

**Scientific review**

## **ANALYSIS OF HAND TECHNIQUES IN KARATE**

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**Abstract:** This paper deals with the issue of hand techniques in karate, which describe and represent the essence of both the former self-defence skills and today's sports karate. Regardless of the methodological and practice system these techniques are taught within and applied (with the open hand or the fist and with a number of striking surfaces in application), they are very attractive and play an important role. The force that is expressed in the application of these techniques carried out with bare hands is fascinating, especially in the demonstration of skills (when breaking various items), while in sports karate they are very useful and have a dominant role in scoring. This paper analyzes the techniques from the methodological, biomechanical and technical tactical points of view, showing the results of scientific research and their temporal characteristics and processes that describe and affirm them as the structural elements of the attack, which in modern sports karate play a dominant role. The displayed techniques are illustrated with appropriate illustrations, diagrams and tables.

**Keywords:** *technique, self-defence, karate sport, structure, attack*

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### **INTRODUCTION**

Although today karate is distinctive almost exclusively as a sports discipline, all the available historical data from the very beginnings until the beginning of the 20th century say that it is an art of self-defence. Only the emergence of some form of karate techniques in the school system of Okinawa in

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1905<sup>2</sup>, especially in the thirties of the 20th century credited to the most famous karate expert Gichin Funakoshi<sup>3</sup>, did this skill begin its transformation into a karate sport, first across Japan and later all over the world. The transformation of this skill into a sport discipline is important to emphasize, as these changes led to new models of teaching content and training, which required that all techniques, especially hand ones, need to adjust to a new situation. This was particularly true of hand techniques that, until the appearance of a sports form, were performed according to the principle “annihilate at one blow” (iken hisatsu) or the application of the technique without any control.

For all authorities for martial arts but also for the laity, the very word karate associates with skill, where the techniques are performed by ‘empty’ hands and the feet. Although today karate is a sport discipline (accepted by the IOC<sup>4</sup> and due to be present at the next Olympic Games<sup>5</sup> in Japan in 2020), which has adherents among recreational practitioners but in essence, it involves the art of self-defence of ‘empty’ hands, as the name itself says. Etymologically, up to the beginning of the 20th century, the name of this skill was written in Chinese calligraphy<sup>6</sup> (Chinese ideograms), and was known as the ‘Chinese hand’ or ‘Chinese fist.’ As the term itself is bound to the Tang dynasty<sup>7</sup> it was known as the ‘hand of the Tang Dynasty.’ Under this dynasty, the Chinese civilization experienced a remarkable boom in all social spheres, including in the field of martial arts which was successfully promoted in Japan, with whom they maintained cultural and trade relations. For many years, karate with this name lettering and Chinese characters was taught and developed primarily on the island of Okinawa, and later in Japan itself. Only in the first half of the 20th century (1932-1935), in the turbulent age of the rise of Japan’s militarism and nationalism and at the request of the imperial authorities did the name of karate change. This time, it was also known by the distancing of Japan from China, and reflected the conversion of Chinese characters in the Japanese interpretation of the code. Thus the name of ‘Chinese hand’ was changed by the same Chinese calligraphy that had previously been indigenous to Japan (kanji ideograms), into the Japanese name ‘empty hand.’ This small historical, etymological examination is important in order to highlight the role of ‘empty or bare’ hands, i.e. the techniques performed by the hands, which derives from the name KARA (empty) TE (fist). The emphasis on the ‘empty hand’ has also directed methodology training and program content in the direction of hand techniques. Along with hand training, with all the striking surfaces that can be used

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<sup>2</sup> Anko Itosu (1831-1915), an Okinawa karate expert considered to be the father of modern karate, introducing karate into the Okinawa school system in 1905.

<sup>3</sup> Gichin Funakoshi (1871-1957), a great Okinawa karate master, known as the creator of sports karate.

<sup>4</sup> IOC – the International Olympic Committee.

<sup>5</sup> The Olympic Games are held every four years. An official announcement from the OC about accepting karate into the family of Olympic sports was received during these games in Brazil.

<sup>6</sup> Ideograms, originally from China, are called Kanji.

<sup>7</sup> The Tang dynasty, a Chinese Imperial dynasty from the 618-907 period.

in the **defence and counterattacks** primarily by the armed attacker, special attention was paid to the development of the entire psychological and physical status. With daily, difficult and very exhausting exercises, especially by the method of a large number of repetitions of one technique, and by strengthening the striking surface, the practitioner with time grew more efficient in self-defence (to defend and guard).

Practicing in this way, which gave the outcome of a highly trained karateka, also paved the way of karate skills as a self-defence discipline. Upgrading training and other techniques (techniques carried out by the feet), successfully completes a self-defence unity.

The techniques performed by the hands, whether blocks or strikes, earlier on, when they were used in the defence of life were, as now, applied in contemporary sports karate with the aim to win a sports victory, they have a unique role and are the most important part of karate.

## **1. THE THEORETICAL BASIS OF THE PAPER**

### **1.1. Systematization of the hand strike techniques in karate**

The large range of karate techniques, especially hand strikes, can be roughly divided into the techniques of blocks and strike techniques. Both groups belong to the most important elements of karate. Unfortunately, in the transformation of karate skills into a sports discipline, many of the techniques that are performed by hands, especially strike techniques (finger strikes, with the open hand, elbow, and head), were thrown out of training and almost completely neglected. This reduction technique was performed at the time of the rapid expansion of karate throughout Japan and the introduction of these skills in the educational school system, which is justified by the fact that it is a technique whose application could cause major consequences for practitioners. Learning and practicing these techniques continued through the training of katas, a specific method of applying the learned karate techniques. Katas are, according to many great authorities of karate, fights with an imaginary opponent or opponents. "A kata is fighting with imaginary opponents; in fact, a continuous series of blocks and strikes according to a strictly regulated system. It can be said that a kata is showing all the elements of the techniques that a karateka has learned; this is also what can help assess the level of his knowledge" (Jorge et al., 1968). Although this definition is entirely correct, the practice of kata as a primary method of learning and training karate techniques, has today been turned into its opposite and represents one of the competitive disciplines. Although these exercises and derived movements are applied in a single form or in combination with certain prescribed movements and rhythm, they are evaluated according to certain criteria, and the outward form of kata radiates incomprehension and superficiality. The techniques in kata are practiced almost exclusively as "empty" movements, with the absence of fighting and especially the absence of understanding and spirit. In this way, the learned and

the shown techniques make no sense. Therefore, a kata and all its elements must be learned, practiced and perfected as “a fight with real opponents with the aim of their complete destruction”<sup>8</sup>. Although this approach seems impossible, incomprehensible and unnecessary (in the era of sports karate), not only is it achievable with hard work, dedication and faith, but it is also our moral responsibility towards tradition and the proper attitude in fostering the same. Of course, as long as there are those who practice karate today as a self-defence skill, these techniques as well as katas, will not sink into oblivion.

