Using a rotating training simulator to train rotational movements in aikido techniques

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Summary

Background. The aim of the study is to present the opportunities of using a rotating training simulator to practice aikido techniques involving rotational movements.

Material and methods. 49 male students aged 21-23 years participated in the experiment. The subjects were divided into two groups. The experimental group A comprised 24 subjects while the comparative group B comprised 25 subjects. The students were taught ryokatadori kokyo nage technique. The experimental group additionally used rotating training equipment. Correct performance of a technique was scored using 1-10 point scale. The assessment was based on film analysis. Among the students from the experimental group a survey was carried out to study their opinions on using a rotating training simulator in learning aikido techniques involving rotational movements.

Results. Group A obtained a significantly higher mean score for aikido technique performance compared with Group B. It was found that the results obtained from both groups significantly differed for p<0.05. The survey results indicate that the subjects using the training simulator confirmed the efficiency of this device to learn aikido techniques involving rotational movements.

Conclusions. Using the training simulator enabled quicker acquisition of aikido techniques. The presented rule of the rotating training simulator and the survey results indicate that this device can be used in teaching/learning aikido techniques involving rotational movements. Using the training simulator resulted in a more effective shortening of the circle radius where the practitioners moved, thus increasing the value of the centrifugal force acting on the attacker. It is also possible to eliminate such errors as excessive head and trunk horizontal tilt while performing ryokatadori kokyo nage technique in randori style.

Introduction

In martial arts and combat sports the techniques often involve rotational movements, both of the attacker and defender. The competitors performing a rotational technique must properly guide their bodies by an adequate input of their own strength and properly use external forces of the rival. When specific movements are performed, the centre of gravity should be properly maintained for movement safety. A sudden loss of balance can result in falling, enabling the rival to take advantage of it. In literature there are no descriptions of devices that could prepare combat sports competitors for their body response to rotational motion. The device should also help the competitor understand how the movements of particular body segments affect physical parameters reflecting rotational motion, such as angular velocity and centrifugal force. This paper presents the new equipment to be used for this purpose, namely the rotating training simulator [1].

Aikido is a martial art often involving rotational movements when fighting [2,3]. Biomechanical analysis explains that a proper performance of this movement by the defender allows taking advantage of the attacker’s strength [3]. The aim of this study is to present the potential of the rotating training simulator to teach/learn aikido techniques involving rotational movements.

Material and methods

The sample comprised 49 males aged 21-23 years, divided into two groups. The experimental group (Group A) comprised 24 subjects and the control group – 25 subjects. The subjects were randomly selected among the physical education students. The study was carried out in 2013. Before, the students selected for the study participated in martial arts classes according to the curriculum. Prior to the classes, none of the studied subjects trained aikido. During the study, the subjects were taught ryokatadori kokyo nage technique [4]. This technique is often used to perform randori. The name of this aikido technique implies neutralizing a specific attack [5]. Neutralizing is also connected with execution of a specific task involving movement. As randori is performed by several attackers, attack neutralizing involves movements rather than immobilization [2].
The way of neutralizing the attack in the applied technique ended with a throw in the reported experiment. After learning safe falls, necessary with aikido technique performance, the subjects were taught *ryokatadori kokyo nage* technique in one month. During this training, the experimental group additionally performed exercises on the rotating training simulator. After the training period, technique performance was assessed according to the model presented by the trainer. Technique performance was scored on a 1-10 scale, used earlier by the author [4,5]. The final score was established by two experienced aikido instructors. The assessment was based on the analysis of the film recorded during the test of *randori* technique performance.

