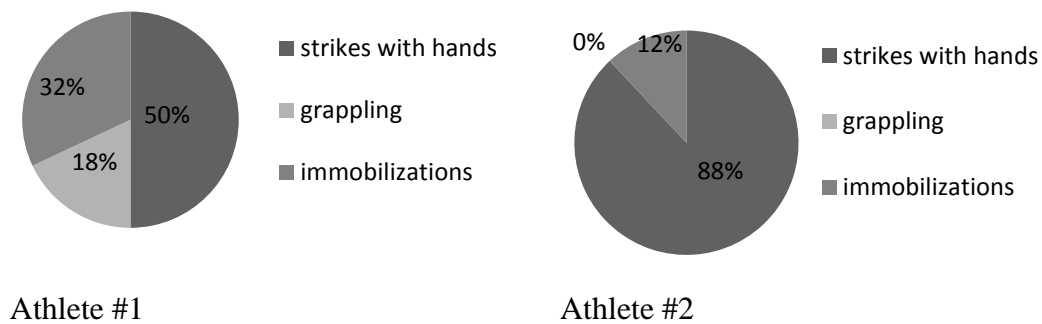


Figure 5. Groups of techniques performed in the second round while fighting on the ground.

During extra time round, in stand-up Athlete #1 mostly used attacks by striking with his hands, and Athlete #2 tried to grapple (Fig. 6). In this round while fighting on the ground, Athlete #1 gave full initiative to his opponent and limited himself to defensive actions. Athlete #2 gained advantage by striking with his hands (Fig. 7).

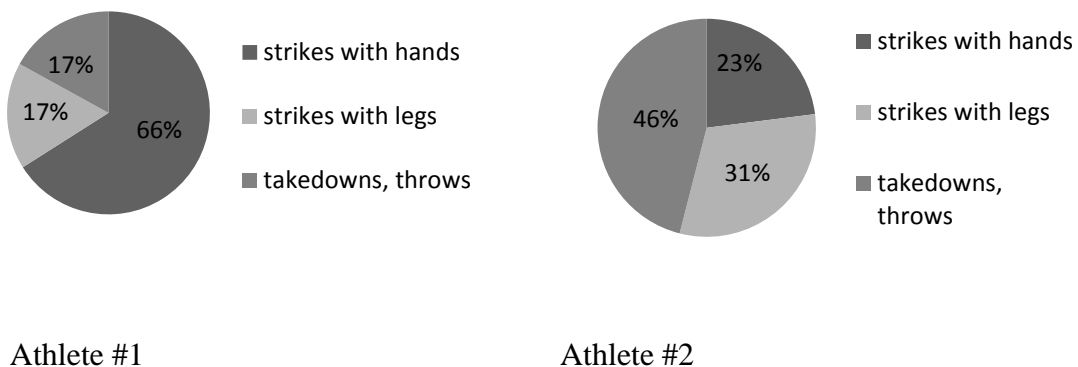
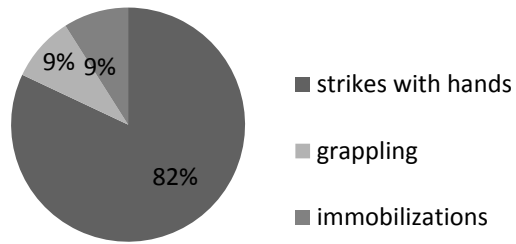


Figure 6. Groups of techniques performed in the extra time round while fighting in stand-up.



Athlete #1

Athlete #2

Figure 7. Groups of techniques performed in the extra time round while fighting on the ground. (Athlete # 1 did not perform any technique during this round).

Both the attack activity indices (frequency of performed attacks) and the versatility indices (range of applied techniques) indicate an advantage of Athlete #2 in the first round of the fight. This advantage increased in the extra time round. Athlete #1 gained an advantage of these indices in the second round of the fight (Fig. 8-9).

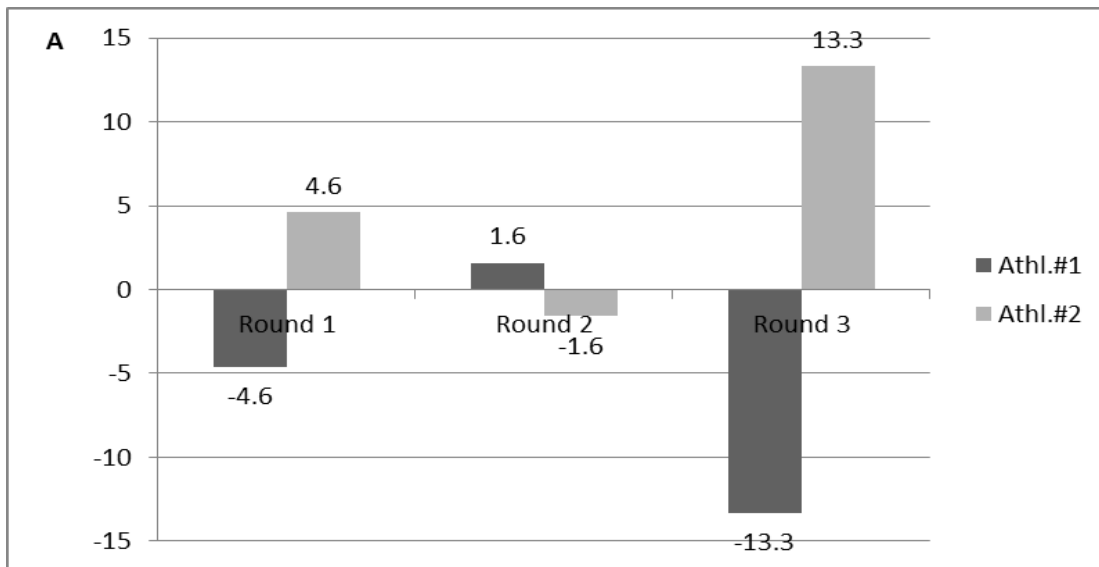


Figure 8. Athletes' attack activity indices in successive rounds.



