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BIOMECANIC CLASSIFICATION OF NAGE-WAZA THROWING TECHNIQUES (I)

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ABSTRACT. JUDO NAGE-WAZA techniques have been developed during the years based on the principle of making maximum use of certain physical conditions of space and time during one session. The issue of classification of JUDO techniques in general, and of NAGE-WAZA techniques in particular, arises out of two didactic considerations: grouping techniques according to logical criteria, in order to facilitate an easier understanding and systematic study; grouping techniques in an appropriate sequential structure in order to allow a gradual learning by beginners, with the result of mastering JUDO as a whole. In our paper "Foundation of the biomechanics of NAGE-WAZA standing throwing techniques" we aim at tackling the classification of JUDO techniques from the viewpoint of the mechanisms the execution of the NAGE-WAZA techniques are based on.

Keywords: judo, biomecanic classification.

REZUMAT. ***Clasificarea biomecanică a tehnicilor de proiectare din picioare Nage-Waza.*** Practicile din JUDO NAGE-WAZA au fost dezvoltate în cursul anilor în baza principiului de utilizări la maxim a anumitor condiţii fizice spaţiale şi de timp în cursul unei întâlniri. Problema clasificării tehnicilor de JUDO în cazul specific, cele de Nage-Waza se naşte din două considerente didactice.: gruparea procedurilor tehnice după unele criterii logice, pentru a ne permite o mai uşoară înţelegere şi un studiu sistematic; gruparea procedurilor tehnice într-o structură secvenţială adecvată pentru a permite o învăţare graduală de către începători, ca în cele din urmă să stăpânească JUDO în totalitatea sa. În lucrarea noastră „Fundamentarea biomecanicii procedeelor de proiectare din picioare NAGE-WAZA" încercăm o abordare a clasificării procedurilor de JUDO din punct de vedere a mecanismelor care stau la baza execuţiei unui procedeu tehnic de NAGE-WAZA.

Cuvinte Cheie: Judo, Clasificare Biomecanica.

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JUDO NAGE-WAZA techniques have been developed during the years based on the principle of making maximum use of certain physical conditions of space and time during one session.

Using a throwing technique during a competition depends on favorable opportunities or transitory circumstances, which occur at a certain point during competition and on competitive abilities, the capacity to know how to exploit for your own gain these opportunities which appear during competition.

This capacity to be able to exploit situations during competition is the result of correctly invoking constant practice, of research and of deepening skills. The issue of classification of JUDO techniques in general, and of NAGE-WAZA techniques in particular, arises out of two didactic considerations:

a) Grouping techniques according to logical criteria, in order to facilitate an easier understanding and systematic study;
b) Grouping techniques in an appropriate sequential structure in order to allow a gradual learning by beginners, with the result of mastering JUDO as a whole.

J. Kano was the first to turn to the two didactic considerations: the classification of techniques and the method of learning. This elaboration started in 1885 until 1992 and then until 1982.

Once JUDO evolved and entered the USA and Europe many European authors or Japanese experts tried to elaborate a variety of classification and teaching versions.

In our paper "Foundation of the biomechanics of NAGE-WAZA standing throwing techniques" we aim at tackling the classification of JUDO techniques from the viewpoint of the mechanisms the execution of the NAGE-WAZA techniques are based on.

At the first glimpse all throwing techniques can seem different as regarding their form, but a scientific analysis reveals that every throwing technique is a combination of general and particular characteristics.

General characteristics are those main actions, which can be found in a large number of techniques, while particular characteristics stop at data level. A bio-mechanic analysis of throwing techniques cannot ignore the problem of rational classification for successive stages:

a) Simplification first
b) Generalization and elevating to a principle for all throwing categories

For the principle of simplification of the force class problem, which we are dealing with, the KANO differentiating model will be used, i.e. the subdivision of the throwing motion in three stages.

