

Determination of biomechanical optimality in the process of training the back leg round kick (ushiro mawashi gaeri)

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Determination of Biomechanical Optimality in the Process of Training the Back Leg Round Kick (Ushiro Mawashi Gaeri): Determining the biomechanical optimality in the process of training and practicing biomechanical stereotypes in karate is essential for proper learning and performance of certain elements. The aim is to determine whether the choice of preparatory exercises is well done and whether the set model is liable to the gradual and systematic process of training. A sample of 10 preparatory exercises is given for training the back leg round kick "ushiro mawashi gaeri" with a descriptive presentment thereof, and by conducting a biomechanical quantitative analysis of the preparatory exercises, 41 variables are determined. We can conclude that the selection and the order of performing preparatory exercises for training of the back leg round kick "USHIRO MAWASHI GAERI" is relatively well chosen and that the process of training is liable to a gradual and systematic approach.

Key words: preparatory exercises, ushiro mawashi gaeri, biomechanical optimality.

INTRODUCTION

Determining the biomechanical optimality in the process of training and practicing biomechanical stereotypes in karate is essential for proper learning and performance of certain elements. The meaning is as following:

- it shortens the time of training
- it keeps the pace of learning of the required elements
- the elements are properly and accurately learnt
- it creates a criterion for the order of performing certain preparatory exercise that lead to the effective learning of the planned items
- we learn which preparatory exercises or elements we should devote special attention to during training.

The above mentioned leads to establishment of proper and scientific concept in the conduct of the training process, which will answer the numeral challenges and will help those who deal with these or similar matters, especially the sports workers, coaches, physical education, and health teachers. In this study, there is an attempt to determine the biomechanical optimality in the training of a karate technique called "USHIRO MAWASHI GAERI", or "back leg round kick". It is among the most difficult foot techniques, but at the same time (if it is well performed) is an attractive technique.

METHOD OF WORK

Here are examples of preparatory exercises for training of the back leg round kick "ushiro mawashi gaeri".

1. Training of impact area of the leg by rubbing the foot or treading upon a ball or medicine ball (OBUDPNGTSTM)
2. Training to maintain balance on one leg "hikejashi" by assistance in holding the knee with both hands (OBODRENHNPDKDR)
3. Training of standing on one leg with a high-hikejashi side holding the knee with one hand (OBSENSVHSDKER)
4. Training of rapid semicircle turn of the body from an upright position "hejsokudachi" (OBBZTISH)
5. Training of rapid semicircle turn of the trunk and a quick look to the back from an upright position (OBBZTBPNIS)
6. Training of rapid semicircle turn of the trunk facing the opponent with high "hikejashi" from an upright position (OBBZTPPVHIS)
7. Training of a rapid semicircle turn of 180 degrees without hikejashi to a semi squat "fudodachi" (OBBPS180 degrees BHPF)

8. Training of a rapid semicircle turn of 180 degrees with "hikejashi" aside from "fudodachi" (OBBPS180o HSF)

9. Training performance of "ushiro mavashi geri" with the outstretching of the striking foot (OBIUISUN)

10. Training performance of "ushiro mavashi geri" with kick and returning into the original position - correct performance (OBIZUUVIPI)

Description of the preparatory exercises to study the back leg round kick "mawashi ushiro gaeri"

Exercise 1

- SP: Normal upright position (hejsokodachi)

- FP: Final position of standing on one leg

On a given sign by the coach, a position is taken standing on one leg. The body is in a semi squat position where with one foot, we are in fulcrum and the other leg is on the ball or medicine ball. We are rubbing and treading upon the ball marking the impact area of the foot (the foot that will perform the kick).

Exercise 2

- SP: Normal upright position (hejsokodachi)

- FP: Maximum flexion of the knee joint

On a given sign, the knee and shin are going forward and as high as possible closer to the chest. We are assisting by holding the knee.

Exercise 3

- SP: Normal upright position (hejsokodachi)

- FP: Position on one leg

On a given sign, the leg goes in diversion with a high uplifting of the knee and shin, thus coming into a parallel position with the area. With one hand, we take a grip of the knee and we stay in the reached position.

Exercise 4

- SP: Normal upright position (hejsokodachi)

- FP: Rapid semicircle turn of the body on one side

On a given sign, a rapid semicircle turn of the body on a side is performed.

Exercise 5

- SP: Normal upright position (hejsokodachi)

- FP: Rapid semicircle turn of the body on one side that we have imagined to perform, with a quick glance and turning the head towards an imaginary opponent.