Strike techniques are classified according to the following criteria (Jovanović, 1992):

1. The body part towards which the strike is afflicted
2. The direction of the strike
3. The shape of the line of performing
4. The striking surface

According to the first criterion, strikes are classified as such:

- Hand strikes
- Foot strikes
- Head strikes

According to the second criterion, strikes are classified as such:

- Forward strikes
- Backward strikes
- Side strikes
- Upward strikes
- Downward strikes

According to the third criterion, strikes are classified as such:

- direct
- circular

According to the criterion determined by the striking surface, the striking surfaces are the following (Illustration 1):

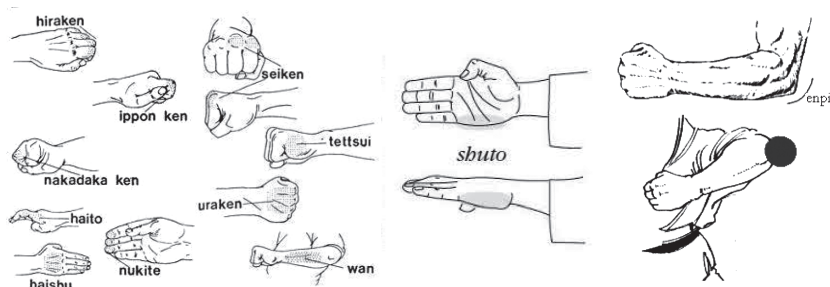
- proper fist (seiken)
- side back strike (uraken uchi)
- a stabbing action using the extended index finger (ippon nukite)
- ‘spear hand’ (nukite)
- ‘one-knuckle fist’ (ippon ken)
- ‘middle finger knuckle’ (nakadaka ippon ken)
- a strike or block with the back of the hand (haishu)
- ‘bare hand’ (kumade)
- ‘knife-hand block’ (shuto uke)
- ‘hammer strike’ (tettsui)
- ‘ridge-hand strike’ (haito)
- top of the elbow

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<sup>8</sup> The definition of a kata by the author.

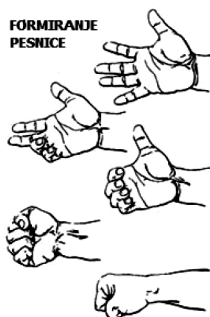
Hand strike techniques, in the strictest sense of the word, can be divided into strikes that are carried out by the fist, or punches (tsuki), edge of the open hand (uchi) and the elbow (empi). It must be noted that man from time immemorial used self-defence in any form as the struggle for self-preservation, also using all the suitable surfaces of his extremities (arms and legs), as striking surfaces. In this way, a set of effective techniques was formed (this was particularly significant at the time when it was forbidden to carry weapons<sup>9</sup>). Of course, in this context we take into consideration the segments of the hands, fist-open hands, fingers, forearm-elbow, which are a series of striking surfaces. By strenuous exercising and training of any of these striking surfaces (fingers, edge of palm, palm, forearm, the elbow and of course the fist) deadly striking surfaces can be created (Illustration 1).

**Illustration 1.** *Striking and blocking hand surfaces*

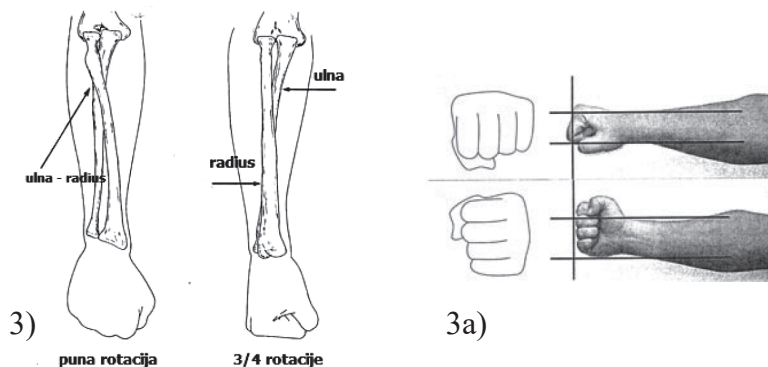


In any form of hand strikes, it is important to emphasize that the effectiveness of the implemented techniques is closely linked with the established striking surface (forming a fist - Illustration 2), i.e. from the correlation of segments that participate in its formulation but also from the strength achieved by the wrist (Illustration 3 and 3a), the elbows and shoulders and the correlation between them.

**Illustration 2.** *Forming a fist*



<sup>9</sup> This age pertains to the period of karate as a self-defense skill.

**Illustration 3.** *The proper correlation between a fist and a forearm*

## 1.2. The time parameters of the hand strike techniques

With the development and influence of science in karate which started in the early eighties of the 20th century, and with various research projects that viewed karate techniques from several aspects, began a new era of understanding and interpreting phenomena in karate. The results of these studies are reflected in the development of unique models of education, the training of new technologies, methods of training and learning, as well as the sports training itself. It must be noted that it was a pioneering scientific endeavour unique of its kind in our country but also in the world, initiated in the former Yugoslavia, especially in the area of the Republic of Serbia. Primarily, this involves a group of younger scientists with great practical experience in karate – PhDs of physical culture, primarily from the University of Belgrade<sup>10</sup>. The value of the results of this experimental research was reflected in the promotion of karate theory but also fighting in general, as their implementation in the practice of karate and fighting.

In this context, hereinafter we will present just some of the results of the aforementioned research. Special attention was paid to research that looked at the techniques of karate, in terms of the time dimension (speed) and manifested power.

It is known that the speed of impact depends on the length of the body lever, the body mass which is empowered, the ability to realize the force at high speeds, etc., and it is measured by the running distance per unit of time, while strength depends on the number of muscle groups involved in the kick and the demonstrated level of force.

<sup>10</sup> The group of scientists researching the area of karate was led by Prof. M. Zulić, PhD, Prof. M. Milošević, PhD and Prof. S. Jovanović, PhD.

Thus the speeds of certain techniques, which are taught in the basic training, are different:

- A jab punch (kizami zuki) has a performing time 110 milliseconds, at a speed of 5.23 m/s.
- A reverse punch (gyaku zuki), with a performing time of 150 milliseconds, at a speed of 5.18 m/s.
- A lunge punch – oi zuki (but combined with gyaku zuki), with a time of 480 milliseconds (Mudrić, 1994)<sup>11</sup>.
- A lunge punch – oi zuki, with a time of about 590 milliseconds.

Supporting the mentioned time parameters is also Table 1, which gives the values of the applied techniques (in seconds) and their speed (in m/s).

**Table 1.** Kinematic indications of attack techniques (Zulić, Milošević, 1989)

Types of attack	Time of attack (sec)	Speed of attack (m/s)
Knife attack	0,30	3,30
Stick attack	0,26	3,90
Direct	0,20	5,00
Hook	0,25	4,00
Kizami zuki	0,11	5,23
Gyaku zuki	0,15	5,85
Mae geri	0,23	11,11
Mavashi geri	0,25	8,16
Ushiro geri	0,24	7,68
Hand blocks	0,11	5,00
Movement (1.5 m)	0,70	2,11

In the boxing technique, the median speed of the hand on impact in a master of sport is 4-5 meters per second, while a fist at the time of the collision has a maximum speed, and it is in with top boxers 8-10 m/s (Ćirković, Jovanović, 1992).

