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TESTING THE DYNAMIC RESPONSE OF THE ATHLETES WHO PRACTICE KARATE AS A PERFORMANCE SPORT

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Abstract: *The paper contains the preliminary tests of the competitors of the Karate sport, by analyzing the dynamic response of them. The testing is performed on a HUBER 360 computerized system, with which sports skills are established to assess injuries during karate sports competitions. The complete tests of three athletes – 2 boys and a girl – are presented with those situations resulting in testing, to which attention is recommended in competitions, or special preliminary trainings, to avoid injuries.*

Key words: *Testing Sportives; Karate as Performance Sport; Avoid Injuries.*

1. INTRODUCTION

In competitions, injuries are an important issue for sports clubs, especially in the situation where several athletes are unable to participate due to acute injuries, thus considerably decreasing the club's chance of success. This entails financial losses that increase with the withdrawal from the competition of one or two key athletes due to injuries [1], [2], [3], [4]. That is why investigations are made with specialized equipment, through which to predict possible disorders or imperfections in the execution of some movements by the athlete.

The literature emphasizes the importance of balance exercises in sports performance and shows that performing them frequently reduces musculoskeletal injuries. Balance exercises performed with the aim of improving proprioception train the brain to determine the position of the body segments at each moment. The presence of balance problems is an indicator of the increased risk of lower limb injuries in athletes. It has been noted that there are a variety of exercises used in neuromuscular training programs, and it has been pointed out that exercises just for balance training are not as effective as when they are integrated into a complex treatment program that includes several types of training.

Through the exact data recorded with the HUBER 360 device obtained at the evaluation, one can observe the sportive's risk of suffering a certain injury and thus intervene prophylactically reducing both the risk of swearing and the negative consequences that they entail.

2. INFORMATION of HUBER 360 COMPUTATIONAL DEVICE

2.1. General Knowledge

The HUBER 360 is an apparatus with an oscillatory platform and 2 handles. It is equipped with force sensors located both under the motorized platform and at the level of the handles (figure 1a).

(a). (b).

Fig. 1. (a). HUBER 360 platform with a subject to investigate; (b). the device tablet with the subject's data

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On the tablet on which the HUBER 360 software is integrated, you can view all the data recorded from the subject's evaluation (figure 1b), it can export the evaluation in PDF format that can be transmitted to the operator, who presents interpretation to the investigated one in order to correct the behaviour beforehand during sports competitions, or in view of performing corrective trainings to the sportive, who practices performance sports in Karate [5], [6], [7].

2.2.Specific Functional Tests of the Device

With the help of this platform, we can evaluate the patient objectively through several 7 specific functional tests: Stability test; Unipodal test; Gait test; Stability limit test; Mobility restrictions test; Test for the strength of the hind limbs; Upper and lower limb coordination test.

The duration of the test shall be 15 minutes [6]. Of the 7 functional tests, 3 are based on the Romberg test and the Fukuda test and these assess balance, 2 focus on measuring the stability and mobility restrictions, and 2 focus on quantifying the force and assessing the patient's coordination capacity [7].

The tests are presented briefly, as follows.

1. The stability test is performed bipodally timed (inspired by the Romberg test) with both eyes closed and eyes open and quantifies the position of the centre of gravity, thus assessing the balance. The balance is better if the registration points have a lower value.

2. Unipodal test - consists of the support of the athlete on a single lower limb for 20 seconds.

3. The gait test is a dynamic analysis, in a position specific to walking and with the help of which we can evaluate both the transfer of weight from one lower limb to the other and the rhythm of walking. It has the advantage of reproducing an activity from everyday life. He quantifies the number of steps executed in 50 seconds.

4. The stability limit test involves transferring the body weight in one direction, without detaching the legs from the platform. The evaluation criterion is the maximum amplitude of the trunk and ankle, in 8 different directions. It is measured in units of length.

5. Mobility restrictions test This test will determine the mobility restrictions and therefore the amplitude of the platform on which the patient will be able to work. The screen is presented by natural numbers from 1 – 10, and the balance is the better, the higher the number.