On a given sign, a rapid semicircle turn of the body on one side with a quick glance and turn of the head towards the imaginary opponent is performed.

Exercise 6

- SP: Normal upright position (hejsokodachi)

- FP: Position on one foot with high hikijashi looking at the opponent

On a given sign, we perform a rapid semicircle of the body on the side that we have imagined to do the kick. The kick is accompanied by a high hikijashi, with a quick glance and turning the head towards an imaginary opponent.

Exercise 7

- SP: Step forward by bending the front leg in the ankle (hock) and the knee joint, where the back leg is slightly bent in the knee (fudodachi pugnacious position)

- FP: Rotation around the front leg to a semi squat position supporting both legs
On a given sign, we perform a quick semicircle turning (without hikejashi) for 180 degrees around the front leg. The body is in semi squat position, the head and the look directing towards an imaginary opponent.

Exercise 8

- SP: Step forward by bending the front leg in the ankle (hock) and knee joint, where the back leg is slightly bent in the knee (fudodachi pugnacious position)

- FP: Rotation around the front leg to a semi squat position, with reliance on one leg and the other in diversion (abduction)

On a given sign, we perform a quick semicircle turning (without hikejashi) for 180 degrees around the front leg. The body is in a semi squat position, while the head and look directing towards an imaginary opponent.

Exercise 9

- SP: Step forward by bending the front leg in the ankle (hock) and knee joint, where the back leg is slightly bent in the knee (fudodachi pugnacious position)

- FP: Rotation around the standing leg, while the other leg being outstretched performs the kick

The whole movement is performed from "fudodachi", the leg being outstretched.

Exercise 10

- SP: Step forward by bending the front leg in the ankle (hock) and knee joint, where the back leg is slightly bent in the knee (fudodachi pugnacious position)

- FP: Position on one leg, the other is in diversion and abduction.

The whole movement is performed from "fudodachi", the foot performing the kick returns into the original position.

Examples of variables of the biomechanical preparatory exercises for training of the back leg round kick "ushiro mawashi gaeri"

The preparatory exercises of the karate strike are biomechanically analyzed respectively, according to the goal of the movement, the initial and final position, the functional-anatomical structure, as well as mechanical structure.

Variables, which define the biomechanical status of all the preparatory exercises, is as following:

1. UDIRA - foot kick 2. SEN- one leg position 3. PPSDN - initial position on both legs 4. PPNIBORSTA - initial position of low pugnacious stance 5. ZPSEN- final position of standing on one leg 6. ZPSDN- final position of standing on both legs put together 7. ZPMAKABZKK – final position in maximum abduction of the hip joint 8. IKFZPSA - isometric contraction of the flexors of the fingers (asymmetrical) 9. IKEZPSA - isometric contraction of the protractors of the fingers (asymmetrical) 10. IKPFGSZS - isometric contraction of the plantar flexion of the upper ankle (asymmetrical) 11. EKPFGSZPPA - eccentric contraction of the plantar flexor of the upper ankle with peripheral support (asymmetrical) 12. IKPFGSZS - isometric contraction of the plantar flexor of the upper ankle (symmetrical) 13. IKEZKNA - isometric contraction of the extensor of knee joint (asymmetrical) 14. EKEZKNPPS - eccentric contraction of the knee joint with peripheral support (symmetrical) 15. IKFZKNA - isometric contraction of the flexor of the knee joint 16. KKFZKNCPPA - concentric contraction of the knee joint with central support (asymmetrical) 17. KKNRZKKPPA - concentric contraction of the external rotators of the knee joint with peripheral support (asymmetrical) 18. IKEZKKA - isometric contraction of the extensors of the hip joint (asymmetrical) 19. EKEZKKPPA - eccentric contraction of the hip extensors with peripheral support (asymmetric) 20. KKFZKKCPA - concentric contraction of the hip