In the context of researching time parameters, karate techniques (strikes) at different levels of situational (un)certainly and the linking of the same with the presence of the same level of force at a distance of 0.5 m and 1 m in performance, interesting results were obtained. The results are shown in Table 2 (Mudrić et al., 2004).

<sup>11</sup> This time is shown as the research showed that this combination (oi zuki-gyaku zuki, stepping at a distance of 1m, at a light signal) is considered to be a simple technique.

**Table 2.** Force of impact in an unconditional, conditional and elective attack

No.	Type of attack	Distance (m)	Force level (dN)
1.	Unconditional kizami zuki	0.5	158.8
2.	Unconditional gyaku zuki	0.5	256.9
3.	Conditional kizami zuki	0.5	135.4
4.	Conditional gyaku zuki	0.5	233.9
5.	Elective kizami zuki	0.5	129.6
6.	Elective gyaku zuki	0.5	228.3
7.	Unconditional kizami zuki	1.0	166.3
8.	Unconditional gyaku zuki	1.0	241.4
9.	Conditional kizami zuki	1.0	160.6
10.	Conditional gyaku zuki	1.0	230.3
11.	Elective kizami zuki	1.0	158.4
12.	Elective gyaku zuki	1.0	298.2

In the context outlined above and complementing the given indicators, also interesting are the research results that speak of the variability of time parameters of karate attacks, where the studied time parameters of karate techniques in coaching situational tasks are of a different complexity (Mudrić, 1999). The research results have enabled extracting time dimensions of karate attack techniques, which are labelled as partial and integral time parameters of attacks that are responsible for planning (marked as LV in the table) and the realization of the movement, expressed in two time frames, the time of realization (marked VP in the table) and the total time of attack realization (marked UVP in the table). Table 3 gives the values that describe these techniques (mean, standard deviation, minimum and maximum values). Via these parameters it was possible to explain the variability of the same, in terms of the different levels of situational (un)certainty.

**Table 3.** Descriptive indicators of time parameters of hand techniques

Rb.	Variable	Mean	Std. dev.	Min.	Max.
1.	OZS1LV	271.13	62.597	193	549
2.	OZS1VP	664.578	81.048	343	917
3.	OZS1UVP	935.716	81.298	687	1158
4.	GZS1LV	293.657	82.59	193	616
5.	GZS1VP	667.304	99.145	384	945
6.	GZS1UVP	961.049	97.627	791	1213
7.	OZS4LV	374.049	105.857	220	738



8.	OZS4VP	695.843	89.566	467	893
9.	OZS4UVP	1071.853	124.422	800	1485
10.	GZS4LV	403.402	106.493	137	781
11.	GZS4VP	675.971	101.175	371	889
12.	GZS4UVP	1079.373	134.833	748	1523

**Note:** The table uses the following abbreviations of the names of variables for the tested techniques: OZS1LV (oi zuki in the regimen of the first level of complexity – the time of planning or programming); GZS1LV (gyaku zuki in the regimen of the first level of complexity – time of planning); OZS1VP (oi zuki – the time of movement realization in the regimen of the first level of complexity); OZSIUVP (oi zuki – the total time the entire movement), etc. for the other techniques of the first level of complexity.

All the tested techniques were carried out from the so-called optimal stance<sup>12</sup> (Jovanović et al., 1989), from a tensiometric platform which was linked with an electronic part of the equipment (a computer) which measured and memorized the obtained values expressed in milliseconds.

- The first level of complexity is a situation in which the respondent was aware of everything (which platform to strike, with which technique, whether by hand or foot, to what level, to the light signal – the LED light was located on a prime part of the platform). By a controlled strike to the platform, the signal light is turned off and the time is stored in the computer unit in milliseconds. This situation represents a minimum level of complexity and it is called an unconditional attack.
- Time planning is the time from making a decision about launching a technique that should be applied to the initiation of movement, by a muscle contraction of the extensors of the ankle and the knee joint, the opposite leg (the 'rear' foot in the stance). In other words, it is the time from the time of the command to the muscles to perform the designed movement to 'raising' the heel from the platform.
- The time of realizing the movement is the time obtained in the so-called pure realization of a certain technique.
- On a more complex level (a level with 4 unknowns), the techniques in the table are marked with number 4.

After the analysis of the partial and integral times in various types of attacks, the following has been concluded:

Partial time parameters for planning, in a situation of unconditional attacks, have different values, depending on whether the attack is done with the hands or the feet, but there are differences even in hand and foot attacks. However, it can be concluded that the process of planning an attack, regardless

<sup>12</sup> An optimal stance, according to this author, must fulfill the following criteria, in order for the applied technique to have a certain desired effect: **1. Stability (balance), 2. Mobility, 3. Optimal anatomic-biomechanical conditions for showing maximum muscle force.**

of whether it is an attack by the arms or legs in this situation, carries an average of about 30% of the integral time of the attack. A partial realization of the attack time parameter, in this situation, according to the previous, takes up about 70% of the time. Partial time parameters of planning attacks with the hands take up 29.74% of the time, while with the feet it is 30.54%.

From this we can see that the processes of planning attacks which are carried out by the feet, in unconditional attacks, are insignificantly more complex than the attacks carried out by the hands.

Partial time parameters of planning, in a situation of an elective attack, have different values depending on whether the attack is done with the hands or feet, but there are differences even within hand and foot attacks. It can be concluded that the process of planning an attack, regardless of whether it was an attack with the hands or feet in this situation, approximately has about 37% of the integral time of the attack. A partial realization of the attack time parameter in this situation, according to the previous, takes up about 63% of the time. Partial time parameters of planning hand attacks take up 35.9% of the time, while the feet are 38.48%.

The use of sophisticated new technologies (tensio platform, new software for testing, etc.) as well as the methodology of research, have enabled a partial extraction of some partial timeframes, which have not been possible to obtain until then. In fact, for the first time we have obtained timeframes that are responsible for **planning (programming)** movements, as the authors call them, and the time for a pure **realization** of movement. The sum of the obtained total timeframes of the derived movements is shown in Table 3.

This partial time, planning the movement, although it is about 300 in non-intrusive circumstances in terms of execution and about 390 in complex conditions, the use of a proper technique is very important, because it involves the times which are most affected by the cognitive abilities of practitioners. The processes analyzed prior to a decision at the start of implementation are the following:

- recognizing the given signal (in a real situation this is a sign which “uncovers” the opponent, a specific movement which precedes the attack),
- comparing the given signal with the structure which should be realized,
- the choice of a given structure and giving orders for realization,
- inclusion of the necessary muscles responsible for initiating movement.

All these processes have one name: **the processes of an initiatory programming of an attack.**

Processing and the analysis of these processes (from the decision on the move to be implemented until the beginning of realization), has a duration time. The aim of the task, which is an imperative, is to enable the trainees to be as efficient as possible, i.e. to enable them to as soon as possible process

as much information (unknown) as possible. This is possible with specific training methods, especially if you take into account the already mentioned fact that this is an area of intellectual abilities.