6. The test for the resistance of the hind limbs assesses the maximum force in the upper limbs generated by the patient at a specific time. The force of each arm is quantified both in pulling and pushing. It is a particularly important test for athletes who practice Karate as a performance sport.

7. The upper and lower limb coordination test assesses the subject's ability to coordinate his movements.

2.3. Objectives of the Subjects Investigation with HUBER 360

The investigation of the subjects, who practice Karate as a performance sport is a modern method of investigation, using the HUBER 360 computerized platform, which is practiced in advance, as exemplified by this work – in order to establish the limits of the practitioner, in order to avoid injuries, but it can also be applied after the sports competition – a situation in which the way of recovering the prophylactic subject or through training is established.

For the sportives who practice Karate, some preliminary objectives have been set, they must be related through the tests performed with the HUBER 360 device, which is presented as follows:

✓ Finding solutions beneficial to athletes in the shortest time through a specific program of diseases.

✓ Improving muscle strength in the lower and upper limbs.

✓ Improving the reaction speed, coordination, and balance from the orthostatic position, in bipodal and unipodal support.

✓ Maintaining or improving the quality of life.

✓ Avoiding or reducing the large number of injuries and injuries that require surgery, resulting in a decrease in the large time interval in which the sportive does not activate.

3. TEAM SUBJECTED TO INVESTIGATION

The team subjected to preliminary investigations with the specialized device HUBER 360 consists of 3 athletes: 2 boys and

one girl, who practice performance karate. They were informed about the objects of the testing and agreed to carry them out to improve the sports performances for competitive confrontations, but also to avoid possible injuries during the competition.

The results of the tests are informative, they are not mandatory. They can be followed by sportsmen, but they can also be ignored by him, because every athlete practices the sport that seems to him according to his Skills, but it is good to be informed, in order to be able to take corrective measures, which flows from the tests.

3.1 The Structure of the Sportives Group, who Practice Karate as a Performance Sport

The three athletes who practice Karate are part of the University Sports Club, in Cluj-Napoca. Table 1 shows the specific sizes of each of them from a physical point of view. According to the table, all can carry out their sports activity in the Karate discipline.

Table 1.
The Structure of the Sportives Group for Investigations

Subject	Sex	Age	Height [cm]	Weight [kg]
K1	Masculin	22	174	79
K2	Masculin	21	162	60
K3	Feminin	19	170	52

In the table 1 the notation is as: K1 is the symbol for the first boy, the K2 in for the second boy, and K3 is for the girl.

4. TESTS MEASUREMENT OF THE SPORTIVES

4.1.General Presentations

The three sportives, who practice Karate as a performance sport, were performed all 7 tests on the HUBER 360 device. All of them were considered necessary for the investigation, but significant results resulted for the tests: stability, balance, and strength, so in this paper will be presented the tests, which highlight this behaviour of the athletes.

4.1.1. Stability Test for the Karateka Group

The stability test is performed with open eyes, and the results of the investigation are presented in table 2, in which the minimum values are denoted in red and in blue the maximum values recorded for the group. The tests are presented in figures 2 to 4, according to the images on the tablet.

Table 2.
Stability Test with them Eyes Open

Subject	Stability – length (eyes open) [mm]	Stability – area (eyes open) [mm^2]	Stability –speed (eyes open) [mm/s]
K1	844.74	407.77	16.89
K2	690	137.57	13.8
K3	694.24	178.26	13.88

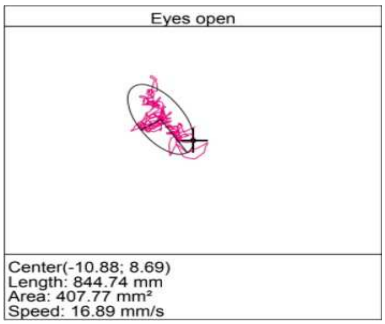

Fig. 2. K1 stability (eyes open)