TUKURI - all preparatory movements, meant to prepare the loss of balance of UKE and the positioning of the body of TORI for the throwing. KUZUSHI – the action of the balance loss forces and the direction and final orientation. KAKE – final execution of the movement in order to perform the

throwing and UKE analysis, by simplifying the secondary forces, then moving towards generalizing the categories of forces the KAKE phase is subject to. This method used by Attilio Sacripanti in his paper "Biomecanica del JUDO" allowed that the throwing techniques be grouped from a bio-mechanical point of view in two groups based on two execution mechanisms of the technical procedures:

a) Techniques where TORI uses a FORCE COUPLE in order to throw UKE
b) Techniques where TORI uses the force moment (lever) in order to throw UKE

The classification of the NAGE-WAZA throwing techniques based on the force couple and lever principle is the classification based on scientific support, which analyses the directions of the forces, static analysis, and the pathway of UKE's body during the throwing phase (flying phase), dynamic analysis, as well as the symmetries of the bio-dynamic group of the athlete couple TORI and UKE.

Static analysis (principle of decomposing of forces)

The static analysis shows the directional problem of the static use of forces, which occur during the performance of a technique. In order to make things easier the force which affects the performance of the technique is analyzed in two planes: horizontal and vertical. The following problems are analyzed:

a) Loss of balance – KUZUSHI – ȚUKURI
b) Launching – THROWING – KAKE

a) Loss of balance – KUZUSHI – ȚUKURI

During the ȚUKURI– KUZUSHI phase the forces are efficient and can be applied horizontally in a 360° angle. This conclusion unifies the bio-mechanic problem of the forces which affect rectilinear, as well as rotational during the ȚUKURI and the KUZUSHI phase.

b) Launching – THROWING – KAKE

The forces are efficient and can be applied in the vertical plane for a range of 90°. In this statement the resulting force of all forces occurring during the throwing phase – KAKE phase – is taken into consideration.

Dynamic analysis (principle of composing of forces)

The solution of the problem of dynamic forces shows the direction variation of forces in time, with the help of studying the trajectory of UKE's body and the property of feeling the trajectory.

Two coverage classes from the point of view of the trajectory are defined for UKE's body during the throwing phase in the case of throwing from a standing position.

a) Circular trajectory, spherical symmetry
b) Spiral trajectory, cylindrical symmetry

a) Circular trajectory, spherical symmetry

For throwing techniques where UKE's body or center of gravity shows a circular trajectory, the radius of the arch on which UKE's body rotates coincides with the radius R of UKE's insertion moment.

Techniques with spherical symmetry also have the trajectory with the smallest mechanical work, resulting in less energy consumption for TORI.

Figure 1 shows circular and spherical symmetric trajectory.

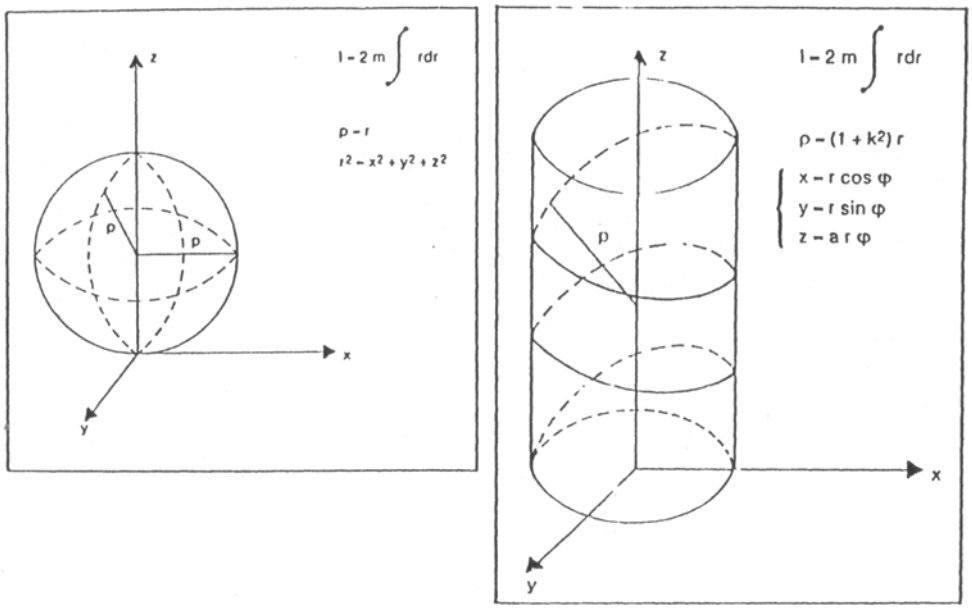


Fig. 1. Circular and spherical symmetric trajectory.