As regards the second separated, partial time, the realization of which accounts for about 70% of the total time, it is burdened by other processes, which are called processes of motor realization of attacks, in which primarily motor skills trainees participate, who are still “limited” and may be less affected.

From the above analysis, it can be concluded that the processes of planning and realization of attacks are more complex in a situation of elective attacks (a higher level of complexity) than unconditional attacks. This conclusion is also justified as increasing the unfamiliar, complicating the situational (un)certainly which requires a greater time for processing and analysis.

Also, results were obtained that speak of a different complexity of the derivative techniques of hand strikes (although there are no statistically significant differences between the techniques and oi zuki gyaku zuki), these techniques differ according to the obtained times, whether it involves unconditional or elective attacks.

When these data are correlated with the results of the investigation of technical and tactical characteristics of karate (Gužvica, 2000) then an answer is received why the strike techniques in a scoring sense, is still dominant in relation to foot techniques.

### 1.3. The representation of strike techniques in a sports fight

Studies that discuss the representation of individual strike techniques and their participation in scoring in a sports fight in karate provide provide clear and relevant indicators that can be used for training. Previous studies of this issue indicate a high concordance of the results when it comes to the percentage share of hand and foot techniques that are used in an attack (Gužvica, 2000). Part of the result of this extensive research is given in Table 4.

Thus, the participation in the total number of points earned by hands is about 90%. In an extensive study of technical and tactical characteristics of Yugoslav karate, it was concluded that the representation of scoring hand techniques, in relation to the total number of scoring, was 89.54%, while the percentage incidence of leg scoring techniques was significantly lower and amounted to 11.02%. In other partial studies of this issue, we obtained higher percentages of representation of hand techniques, compared to the kicks: from 94% (134) to 98% (Vučenović, 1998).

The representation of techniques carried out by hands and weight categories is different, while the strike of **gyaku zuki** (counter punch, fist forehead), is the most represented, with a percentage value of about 72%, and the lowest percentage recorded is in the super lightweight division (around 65%), with the highest being in the lightweight (about 79%). **Kizami zuki** (direct shot

forehead fist forward hand in the guard) is next in ranking hand techniques whose percentage of representation is in about 15% of the cases. The lowest percentage of **kizami zuki** is registered in the lightweight category (about 11%), and the largest in the super lightweight (about 22%). It is interesting that these two most represented scoring techniques were applied the most performed in the attack (in about 67%), while intercepting took place in about 24% of cases.

The frequency of the occurrence of other scoring techniques in relation to the total number of scoring is almost negligible.

**Table 4.** Distribution of frequency representation of scoring hand techniques by category

Categories	GZ	KZ	OZ	UU	URT
1	113 65.32%	37 21.38%	1 0.57%	3 1.73%	154 89.01%
2	118 79.12%	17 11.40%	1 0.67%	1 0.67%	137 91.94%
3	129 70.87%	27 14.83%	2 1.09%	3 1.64%	161 88.46%
4	162 74.65%	26 11.98%	1 0.46%	1 0.46%	190 87.55%
5	122 70.52%	27 15.60%	3 1.73%	2 1.15%	154 89.01%
6	111 67.68%	27 16.46%	0	8 4.87%	146 89.02%
7	110 72.36%	19 12.5%	5 3.29%	4 2.63%	138 90.78%
Total	865 71.72%	180 14.92%	13 1.07%	22 1.82%	1080 89.54%

Category column represents:

1. Superlight, to 60 kg
2. Light, to 65 kg
3. Middle weight, to 70 kg
4. Middleweight, to 75 kg
5. Light heavyweight, to 80 kg
6. Heavyweight, over 80 kg
7. No limit

The abbreviations of the tested techniques:

- GZ – gyaku zuki – reverse punch  
 KZ – kizami zuki – jab punch  
 OZ – oi zuki – lunge punch  
 UU – uraken uchi – back knuckle  
 URT – total of hand techniques

## 2. HAND TECHNIQUES

The techniques in this group are the following: **punch techniques (Tsuki) and block techniques (Uke)**.

All strike techniques, whether those concerning the hands or the feet, can be defined as “movement structures of a varying complexity to be performed with the purpose of destroying opponents” (Mudrić, 2004).

The level of destruction depends on the specific application techniques. Thus, in a sports fight there is a symbolic destruction which is determined by the rules of the trial, while in some real situations, in moments of life danger and vulnerability, strike techniques can be applied partially, or in an extreme case, for complete destruction, as the last possibility.

There is also another definition: “Strike techniques as certain movements can also be defined as the movement structures that are carried out by the hands and feet with the participation of other parts of the body” (Milošević et al., 1991).

## 2.1. Hand strikes

To perform any strike, we use appropriate movements which can be straight and circular. The effectiveness of the applied impact depends directly on the learned movement in a proper position. Also, the strikes can be effective only when they are carried out fast, but in a strong and timely fashion. Sometimes, a timely reaction that leads to the manifestation of technique in the form of a strike is more important than the strength of the strike carried out (the obvious example of this being boxing techniques and their application in the fight).

The hand techniques can be applied as direct attacks and in the form of counter strikes<sup>13</sup>.

Performing most strikes can be viewed through three characteristic stages, which speak of the speed of the body segments participating in the strike. Thus, in the first phase there is an abrupt growth rate (around maximum), and in the other, mostly a stabilization speed (some segments even stop their movements), and in the third to a steady decline in speed of all segments, when the muscles antagonists are included to stop the extreme parts which carry out the strike.

This blocking, although seemingly paradoxical, has a multiple role, primarily in the following:

- Strengthening the extremity joints which carry out the strike (preventing injuries and the possibility of a maximal transmission of a force);
- Increasing the total mass which takes part in the strike;
- Prevention of “repelling” during the collision with the body of the opponent;
- A reactive transmission of the totally created strike after a sudden stop of movement (Milošević et al., 1995).

Regarding the participation of the mass of the body in the strength of the impact, it is relatively proportional, and it is very important that as much

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<sup>13</sup> The techniques which are applied as a response to the opponent’s attack. They can be carried out after blocking an attack or as prevention.

mass as possible in brought into the strike. However, in terms of the speed of the technique, the mass is adversely affected, and in some situations, at the moment of contact with an aim, the strike turns into pushing. Thus, contact with the objective should be brief, up to 5 milliseconds. In boxing techniques, with a properly carried out and efficient strike, the time of the collision of the fist amounts to 14-18 m/s, and in maximizing the time, up to 30 m/s, the strike turns into shoving (Ćirković, Jovanović, 1992).

