ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering

BIOMECHANICAL PREVISIONS OF ACCIDENTS IN JUDO

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Key words: defective falls, biomechanical model, suprastretching zones

Abstract
In this paper we are studied two defective falls in judo: Kata Guruma and Kouchi Gari. It were established the media of external parameters, the internal mechanical tensions and were estimated the tolerable biomechanical limits of suprasolicited zone. In the ending of study it was made a prevision about possible traumas in analyzed falls down. The supratensions zones were biomechanical modelated and analyzed.

1. INTRODUCTION

The experience demonstrates that at the going out of some procedures are dangerous landings. Ones of them, which products very serious traumas – because the impact speed is great – are the corresponding with the going out from the Kouchi Gari and Kata Guruma techniques. The schematic representations are presented in the next figure (the medium external mechanical parameters are presented; the marked parts present the supratensions zones, with maxim risk.)

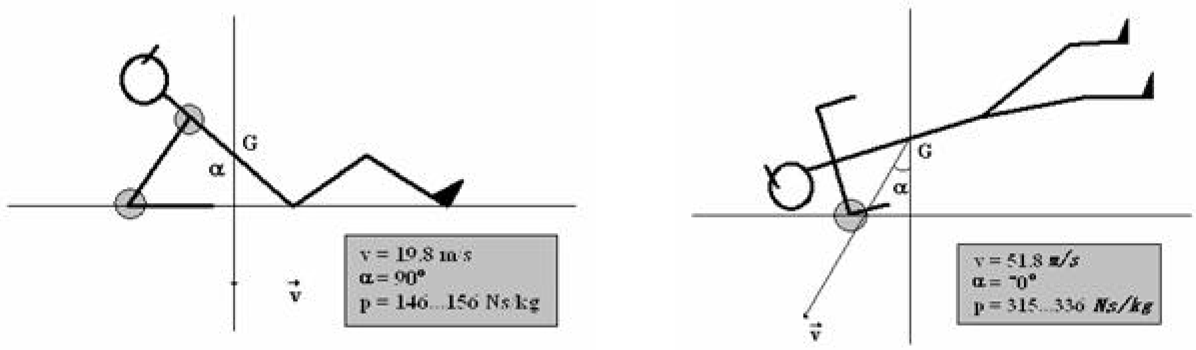

Fig. 1. left: Kouchi Gari, right: Kata Guruma

2. METHOD AND SAMPLES

The next numerical dates were obtained using three methods:

- The realization of small movies in some national competition of judo – juniors (Bucuresti, Pitesti, Brasov), which were discriminated and then videocomputing analyzed by using a special soft ("*Word in motion*"). In this way were obtained the kinematics and dynamics characteristics.
- The taking over from international channels of sports of significant images, in studied domain, and then a similarly analyze;
- The comparison to similar dates from biomechanical papers [8], [9].

At the end, the presented dates were mediated for junior sportsmen (medium mass – 50 kg, medium high – 1,60m).

The anthropometrical dates were obtained by three methods: direct measurements (made in the Laboratory of Anatomy and Physiology from University of Pitesti), by using biomechanical papers and intuitive considerations.

3. THE BIOMECHANICAL MODEL OF IMPLICATED FALLS

In the next figure the main components of model implicated by biomechanical state analyzed are presented. Figure 2 present the fall in shoulder and figure 3 the falls in arm (with the isolation of mechanical elements, the evidence of direct forces, intern tensions and intern moments of resistance created in the stage of maxim reaction of impact).