b) Spiral trajectory, cylindrical symmetry

With the throwing techniques, where UKE´s body describes a spiral trajectory (screw movement), the radius of the movement of UKE's body is directly proportional to the radius R of the rotation axis of the inertia moment.

The techniques have a cylindrical symmetry and the propeller, according to which UKE's body moves is the trajectory of a minimum mechanical work, thus with minimum energy consumption.

In the next paragraph we will show a static and dynamic analysis of the two classifications from a bio-mechanic point of view.

1) Techniques where TORI uses FORCE COUPLE to throw UKE.
2) Techniques where TORI uses PHYSICAL LEVER to throw UKE.

Types of throws according to the bio-mechanical classification

Static Analysis of Throws

The static analysis of throws is conducted according to the two classifications:

1) Performing the throw using FORCE COUPLE
2) Performing the throw using VARIABLE PHYSICAL LEVER

Performing the throw using FORCE COUPLE

In figure 2 the way of applying forces as force couples, as well as the static work conditions are presented.

Static conditions: a) loss of balance angle 360°
b) throwing angle 90°

In figure 2 the loss of balance angle and the throwing angle are presented.

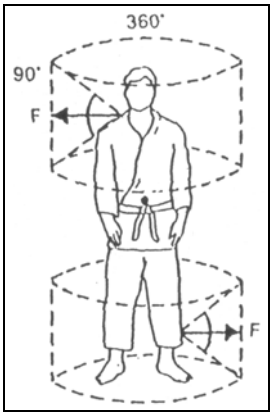


Fig.2. The loss of balance angle and the throwing angle

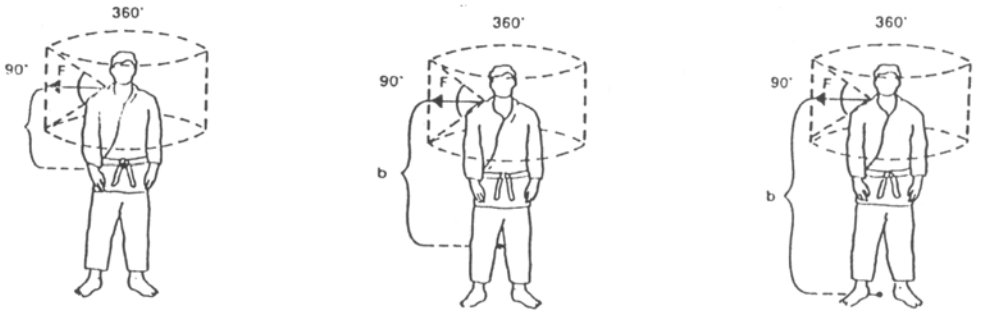
Performing the throw using VARIABLE PHYSICAL LEVER

Static conditions: a) loss of balance angle 360°
b) throwing angle 90°

In the case of throwing by using variable physical lever we will analyze three situations:

1) Minimum arm – maximum applied force
2) Medium arm – medium applied force
3) Maximum arm – minimum applied force

In figure 3 the three variants with the area where the force is applied and the length of the arm are presented.



b, minimum arm
F, max. applied force

b, medium arm
F, med. applied force

b, maximum arm
F, min. applied force

Fig. 3. The three variants with the area where the force is applied and the length of the arm

Dynamic Analysis of standing throws (Nage-Waza)

The dynamic analysis of standing throws consists of applying static and dynamic characteristics, which occur during the throwing phase of UKE. The analysis is conducted for the two cases of bio-mechanical classification:

a) Performing the throw of UKE using FORCE COUPLE
b) Performing the throw of UKE using PHYSICAL LEVERS

Performing the throw by applying FORCE COUPLE

The dynamic analysis consists of presenting the characteristics of loss of balance, the throwing angle, the trajectories and the perception of the throwing.