## **2.2. A methodical review with a muscle analysis of hand techniques**

The practical applicability of the strike techniques, which is confirmed in practice, a sports karate fight or a real situation, supports the opinion that this is a simple and free technique. However, the hand strike techniques are coordination-wise more complex activities than the external image of the applied technique implies. A particular problem with learning techniques is a well-formed striking surface, which is protruding towards the end, the correlation between the fist segments, the thumb position in relation to the fingers which make a fist, or in correlation to the extended fingers of an open hand, than the ratio of the hands and forearms, which also depends on whether the hand is clenched into a fist or with an open hand (fingers extended). The most subtle positions are those that concern the correlation between the fingers with the thumb and vice versa. This is stressed due to bad wrist bones and their connections, especially the front phalanges which make contact with the objective. Therefore, the training for the striking surface is performed gradually, cautiously and during a longer period. That all these warnings are true is corroborated by the data on the application of learned techniques (which are primarily taught in as 'empty' and without contact), when the first contacts were made with the aim, especially when it comes to hard surfaces (lumber, stone, etc.), and there occur light or serious injuries. Such traumatic situations are overcome by choice, rational and effective methods of exercise, through various forms of negotiated sparring and hitting the famous karate props (makiwara, sutanawara, etc). Exercise and application techniques through various forms of negotiated sparring as one of the most effective methods, have the aim, among others, to strengthen the blocking surface. Specifically, it should be borne in mind that in the first contact with the enemy, there is a sensation of pain, which should deconcentrate him, paralyze and disable the execution of further attacks. Basically, in real situations, the first contact is realized by a block, which is a response to an opponent's attack. The situation should be used to quickly and efficiently overcome the attacker (or to win the fight). We should also bear in mind the well-known fact that pain spreads at maximum speed and this it is important that the sensation of pain is of as high an intensity as possible. However, in today's karate, where the dominant attack is in the

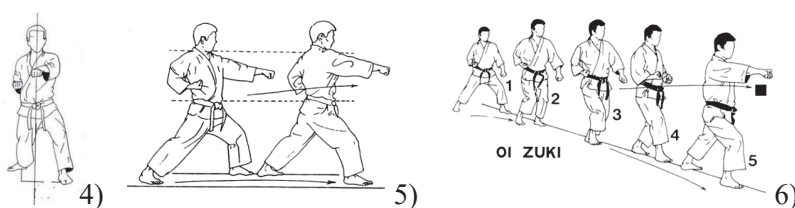
conduct of sports combat, where the first contact with the enemy is realized by techniques of kicks and not blocks, almost no attention is paid to any form of prearranged sparring or to the strengthening of blocking the striking surface.

### 2.2.1. Direct hand strikes – a lunge punch (*oi zuki*)

This technique belongs to the group of offensive techniques, and it has exclusive use in direct attacks, performing frontwards and after the avoiding or blocking of an opponent's technique. It is one of the more complex techniques in view of co-ordination, and in many cases, its performance is identified with a similar impact, *Kizami zuki*, with sloping shoulders and hips, in the final stage of the movement.

The complexity of the movement is most drastically manifested in the final stage, by insisting on the closure of the hips and shoulders, and their frontal position regarding the target (in the direction of movement, counter rotation of the hips).

**Illustrations 4, 5, 6.** A direct lunge punch (*oi zuki*)



#### **Carrying out the oi zuki technique**

- Preparation position: the start of the movement from the front stance with a low block (Illustration 6/1).
- The maintaining of movement is carried out by engaging the extensor ankle muscles (m. triceps surae; m. plantaris; m. tibialis posterior; m. peroneus longus) and the knees (m. quadriceps femoris), the 'back' legs, and resisting with the back leg against the surface and rolling a part of the body mass towards the front (projecting) leg and knee. The movement of the hind leg towards the forward step should be an isolated movement, and during that time the hands are in an unchanged position. This is significant because we should first change the position of the body in a movement forward, and then take up a new front position, followed by performing hand movements. At a basic level of learning, this sequence supports a basic methodological concept, according to which the previously started movement must be completed in order to proceed with the following one. Starting a hand movement leads, in principle, to a situation in which the technique is too fast, with no stance, which reduces the ultimate effect. A semi-circular movement of

the back leg to the front is the result of shifting the body weight slightly and a somewhat lower body centre of gravity (in the occupied preceding position, compared to a normal gait, where the centre of gravity is raised, Illustrations 6/2, 3, 4). If in training there is respect for the basic principle of 'as soon as possible to the finish line,' which means the most rational move without oscillations of the body gravity, then the movement must be learned and practiced as a straight-line movement. Therefore, it would be good to have in mind the methodological change of the image of the back foot position. Changing positions is related to possibly reducing the angle of the foot which slants the direction (instead of an angle of 450 to an angle of around 250 - Savić, 2015)<sup>14</sup>.

- In the final phase (completed movement step) a 'new' front stance has been taken. The hands start carrying a strike to the front, with a straight-line motion, never taking the elbows away from the body (m. deltoideus, pars medius; m. deltoideus, pars posterior; m. tricepsbrachi; m. anconeus; m. pectoralis major; m. coracobrachialis). With the impact, the twisting (pronation) of the forearm is carried out (m. tricepsbrachi; m. pronatorteres; m. pronatorquadratus), as well as the rotation of the hips forwards which impacts the turning of the body (m. gluteusmedius; m. gluteusminimus; m. tensorfasciaeatae; m. adductormagnus), frontally towards the target (m. quvadriicepsfemoris; m. vastusmedialis; m. gastrocnemius; m. soleus); (Illustration 6/5). In the final stage, the hand carrying out the strike is extended in the elbow and under the body, in a desired level (head, torso or stomach), in a forward stance (Illustration 4). The body and the head are straight, the other hand is on the hip, rotated with the palm turned upwards (supine). The engaged muscles which enable this position of "twisting" the forearm (hand) are the muscles supinators: m. supinator; m. biceps brachi; the eyes are directed towards the direction of movement and eye height. The striking surface is the fist (seiken).
- Of course, included are the muscles which are not key in a dynamic sense, but rather the static muscles which carry out movements (m. serratusanterior; m. rectusabdominis; m. obliqvusabdominisexternus; m. rectusfemoris; m. vastuslateralis and m. biceps femoris).

It must be said that the application of the technique in the fight variant is drastically different from the basic, school form. In order for this technique to be efficient in attack, it must be carried out with a modified front ("back" leg bent at the knee, with a raised heel or the entire foot, and a jutting hip) or a fighting stance (fudo dachi). The efficiency of the applied technique is achieved exclusively by direct movements.

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<sup>14</sup> The position of the foot of the opposing leg ('back' leg) is very important and has justification from the anatomical and biomechanical aspects. In that sense, mostly the foot is placed in an angle max. 450. However, some initial theories in that direction have in mind a foot angle between 00-200 (Savić, 2015).



Typical errors:

- A hasty carrying out the impact without a prior stance.
- A body inclined forward, 'to the fist.' The error is the result of an untimely stopping of movement and taking a stance.
- A raised foot of the back legs in the position taken. This position of the foot, leading to a reduction in the support surface and disrupting the equilibrium position, is a result of an inadequate width of the position taken.

### 2.2.2. Direct strike – a jab punch (*kizami zuki*)

The technique is virtually identical to the one previously described, with the difference that in the final stage, the position of the hips and shoulders is slanted in relation to the direction of movement (Illustration 7 and Figure 1). The striking surface is the first. The muscles involved in the movement are identical as with the *oi zuki* technique and they will not be specifically stated herewith.