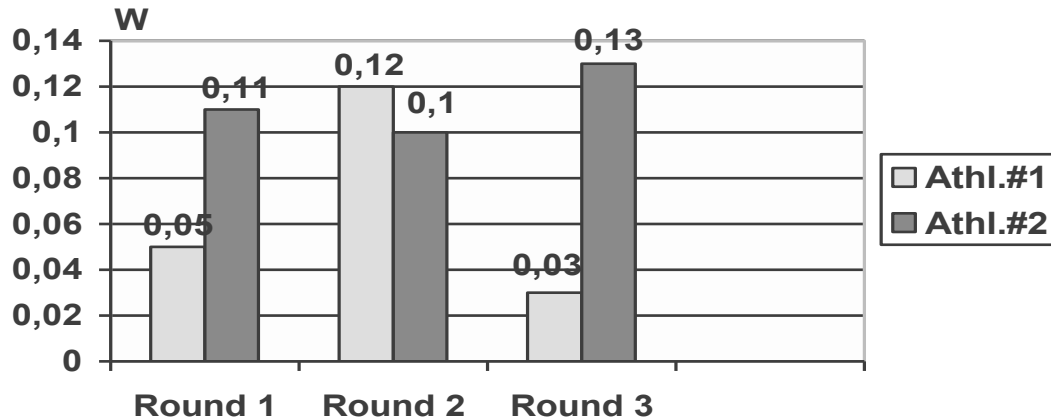


Figure 9. Athletes' versatility indices in successive rounds.

## Discussion

Athlete #1 was a world class judoka who had a wide range of effective techniques of throwing and grappling [11]. Yet, during the analyzed MMA fight in stand-up, he usually applied techniques of striking with his hands. Athlete #2 was a former world-class representative of strength sports. During the MMA fight in stand-up he applied grapplings more effectively than his opponent.

While fighting on the ground Athlete #2 was in a dominant position, which facilitated striking with one's hands from the top, for 6'23", while Athlete #1 was in this position only for 1'38" in the second round. During the analyzed fight both athletes most often used techniques of striking with hands. Athlete #1 preferred these techniques in stand-up, while Athlete #2 on the ground.

The paper has not divided the techniques into those which reached the goal or failed to do so (were effective or ineffective). None of the strikes or grapplings led to finishing the fight before the end of normal time of fight, and their effect was only to gain activity, stop the opponent's attacks and keep one's distance. Also surprising can be an effective way of fighting by Athlete #2, being the "ground and pound" style, which resulted in gaining significant advantage, particularly in the extra time of the fight and in the first round. Athlete #1 was characterized by a certain one-sidedness of conducting the fight in stand-up, during which he mainly tried to strike on the head with his hands, which did not produce the intended effects.

In MMA one fifth of all victories through knockout before the end of the regular time as a result of pounding on the head with hands takes place in the first minute since the beginning of a round. Victories through knockout are not rare in this discipline, but are still more seldom

than in boxing [12,13]. This fighting style did not lead Athlete #1 to victory nor did it bring any other desired effects

By contrast, his opponent more evenly used the remaining techniques in fighting in stand-up, trying to strike with his legs and to grapple, which led to taking the fight to the ground.

The legitimacy of Athlete's #2 actions is confirmed by the results of studies conducted by Kirk et al. 2015, who proved in MMA winners, among others, a higher number of successful takedowns and taking the fight to the ground in comparison to the same actions in their defeated opponents [14]. MMA athletes fighting on the ground, similarly to wrestlers, must prove an ability to make both dynamic and isometric effort [15] prove that nearly 50% of MMA bouts are finished by actions conducted on the ground. Stressing the action in this area may result in more effectiveness of the fight [16].

Because the athletes did not perform any technical element (strike, grappling) which would decide about the victory, one of the criteria of their effectiveness was the frequency of the applied techniques requiring adequate physical fitness [17,18,19,20].

Athlete #2 showed greater efficiency by gaining a significant advantage of indices in the extra time round. During the analyzed fight, it was found that the increasing dominance in the frequency of attacks was connected with a simultaneous increase in the range of techniques. The question whether the growth in the number of attacks led to the growth in the range of applied techniques, or whether the increasing range of techniques favored performing more attacks remains unanswered.

During MMA fighting, the variety of techniques derived from the many sports and fighting styles does not allow defining the scope of effectively applied techniques, which in this study was the denominator of the "W" index.

The conventional value of one hundred gave an opportunity to mark a range of techniques used by athletes during the analyzed fight. In many sports disciplines a classification techniques has been made, although there are still doubts whether it includes all technical elements used in sports competition [21,22,23].

The authors decided to resign from the analysis of the handle at the MMA fight, although it is a component of many studies in other martial arts [24,25].

The observed athletes did not manifest a wide range of tactical and technical preparation, which was defined by this index. Both the level of the fight and its virulence might not have allowed them to demonstrate the full potential of their individual capabilities.

## Conclusions

- MMA fighters showed a narrow range of techniques used during the analyzed fight, both in standing position like on the ground.
- Athlete #1 limited himself mainly to attempts at striking with his hands in the stand-up position, while Athlete #2 tried to strike with his hands fighting on the ground, which results him a victory in extra time
- Both fighters must increase the number of techniques used in the standing position in order to lead a successful attack

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