In figure 4 these characteristics are presented

STATIC CHARACTERISTICS	DYNAMIC CHARACTERISTICS
Angle of loss of balance - 360°	CIRCULAR TRAJECTORY
Throwing angle - 90°	SPHERIC SYMMETRY

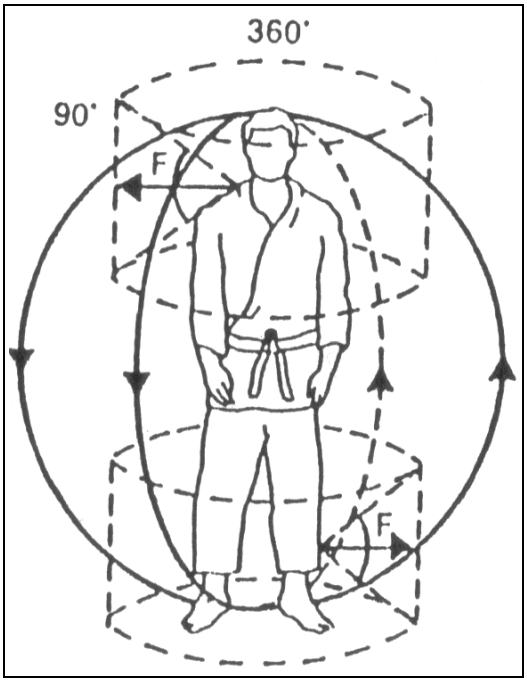


Fig. 4 . Static characteristics and dynamic characteristics

Performing the throw by applying a PHYSICAL LEVER with variable arm

From a dynamic point of view in the case of the physical lever both the static and the dynamic characteristics in the throwing phase of UKE are analyzed.

In the case of the physical lever three situations are analyzed:

a) Minimum arm – maximum applied force
b) Medium arm – medium applied force
c) Maximum arm – minimum applied force

STATIC CHARACTERISTICS
Loss of balance angle - 360°

DYNAMIC CHARACTERISTICS
Trajectories: circular, spiral
Symmetry: spherical, cylindrical

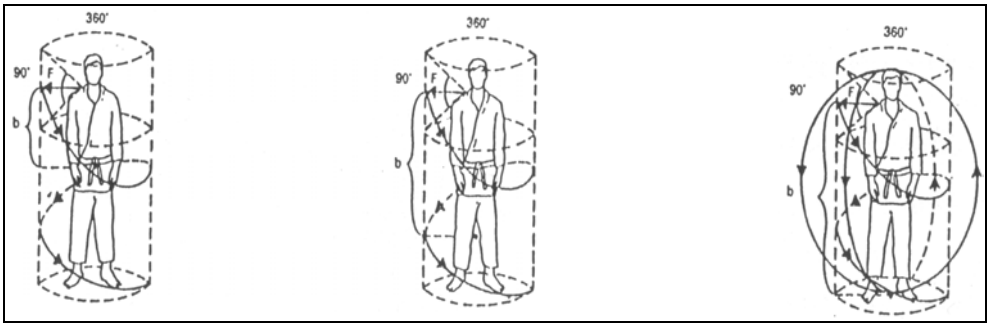


Fig. 5. Minimum arm – Medium arm – Maximum arm

Fundamentals of the FORCE COUPLE group

Explaining the entire scientific data base led to the classification of all NAGE-WAZA throwing techniques in two groups:

a) Applying a FORCE COUPLE
b) Applying a PHYSICAL LEVER WITH VARIABLE ARM

We will attempt to analyze the physical principle, the symmetries, the kinetics of throwing, the energy consumption, the muscles used from a bio-mechanic point of view.

This classification, originally performed by Attilio Sacripanti, is based on explicit scientific principles, and explains physical mechanisms JUDO throwing techniques are based on.

This bio-mechanical classification analyzes all throwing which are integrated in the KODOKAN classification from the point of view of the two mechanisms: FORCE COUPLE and PHYSICAL LEVER.

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