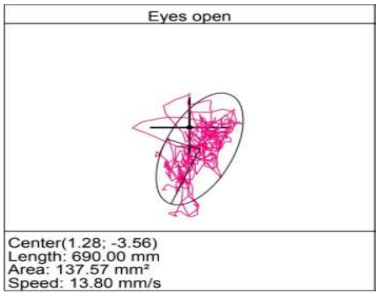

Fig. 3. K2 stability (eyes open)

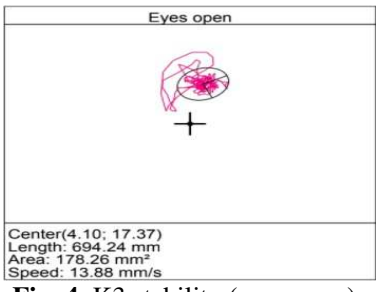

Fig. 4. K3 stability (eyes open)

From table 2 and from figures 2, 3, 4 for the stability test with open eyes they can interpret the results, as follows:

- Karateka K2 has the lowest values, noted for the three tests performed, so she **can practice Karate as a performance sport.**
- The K1 sportive has the highest values recorded for the stability test with his eyes open, so it is considered that he can practice the **karate sport after a sustained specialized training, to avoid injuries.**
- The K3 girl has the intermediate values for the three measurements made, so it is considered that it can practice **Karate as a performance sport, but she must pay attention to stability with her eyes open.**

The stability test is performed with closed eyes, and the results of the investigation are presented in table 3, in which the minimum values are denoted in red and in blue the maximum values recorded for the group. The tests are presented in figures 5 to 7, according to the images on the tablet.

Table 3.

Stability Test with them Eyes Closed

Subject	Stability – length (eyes closed) [mm]	Stability – area (eyes closed) [mm^2]	Stability –speed (eyes closed) [mm/s]
K1	1254.47	365.74	25.09
K2	1170.82	253.15	23.42
K3	896.02	352.14	17.92

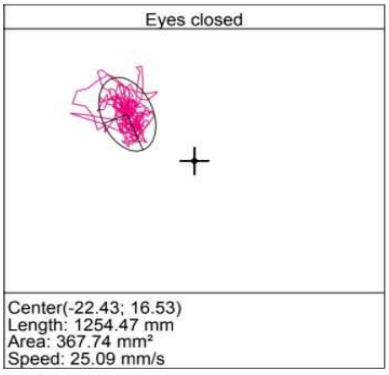

Fig. 5. K1 stability (eyes closed)

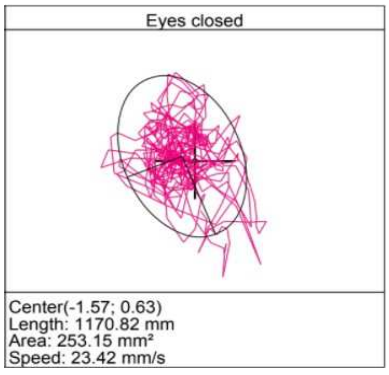

Fig. 6. K2 stability (eyes closed)

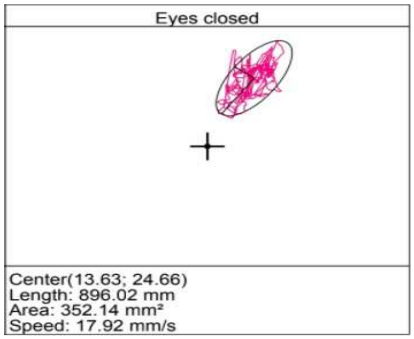

Fig. 7. K3 stability (eyes closed)

Table 3 and figures 5, 6, 7 recorded in the closed-eyed stability test performed on the Karate fighters draw attention to the following aspects:

- K2 and K3 Karate practitioners have minimum values in some tests and intermediates in the others, this means that they **can practice Karate as a performance sport.**
- K1 shows the maximum values of three sizes recorded in the stability test with his eyes closed, this means that this player from this investigated group **shows increased instability, but can practice this sport as a performance, with trainings well oriented to possible situations with his eyes closed.**

4.1.2. Unipodal Test for the Karateka Group

The unipodal test is performed with a single leg on the platform and the length of the distance from the equilibrium position is measured, or the area matured by the centre of the masses for 30 seconds. The measurements are made with the left foot on the platform, and the results are found in table 4, with the representations in figures 8 – 10. Measurements are made with the right foot on the platform, and the results are found in table 5, with the representations in figures 11 to 13.