joint with central support (asymmetrical) 21. IKFZPSHS - isometric contraction of the hand fingers (symmetrical) 22. IKFZSHS - isometric contraction of the wrist (asymmetrical) 23. IKFZLS - isometric contraction of flexors of the elbow (symmetrical) 24. IKAFZRS - isometric contraction of ante flexors of the shoulder joint (symmetrical) 25. IKFZG - isometric contraction of flexors of the head joint 26. IKABZRA - isometric contraction of the abductor of the shoulder joint (asymmetric) 27. IKFRS - isometric contraction of flexors of the spine 28. KKSURSCP - concentric contraction of pronation of the spine with central support 29. KKSURSVDCP - concentric contraction of pronation of the spine (neck) with central support 30. KKSURSSGDCP - concentric contraction of pronation of the spine - lumbar chest column 31. МАПОТPOV - small supportive surface 32. POTKINSIPEN - semi-open-kinetic chain with a support on one leg 33. POTPOVEN - supportive surface on one foot 34. DVISAGRAM - movement in sagittal plane 35. DVIHORRAM - movement in the horizontal plane 36. DVINADOS - movement around the longitudinal axis 37. MALPOMTT - low movement of the body center (gravity point) 38. UMEMNAT - moderate muscle tensions of body agonists 39. UMEMNAN - moderate muscle tensions of the feet agonists 40. UMEMNAR - moderate muscle tensions of the hand agonists 41. ADAAS - acyclic movements with asymmetrical anatomic

RESULTS

The biomechanical characteristics of the preparatory exercises for training of the back leg round kick "USHIRO MAWASHI GAERI" are determined with 41 variables. The results of the analysis are given in binary matrices.

- Standardized measures of biomechanical similarity in the preparatory exercises range within the low biomechanical similarity between preparatory exercises (1, 2) and (6) with coefficient of (0.231), up to the high biomechanical similarity between preparatory exercises (9) and (10) with a coefficient of (0.926), while other preparatory exercises range within the medium biomechanical similarity.

The biomechanical similarity coefficient of the whole system of elements is (0.58), suggesting homogeneity of the analyzed elements.

CNBS - the coefficient of neighboring biomechanical similarity that gives us data on optimality for performance of the elements is (0.67), which clearly indicates that there is a great similarity between the biomechanical elements that are defined by the biomechanical variables of sport karate.

REBR - ratio effect on biomechanical relationship of one element with all the others Seeing the coefficient of biomechanical association of motor manifestations (preparatory exercises), it can be noted that the biggest effect on the biomechanical relationship is present in motor manifestations in the preparatory exercises 8 (OBBPS180 ° HSF) and 9 (OBIUISUN) with coefficient of 0.669 *. This suggests that we should mostly pay attention to those exercises during the training.

Determination of the coefficient of biomechanical similarity

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	1.000									
2.	0.800	1.000								
3.	0.776	0.816	1.000							
4.	0.694	0.572	0.667	1.000						
5.	0.613	0.519	0.481	0.770	1.000					
6.	0.231*	0.231*	0.236	0.354	0.354	1.000				
7.	0.524	0.436	0.490	0.802	0.772	0.378	1.000			
8.	0.567	0.680	0.733	0.694	0.579	0.327	0.742	1.000		
9.	0.529	0.643	0.733	0.694	0.535	0.327	0.742	0.893	1.000	
10.	0.490	0.612	0.708	0.625	0.529	0.118	0.624	0.810	0.926*	1.000

CONCLUSION

Standardized measures of biomechanical similarity in the preparatory exercises range within the low biomechanical similarity between preparatory exercises (1, 2) and (6) with coefficient of (0.231), up to the high biomechanical similarity between preparatory exercises (9) and (10) with a coefficient of (0.926), while other preparatory exercises range within the medium biomechanical similarity.

Determination of the coefficient of the biomechanical similarity system

- The biomechanical similarity coefficient of the whole system of elements is (0.58), suggesting homogeneity of the analyzed elements.

0.58

Determination of the coefficient of neighboring biomechanical similarity

KNBS - the coefficient of neighboring biomechanical similarity that gives us data of optimality for performance of the elements is (0.67), which clearly indicates that there is a great similarity between the biomechanical elements that are defined by the biomechanical variables of sport karate.

0.67

Determination of the coefficient of the power of connection of one element with the others

1. 0.580	2. 0.590	3. 0.627	4. 0.652	5. 0.533
6. 0.245*	7. 0.612	8. 0.669*	9. 0.669*	10. 0.605

REBR - ratio effect on biomechanical relationship of one element with all the others. Seeing the coefficient of biomechanical association of motor manifestations (preparatory exercises), it can be noted that the biggest effect on the biomechanical relationship is present in motor manifestations in the preparatory exercises 8 (OBBPS180 ° HSF) and 9 (OBIUISUN) with coefficient of 0.669 *. This suggests that we should mostly pay attention to those exercises during the training.

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The report has been reviewed.