**Illustration 7.** *Kizami zuki*



**Figure 1.** *Kizami zuki and makiwara*

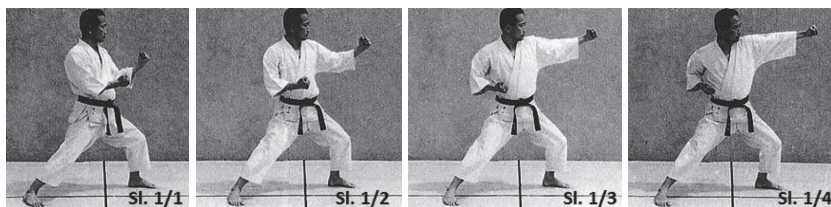


The strike is carried out with moving steps, sliding or a double step and is solely carried out onto the head of the opponent. When this technique is practiced by movement of sliding and double step, then this is done with the front hand from the combat position (guard). The technique is often used in combination with another karate technique, usually as an introductory technique that creates (provides) the position for placing the finishing touch.

A similar technique is practiced in boxing, which is called direct. They are of similar characteristic, identical striking surfaces and methods of execution. In boxing this shot is often used as an independent technique, which is awarded points, while in karate it is often performed in a combination of techniques.

Techniques in combat sports can be successfully applied in a direct attack or in the interception of opponents.

The carrying out of the strike is shown in stages from the fighting position in Figure 1/4.

**Figure 1/4.** Carrying out the kizami zuki (stages)

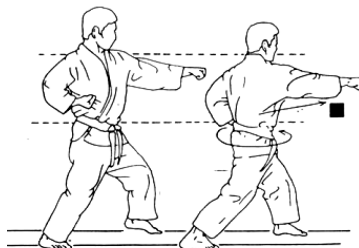
### 2.2.3. A reverse punch (gyaku zuki)

The technique is known as a counter strike carried out with the fist forwards (Figure 2). A counter strike as a manifestation is also known in boxing, as the technique is applied mostly after a block, in the head or the body of the opponent. It can be carried out from any position, using diverse movements (steps, sliding, double step). This technique is commonly applied in sports karate fighting (as much as 80% points earned refer to gyaku zuki; Gužvica, 2000), where it is performed in a specific, modified form (Figure 3). Namely, in the changing, complex conditions of the fight, where the reaching distance cannot be so easily reached (making contact with the target), and the competitors resort to a prolonged strike, executed in position with the foot if the back leg is raised on the toes, which greatly reduces the power kick. Since in a sports karate fight the goal is to score, where the force of the technique is not in the foreground, but the speed of impact, the techniques are carried out in this applied position, and they are justified. But regardless of the previous, a strike belongs to the group of techniques that can be performed with great force, due to the possibility of entering a high molecular weight and a favourable position of the body, prior to the achieved contact with the target (Figure 8).

In Figure 3, the technique is shown like in the previously described situation and a position which is usual in karate.

**Figure 2.** Counter strike with the hand carried out in makiwaru**Figure 3.** Technique applied in a fight

**Illustration 8. Counter strike with the hand**



**A short description of the technique and stance with which the technique is carried out**

- The width of the position corresponds with the width of the hips of the trainees. This is important for the free movement of the current hip forwards, during the execution of the strike (hip rotation at a longer path possible).
- The length of the position is about two hip widths. In the case of the need for exertion of maximum impulse of the force of impact, this length is increased due to achieving a greater stability in the directions of back and forth, i.e., a stronger support for the transfer of momentum in a collision with the impact surface and the body of the opponent.
- The foot of the protruding leg is directed with the toes forwards (the axis parallel with the direction thereof), in order to enable the highest possible rotation during the strike. The foot of the opposite leg holds the position to a max. 450 degrees, in relation to the direction of movement.
- The projection of the centre of gravity of the body is shifted more towards the forward foot because of the tendency to incorporate as much body mass in producing a momentum kick in the direction of forwards and enhancing the support during the strike.
- The position of the hips and shoulders corresponds to the classical frontal position, which occurs as a result of the maximum rotation of the torso and hips, the transfer of momentum. It should be noted that this position of the hips is held only at the moment of giving the blow, after which the rotation is in the opposite direction (resetting).
- Other characteristics: the protruding leg is bent at the knee at an angle slightly greater than 90 degree, the opposite leg is maximally stretched out or bent at the knee joint, depending on the level of training<sup>15</sup>. Active support is realized by the small areas of both feet. The torso is approximately vertical.

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<sup>15</sup> Note: in basic training, the techniques are learned and applied in the school form, where there is an insistence on the technique being carried out extensively in order to achieve a larger striking force (physical and mechanical laws). However, with long-term exercising and

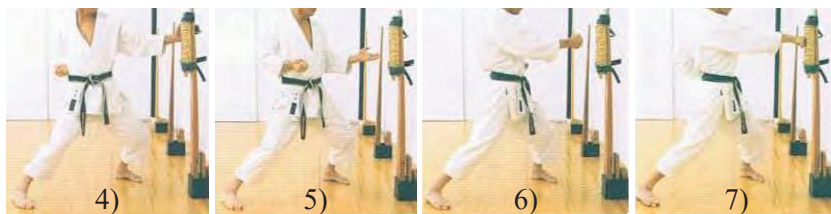
### **The reverse punch (gyaku zuki) in a fighting stance (fudo dachi)**

- Starting position: from the fighting position, where the right hand is on the hip, with slanted shoulders, which is a prerequisite for the production of swinging of the hip and shoulder, which ensures that the blow is delivered extensively.
- The initial impetus for the execution of a strike creates a rapid contraction of the extensor muscles of the ankle and the knee supporting (right) leg by pushing against the surface; muscles listed in the previously described techniques. The produced ground reaction force is transmitted through the ankles and knees, to the appropriate hip. The vertical component of this force enables a firm support for the inclusion of the hip rotator muscles inward (m. Gluteus medius; m. Gluteus minimus; m. Tensor fasciae latae; m. Adductor magnus) and the spine (m. Obliquus internus abdominis; m. Obliquus externus abdominis, while the horizontal component gives an initial impulse for a swing of the hip forwards (m. Gluteus maximus; m. Quadriceps femoris). Thus, by a synchronized contraction of the appropriate muscles, a maximal rotation of the pelvis is carried out to a frontal position, which creates preconditions for swing of the shoulders and then a hand extension in the elbow (m. Deltoideus medius; m. Deltoideus posterior; m. Triceps brachii; m. pectoralis major; m. Serratus anterior; m. anconeus) and a final rotation (supinatio) of the fist (m. supinator; m. biceps brachii). During that time, the other hand is powerfully pulled back (m. biceps brachii; m. brachialis; m. brachioradialis), with the fist on its side and a rotation of the forearm (a supine fist – muscle analysis just as with oi zuki) along with a synchronized withdrawing of the appropriate shoulder. This, according to the principle of force couple, strengthens the swing of the torso and the shoulders.
- The final stage is the frontal position. The hind leg in position can be maximally stretched or bent at the knee (depending on the level of technical training), the body is upright and the hips and shoulders facing frontally towards the target. The hand which carried out the stroke is extended at the elbow, in front of the body with the fist downwards. The corresponding synchronized contractions of all the necessary muscles involved in the movement (as described above), enables at the moment of impact a fist with the aim of expressing maximum force (maximum force transmission). The performing of the movements is followed by Figures 4, 5, 6, 7.