Table 4.

Unipodal Test - Left

Subject	Unipodal left – length [mm]	Unipodal left – area [mm^2]
K1	1336.13	1017.96
K2	1906.88	5540.42
K5	1829.07	656.83

In the unipodal test on the left leg situations given by table 4 and runs 8, 9, 10, the recommendations are:

- K1 and K3 fighters have minimum values recorded on some measurements and intermediate on the others, so they have good stableness on the left leg, **they can practice Karate as a performance sport.**
- K2 shows high values in the group under investigation, in this test, so **it must be careful with the left leg, in order not to be injured in the competition.**

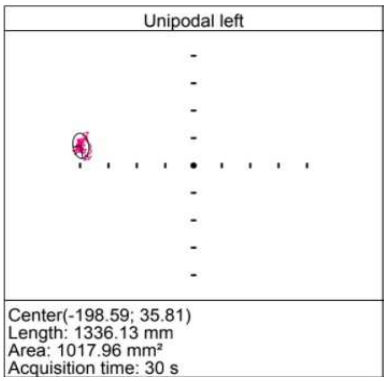

Fig. 8. K1 unipodal - left

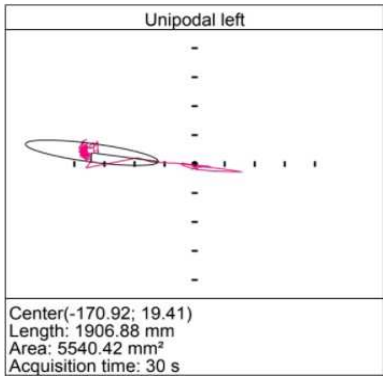

Fig. 9. K2 unipodal - left

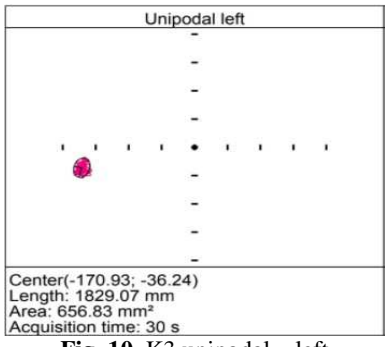

Fig. 10. K3 unipodal – left

Table 5.

Unipodal Test - Right

Subject	Unipodal right – length [mm]	Unipodal right – area [mm^2]
K1	1685.18	848.9
K2	1759.01	3919.04
K5	1679.22	691.55

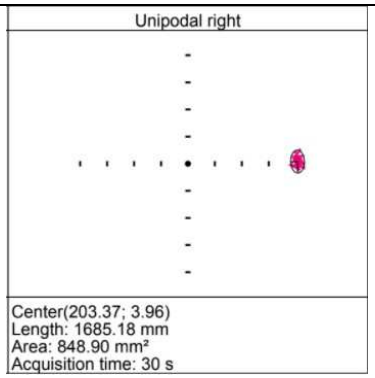

Fig 11. K1 unipodal - right

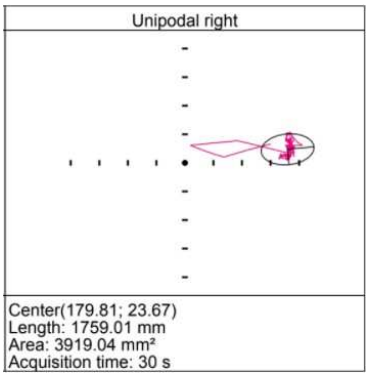

Fig. 12. K2 unipodal - right

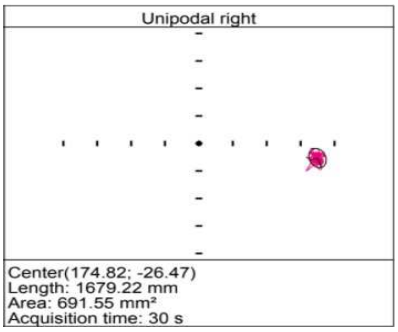

Figure 13. K3 unipodal – right

With the right foot the situation changes:

- The K1 fighter has the best stability.
- The K2 fighter has increased instability.
- The K3 fighter has the intermediate behavior, from this point of view.

4.1.3. Stability Limit Test Applied to Karateka Break

The stability of a high-performance Karateka is especially important for the fact that it must maintain its vertical position under all the aggressions to which it is subjected. In this test,

the positions of the center of gravity of the investigated subject are established on 8 different directions (front – back, left – right and at 45° from them), for 30 seconds, and the platform moves according to a random law. Stability is good at low values, and high values draw attention to the fact that in that direction the dangerousness is high.

The centralizers situation is presented in table 6, and the representations are successive in order 14, 15, 16.

Table 6.

Centralization of Stability Limit Test for Sportives

Subject	Limits of stability 1	Limits of stability 2	Limits of stability 3	Limits of stability 4	Limits of stability 5	Limits of stability 6	Limits of stability 7	Limits of stability 8
K1	132	191	269	211	142	203	259	214
K2	131	222	256	174	122	185	249	181
K3	141	158	245	175	156	135	241	124

The minimum values are marked with red and with blue the maximum ones in one direction. If the values are close or identical, do not mark.

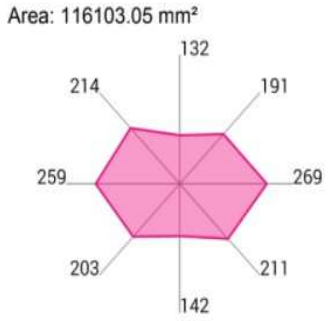

Fig. 14. K1 stability limit test

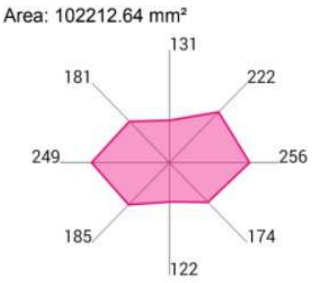

Fig. 15. K2 stability limit test

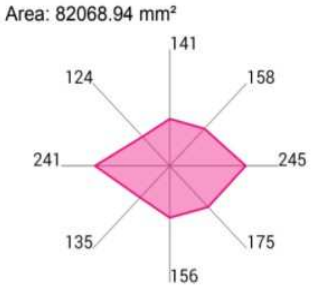

Fig. 16. K3 stability limit test

From table 6 the directions of the recordings in the figures corresponding to the stability limit test are made from the front direction – which is direction 1 – and the sequence is in direct rotation of the clockwise direction. With this observation, it is found that the three components of the Karateka group behave as follows:

- ✓ The K1 fighter has instability in the right, right – back, left – back, left – left, left – front directions. **He is heavily injured during competitions if** he does not return to training.
- ✓ The K2 fighter has instability in the right-front direction, and he are properly determined in the rear, left – rear directions. He has good stability, so **he is a good competitor in Karate.**
- ✓ The K3 fighter has instability on the left – rear direction and good and very good stability in all other directions. The attention directed to the left – back, makes this **a very good competitor in Karate.**

4.2. Gait test

The gait test is particularly important for karate practitioners because it is a dynamic analysis, in a specific position of the body, with the help of the cerium, and they can assess the transferal weight from one lower limb to the other, as well as the rhythm of walking.

The gait of the three Karateka is tested in the same time interval, the centralization is given in table 7, and the recordings in figures 17, 18, 19.