A survey was conducted in the experimental group to study the subjects’ opinions on using the rotating training simulator in aikido training, involving techniques with rotational movements. The rotating training simulator applied in the study can be operated in two modes. The first mode calculates the moment of subject’s inertia. The device consists of a rotating platform, which is set in motion by a falling weight to calculate the moment of inertia. This way of calculating the moment of inertia has been already used by Griffiths et al. [6]. During the experiment, the training simulator was operated in the second mode, called the training mode. The subject assumed a specific position on the rotating platform (Fig. 1) holding metal bars. The platform with the subject was driven by the electric engine to obtain a selected rotating frequency. After obtaining the desired frequency by the clutch, the electric power feed was switched off. Then the platform rotated itself. With the power feed switched off, it was also possible to drive the subjects on the training simulator using external forces, e.g., by pushing the bars in a proper way. After obtaining a specific rotating frequency, the subject moved closer or farther from the bars. Gripping the bard may imitate grabbing the attacker’s judogi.

The dynamics of the *ryokatadori kokyo nage* technique, selected for the study during the attack of several competitors while performing *randori* is based on using the attackers’ speed. The defender in *randori* makes the attacker perform rotational motion by leaving the attack line in a proper way [2]. The defender tries to be the closest possible to the centre of rotational motion while the attacker tries to be on the periphery. The mass arrangement of the competitors is in accordance with the parallel axis theorem by Steiner [3]. With some approximation, we can say that that the rule of rotation moment is fulfilled. The defender, to increase the angular velocity, has to reduce the subjects’ mass inertia moment optimally by reducing the distance between his body segments from the rotation axis.

The frequent errors while performing this technique are due to the fact that the competitors fail to fulfil this rule. The trunk should not by excessively tilted horizontally as the inertia moment is not adequately reduced as related to the vertical common rotation axis of the subjects [3]. The trunk should

![Fig. 1. Using the rotating training simulator in the training mode.](image-url)
be optimally maintained in a vertical position to significantly reduce the inertia moment. It is also important to reduce the rotational motion radius where the defendant moves. Its gravity centre should be the closest possible to the rotation axis of the movement [3]. The competitors often fail to understand the rules of rotational motion mechanics laws. The rotating training simulator allows testing the applicability of these rules. The most important elements of ryokatadori kokyo nage technique can be simulated during training on this simulator.

The subject, standing at a long distance from the bars (Fig. 1) he gripped after obtaining the adequate speed, moved optimally towards the centre of the rotating platform. The correct position assumed during exercising resembled the natural shizen-tai position, recommended in aikido or judo [7,8]. By shifting towards the centre of the platform, the subject reduced his total mass inertia moment as well as the total mass inertia moment of the rotating parts of the device, causing an increase in angular velocity, according to the rule of maintaining the rotation moment. This exercise could either be performed correctly, as presented by the trainer or incorrectly, by the subject tilting the head and trunk horizontally or inadequately reducing their distance from the rotation axis. This made the subject notice the changes in his angular velocity – when they were big and when they were small. During the next stage of exercise, two subjects stood on the rotating platform, coming closer or further to the rotation axis as required, holding the bars. They were told to come close to the centre of the rotational motion when performing the defender’s technique. This causes an increase of the centrifugal force exerted on the attacker [3]. The simulator makes the subjects aware of the relationship between the changes in angular velocity and the changes in the distance between the subject’s body segments and the rotation axis. Rotational motion of the platform allows obtaining the speed, simulating the speed of the subjects’ movements when performing ryokatadori kokyo nage technique in randori style. Under training conditions, the attackers chase the defender who tries to move with an adequate speed, performing rotational movements. In this experiment, due to the subjects’ little experience, the defender’s techniques were assessed during two competitors’ attack. The attackers were not allowed to oppose or counter the technique performed by the defender. During the assessment, the subjects having similar body height and body weight were selected. When the technique is correctly performed, the resultant force, consisting of the centrifugal force and the force from a proper transmission of the defender’s weight acts on the attacker [3]. During the experiment, the assessment considered adequate performance of the technique to obtain the desired centrifugal force acting on the attacker. The transmission of force originating from the defender’s weight was not analysed as, according to the author, only the competitors who train for a longer time have acquired this skill.