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improvement, it is desirable to apply the technique in a shorter way, with an insistence on achieving max. force (as in school training), using proper breathing and inner energy (KI). Of course, the comment also relates to the applying of block techniques. In this way, there is an insistence on achieving max. force and speed in as short a way as possible, due to larger efficiency, which requests exercising, personal improvement and seeking new work methods.

**Figure 4-7.** Carrying out the *gyaku zuki* technique in stages



- The most typical error that occurs in the impact associated with this strike is a badly struck position. Namely, mostly it happens that the position in which the technique is applied does not have sufficient width, which prevents closing the hips and shoulders forward. In this way, the strike is running on a shorter path and it is impossible to achieve to the end, to the previously described mode of transmission of force and momentum, which much reduces the effect and efficiency of the applied strike.
- A big mistake is a bad foot position of the back leg (the foot in the direction of movement forms an angle greater than  $45^\circ$ ). In this way, prevented is the closure of the hips forward (it is impossible to rotate the pelvis forward). Thus the strike carried out will be manifested only by the power exerted by muscle contractions of the arm extension.

#### 2.2.4. The back fist strike (*uraken uchi*)

The specific striking surface and trajectory of the fist are the basic characteristics of these hand techniques. The striking surface of this technique is represented by the back of the fist, formed by the index finger, middle finger and their joints, and the back of the hand. The fist is located in the extension of the forearm and with it makes a whole (Illustration 1).

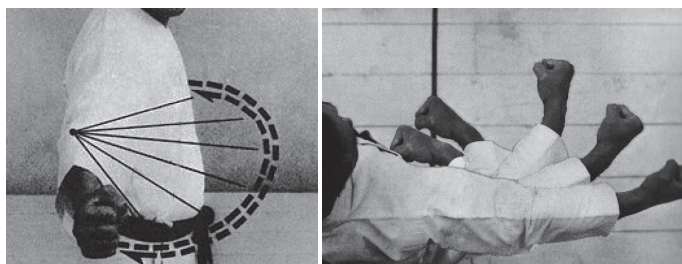
The technique is usually performed in the attack with various movements (forward, backward or side-step sliding or double step) and is effective in any position. Due to these favourable characteristics, in sports karate it is used as one of the techniques which scores points. It is mainly applied to the head of the opponent, the temples, the root of the nose and cheek bone (Illustration 9).

**Illustration 9.** Technique application



The specific starting position (a fist on the opposite shoulder), causes a semi-circular hand path with the fist toward the target and it can be carried out horizontally (to the side or front) or the vertical (top to bottom) path. The technique is carried out with a fast and powerful stretching of the arm at the elbow, throwing the fists back toward the target (Figure 8). The maximum force is generated by stretching the hand movements of the shoulder and elbow. This technique is very important for the precision of execution. The technique is very effective and it can be applied by turning or rotating the body.

**Figure 8.** Carrying out the movement technique with the elbow on the side



**The back first strike (uraken uchi) in a straddle stance (kiba dachi)**

- Starting position: a ready stance has been taken (Figure 9) with a starting position of the fist on the opposite shoulder (if the technique is left-handed, the fist is on the right shoulder). The fist with the fingers faces the ear (Figure 6). The elbow is directed towards the execution of the strike, while the other arm is extended forward in front of the body.
- In the second stage, the hand that is carrying out the technique carries out the stretching of the elbow, discharging the striking surface frontwards. Another hand is positioned on the hip (Figure 10).
- In the final position, in the front position, the back of the hand is stretched forward (thumb facing upwards), with slanting hips and shoulders. Another hand is on the hip, pulled maximally toward the spine (Figures 11 and 12).

**Figure 9-12.** A review of the technique

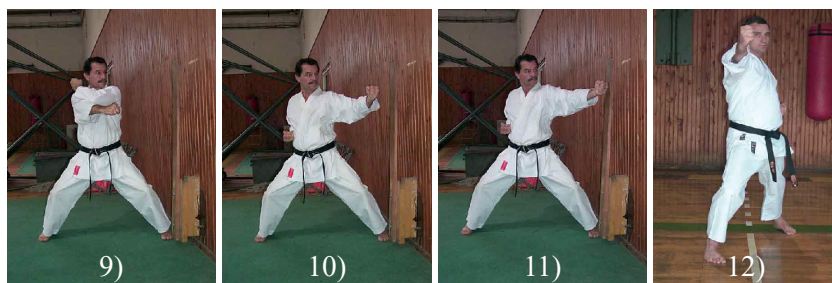


Figure 12 shows the technique applied in the front or fighting stance. On the basis of this position, a short muscular movement analysis will be given. The stretching of the hands is done by the following: m. trapezius; m. romboideus; m. deltoideus; m. tricepsbrachi; m. anconeus; m. extensordigitorum. The rotation of the body is done by m. abdominisexternus. Moving the body forwards are the following: m. gluteusmedius; m. gluteusmaximus; m. gastrocnemius; m. soleus; m. quadricepsfemoris.

When the strike is carried out by a vertical trajectory of the fist, from top to bottom, then the starting position of the fist is level to the waist and with the fingers facing down. From this position, the arm with the fist moves in a semi-circular way, from bottom to top (toward the opposite shoulder). From there, the path continues also by a semi-circular motion, from the top down and forwards, pulling forward the forearm towards the goal.

The biggest mistake in this technique is in an incorrect position of the first in relation to the forearm (a fist 'broken' in the wrist, upwards or downwards).

#### 2.2.5. The inside centre block strike

It is probable that the Shuto uchi<sup>16</sup> strike is the most famous karate technique via its recognizable striking surface, which is the bottom part of the open hand (Illustration 1). This attractive technique is mostly used in karate demonstrations, where the bottom of the palm breaks certain objects, boards, bricks, ice, etc. (Figure 13). Also, it is one of the many which are banned in sports karate.

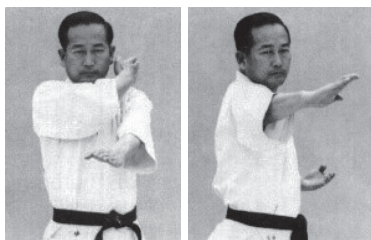
The strike is carried out with a wide movement of the hand in two directions. One is from the body outwards, inwards (uchi mawashi uchi, Figure 14), and the second one is externally inwards (towards the body), external (soto mawashi uchi, Figure 15).

Figure 13. Breaking objects



16 **Shuto** – “Knife-hand”. The striking blocking surface is the hand from the root of the pinky finger to the joint. The fingers are extended and together. The thumb is bent and positioned on the inner side of the palm. The hand with the stretched fingers is extended from the forearm and makes a unity. The techniques which are carried out by applying this area, blocks or strikes, have a specific trajectory which is similar to ‘cutting’ with a knife.