Table 7.

Gait Test

Subject	Acquisition time [sec]	Number of steps
K1	50	87
K2	50	56
K5	50	89

Fig. 17. K1 gait test

Fig. 18. K2 gait test

Fig. 19. K3 gait test

From table 7 and from the related figures it is found that all competitors have good mobility in the gait test, each has a faster step of one second. Of all of them, the fastest is the girl – K3, and the slowest is Karateka K2. **Everyone can practice Karate as a performance sport, from this point of view.**

4.3. Upper Limb Resistance Test

The upper limb resistance test, which evaluates the maximum force generated by a subject both in shooting and pushing, is distinguished by the importance for a Karateka fighter. It can determine how dangerous a competitor's blow can be and how strong his reaction to an outlet is. The test is static, also called "in force", but gives a suggestion on the behavior of a competitor.

In table 8 are recorded the measurement data, and in figures 20, 21 and 22 the test results, both measurements being presented on the same figure.

Table 8.

Upper Limb Resistance Test

Subject	Strength – push left [DaN]	Strength – push right [DaN]	Strength – pull left [DaN]	Strength – pull right [DaN]
K1	14	13	-10	-15
K2	12	13	-8	-9
K3	12	15	-10	-9

Fig. 20. K1 upper limb resistance test

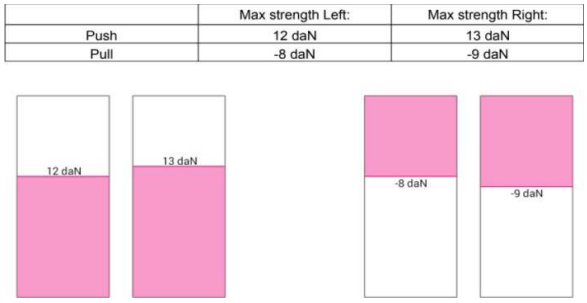

Fig. 21. K2 upper limb resistance test

Fig. 22. K3 upper limb resistance test

From table 8 and from figures 20, 21 and 22 it results that in the upper limb resistance test all athletes have similar behaviors both in terms of pulling and pushing force. If they compete against each other the results will be unpredictable. If they compete with other competitors, then it should be noted that, in this team:

- The K1 fighter has the best push – left and pull – right.
- The K3 fighter has the best push – right and pull – left.

- All Karateka must improve their performances in terms of pulling and pushing force with each individual member.

5. CONCLUSION

The present work continues a preliminary test, which is applied to Karateka fighters before sports competitions, in order to establish the sports skills applicable to the preferred performance sport.

A grouping of tests is performed: stability, balance, displacement dynamics, force on a specialized HUBER 360 device.

The tests dedicated to this sport were selected from the possible ones of the device and were presented the recommendations for each athlete in part how it corresponds or not to the sport, in which he wants to participate in competitions, as a performance sport.

It is emphasized that those presented in the work are recommended, there are no obligations to follow. The athlete is free to follow these recommendations or not. They are made to limit the injuries to which competitors are subjected during his / her training or chose during competitions.

From the group of three Karatekas each excels in a test in comparison with the others. There was no one superior to the other two.

The important conclusion that results from this test is that: **each Karateka must be very careful about the way it evolves in training, not to leave any aspect of balance, stability, movement, or strength inexperienced, because a competitive is unforgiving, if one wins, the other loses.**

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Testarea raspunsului dinamic al sportivilor ce practica Karate ca sport de performanta

Rezumat: Lucrarea conține testele preliminare ale concurenților sportului de Karate, analizând răspunsul dinamic al acestora. Testarea se face pe un sistem computerizat HUBER 360, cu ajutorul căruia sunt stabilite abilități sportive pentru evaluarea leziunilor în timpul competițiilor sportive de karate. Testele complete a trei sportivi – 2 băieți și o fată – sunt prezentate cu acele situații care duc la testare, la care se recomandă atenție în competiții sau antrenamente preliminare speciale, pentru a evita accidentările

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