The analysis of scores obtained for aikido technique performance in each group was carried out using Student-t test for independent variables.

**Results**

In both groups, the mean score for aikido technique performance was established. Group A obtained a significantly higher mean value, as compared with Group B, for technique performance. At the same time it was found that the between group differences were statistically significant for p<0.05. The results of the survey conducted among the subjects exercising on the rotating training simulator showed that 95 % of the subjects confirmed the effectiveness of the simulator in aikido training involving rotational motion. 100% of the subjects reported they had never used the device that would allow them to learning their body responses to rotational motion when learning the techniques involving rotation. 92% believed that thanks to the training on the simulator, they knew what movements to perform to increase or decrease their angular velocity in the rotating technique. 95% believed that exercising on the rotational training simulator could be useful for the development of movement habits, necessary for adequate technique performance.

![Fig. 2. The mean scores obtained from the students in both groups for aikido technique performance. A statistically significant difference was found for p<0.05](image-url)
Discussion

The rule of rotating training simulator workout shows the opportunities of using this equipment to train martial arts techniques involving rotational motion. During the experiment in Group A, a significantly higher mean value was obtained for aikido technique performance. The subjects from this group significantly more seldom made the error of excessive horizontal tilt of the trunk while performing the technique and better reduced the radius of motion while moving on it.

According to the author, such good results are due to exercising on the rotating training simulator. In the reported experiment, the correctness of body position was assessed in the subjects while they performed the technique. The significance of maintaining a correct posture during execution of the reported technique has been noticed by many researchers dealing with judo and aikido [3,8,9].

Kano assumed that judo he created should not only develop as a sport discipline, but also as a comprehensive martial art. Excessive horizontal head and trunk tilt was considered incorrect during the practice on the rotating training simulator. Assuming such a position by competitors is frequent in judo [9]. The creator of judo was against assuming this position too often. He believed that it reduced the chance of quick counter-technique execution in real fight, e.g. kicks or blows with hands. At the end of his life, he hoped that judo would develop as a martial art to be applied as a defence against various attacks, not only in judo sport practice. Moreover, he emphasised the significance of assuming a natural body posture during fight, the so called shizen-tai in the future development of this discipline [8]. We can conclude that assuming such a position in the reported experiment, with a proper shift of the subject’s gravity centre towards the rotation axis of the simulator platform, enabled a proper increase of the platform angular velocity while exercising. According to Kano, assuming a correct position facilitates quick application of the technique and avoiding the rival’s techniques. He also thought that further development of judo should involve inclusion of kendo elements in training [9,10] in which a correct body posture is necessary for quick moving.

The survey results suggest that the subjects exercising on the rotating training simulator considered the device to be very useful in learning aikido techniques involving rotational motion. According to the author, the rotating training simulator can serve not only perfection of some elements of aikido techniques involving rotational motion, but also to learn the competitor’s responses to rotational movement performance, particularly to sudden changes in acceleration being part of this movement. In combat sports, e.g. in judo or wrestling, when throwing techniques are executed, the rival often forces rotational movements. A delayed response to a sudden rotational movement can be the reason of losing fight. Learning proper body responses to rotational motion through exercising on the rotating training simulator may be important for the competitor’s development in combat sports. Kalina, among the main approaches in combat sports [11], describes the strength pre-

Conclusions

1. Using the rotating training simulator enabled quicker learning of ryokatadori kokyo nage technique.
2. Using the rotating training simulator allowed the defenders better reduction of the circle radius where they moved
while performing randori and increasing properly the value of centrifugal force, acting on the attacker.

3. Using the rotating training simulator eliminates the error of excessive horizontal head and trunk tilt during ryokata-dori kokyo nage performance in randori style.

4. The presented rule of the rotating training simulator and the survey results indicate the opportunities of application of this device in learning aikido techniques involving rotational motion.

References


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