**Figure 14.** *Uchi mawashi uchi*



**Figure 15.** *Soto mawashi uchi*



The most frequently applied stance along with this technique is the front stance (zenkutsu dachi) or the fighting stance (fudo dachi, Illustration 10).

The arm at the elbow is never maximally stretched but it is a little bent, so as to allow a normal strike of the palm. The hand is in the extension of the forearm and attached to its joint (Illustration 9).

#### **Carrying out the shuto uchi technique in a forward stance (zenkutsu dachi)**

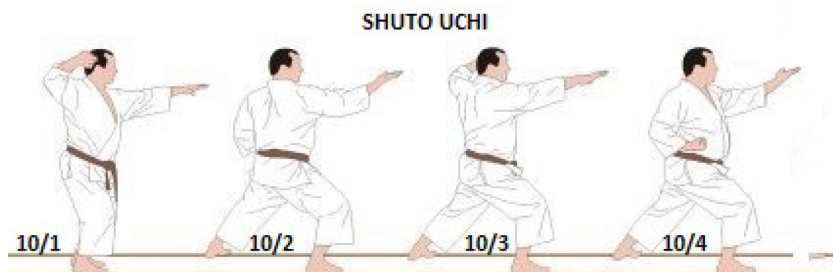
- The hand which carries out the strike is in the preparation position (Illustration 10/1).
- A stance forward is taken with the foot jutting forward, and the hand is in a striking position, carrying out a semicircular movement forwards and at the height of the karateka's neck (the opponent's neck or the temples, Illustration 10/2 or Illustration 10/4).
- In the final position, the appropriate stance is taken, the hand is stretched forwards, with an open palm and the bottom of the palm turned towards the target. The movement is carried out by engaging the extensor muscles of the ankle (m. triceps surae; m. plantaris; m. tibialis posterior; m. peroneus longus) and the knee (m. Quadriceps femoris), the 'back' leg, by pushing against the surface; moving the body forwards: m. Quadriceps femoris; m. Gluteus maximus; m. gluteus medius; m. gluteus minimus; m. tensor fasciae latae; m. adductor magnus; m. vastus lateralis; m. gastrocnemius; m. soleus; m. abdominis externus; m. rectus abdominis; m. serratus anterior; stretching the hands: m. deltoideus; m. triceps brachii; m. pectoralis major; m. serratus anterior; m. extensor carpi; m. brachioradialis; and the supinator muscles: m. supinator; m. biceps brachii; or the pronator muscles: m. triceps brachii; m. pronator teres; m. pronator quadratus.
- During that time, the other hand is strongly punches back (m. biceps brachii; m. brachialis; m. brachioradialis), with the fist on the side and a rotation of the forearm (hand in supination – the same muscle analysis like in oi zuki), along with a synchronized withdrawing of appropriate shoulder. This, according to the principle of coupling forces, strengthens the movement of the torso and the shoulders.



Typical errors:

- The striking surface is insufficiently formed.
- The body is insufficiently rotated and turned towards the target

**Illustration 10.** *Front stance strikes*



### 2.2.6. Short hand strike techniques

These techniques include short strikes carried out by the fist, elbow, front (forward) and rear (opposite) hand. The technique of short strikes is exclusively used in direct contact, or a short range. The short strikes are exclusively applied in a direct contact, on a short range. These strikes can be very efficient but since they are carried out at a short range, they require the engaging of the entire body (synchronized contractions of all muscle groups are necessary) in order to exert the muscular force necessary. This becomes more significant when one bears in mind that these techniques are applied without the support of any movement.

The following strikes carried out with the elbow belong to the group of short strikes (Illustration 11):

- Upper elbow strike, age empi uchi
- Forward elbow strike, mae empi uchi
- Side elbow strike, joko empi uchi
- Back elbow strike, ushiro empi uchi

**Illustration 11.** *Elbow strikes*

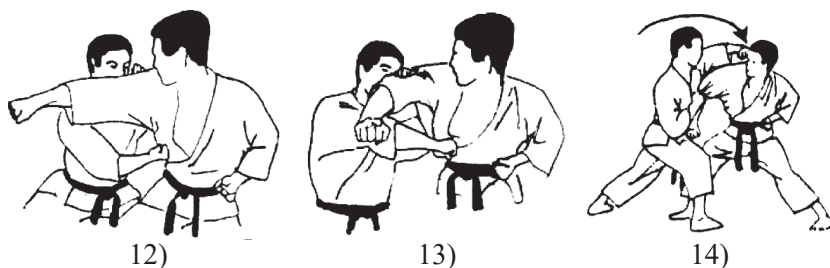


The group of short strikes which are carried out with the entire fist includes the following:

- An upper cut strike used at close range (ura zuki, Illustration 12); this technique, according to how its carried out, corresponds to the upper cut in boxing;
- Vertical punch, tate zuki;
- Hook punch, kagi tsuki (Illustration 13) and mawashi zuki (Illustration 14); this technique has some similarities with a hook in boxing.

The starting position for the implementation of short strikes with the fist and the hand with the fist on the hip, while in an elbow strike is different for almost each technique, just like the parts of the elbow which are striking surfaces are different

**Illustration 12-14. Short fist strikes**



## CONCLUSION

Hand techniques such as strikes and especially blocks, represent elemental techniques used by man in self-defence. These techniques played an important role in all forms of the practice of karate, from self-defence where these techniques were dominant, as well as today, applying them in the sports form. Results of studies indicate that the presence of these techniques is extremely dominant and ranges from 70% – 90% of the total number of scoring techniques. It is surprising that, despite favouring the foot techniques, in terms of scoring, hand techniques still dominate. Thus, in modern sports karate, where the fight takes place mainly in the attack and not as it once was, in the defence and counterattack, these techniques are still decisive factors in the victory of a competitor.

The explanation can be found in unchanged methodological contents and forms of work, which are still reliant on traditional principles and concepts of training. Also, the results of scientific research, especially those related to the time parameters of karate techniques and the processes that describe them, **clearly indicate that hand techniques, techniques of less complexity, are shorter lasting and therefore safer for execution and implementation.**

Regardless of the obvious tendencies of favouring foot techniques, and looking for ways to take advantage of attractive prices and a greater popularization of karate hand techniques, as the most natural human movements, they will continue to be the focus of experts in this field, especially from the methodological aspects and then via training technology.

In this paper, these techniques are analyzed by way of biomechanical and methodical aspects, through the dominant, dynamic muscle groups to key static muscle which help to engage enough body weight in the execution of movement or strikes.

Also, presented are time parameters of strike techniques in various conditions and situations of performing and application, as well as the representation of the same in the score system in contemporary sports karate.

The possible errors that may occur in the training are precisely pointed out, which facilitates a better understanding of the basic techniques of strikes, which are mostly used in karate practice.

By applied analysis, these attractive hand strikes were partly explained. Also, they were in this way pointed out to those who are just starting to practice karate, those who are already in the training process, as well as coaches and students of vocational schools. The paper certainly enriches the theory and practice in the area of martial arts, especially karate, regardless of the form of practicing.

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