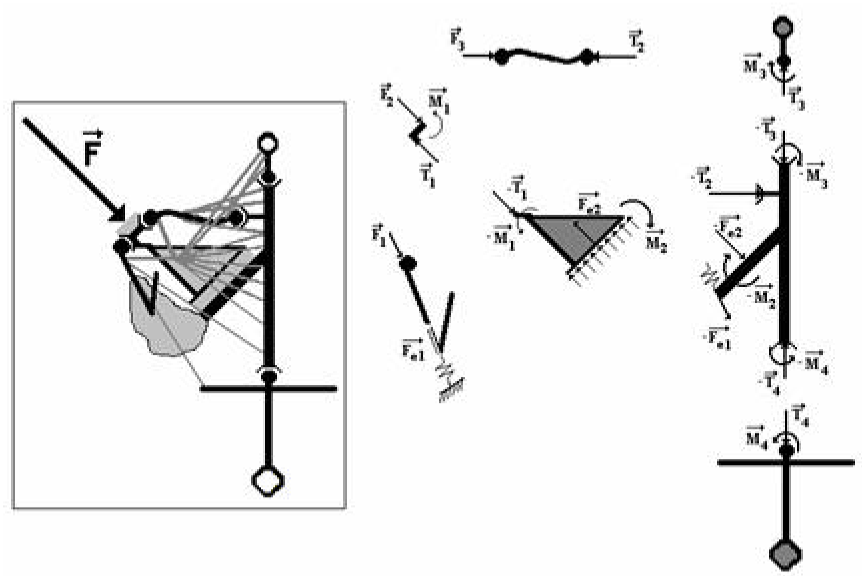

Fig. 2. Biomechanical representation of shoulder fall with the element isolation

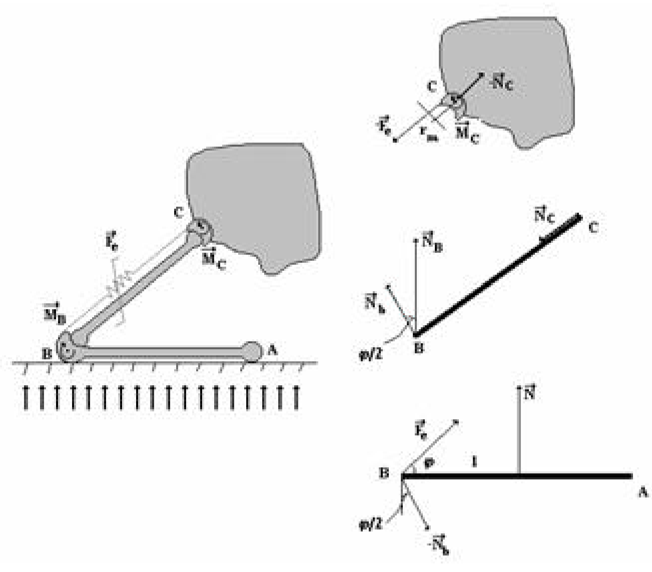

Fig. 3. Biomechanical representation of arm fall with the element isolation

4. THE MATHEMATICAL MODEL (THEORETICAL)

In this part of paper it was made the correspondence mathematical models, using biomechanical models made on anterior considerations. Then, the mathematical models for each analyzed situation and the numerical approximation of implicate elements and the estimations of mechanical interactions: are presented

- the fall in shoulder:

$$\begin{cases} T_2 = F_3 - R \\ T_1 = F_2 \\ F_e = F_2 + R\sqrt{3} \\ N \geq \dfrac{F_1 - R}{m} \\ M_1 = F_2 d_1 \\ M_2 = (F_2 + R\sqrt{3}) d_2 \end{cases} \qquad \begin{array}{l} d_1 \cong 0{,}05\ m \\ d_2 \cong 0{,}15\ m \\ m \cong 0{,}5 \end{array} \qquad \begin{array}{l} T_1 = 6{,}5\ kN \\ T_2 = 4{,}5\ kN \\ F_e \cong 10\ kN \\ N \geq 9\ kN \\ M_1 = 0{,}32\ Nm \\ M_2 \cong 1{,}5\ Nm \end{array} \tag{1}$$

- the falls in arm:

$$\begin{cases} F = \dfrac{NI}{r_m} \\ N_b = \dfrac{N + F_e \sin j}{\cos j\ /2} \cos j\ /2 = N \dfrac{1 + \dfrac{l}{r_m} \sin j}{coc j\ /2} \\ N_C = F_e \\ N_B = N_C \sin j - N_b \cos j\ /2 \end{cases} \qquad \begin{array}{l} l \approx 0{,}15\ m \\ r \approx 0{,}05\ m \\ j \approx 60^o \end{array} \qquad \begin{array}{l} F_e = 3{,}28 \ldots 3{,}51\ kN \\ N_b = 4{,}55 \ldots 4{,}86\ kN \\ N_C = 3{,}28 \ldots 3{,}51\ kN \\ N_B = 1{,}09 \ldots 1{,}17\ kN \\ M_B \approx M_C \approx 1{,}64 \ldots 1{,}75\ Nm \end{array} \tag{2}$$

5. THE THEORETICAL PREVISIONS: ACCIDENTS

One of the most important accidents is recorded in the going out from the Kata Guruma technique - fracture of clavicle. The clear prevision of this (and many others) is a first verification of biomechanical model.

The mathematical analyze, based on the proposed model lead us to the tension distribution, like in the next diagram.

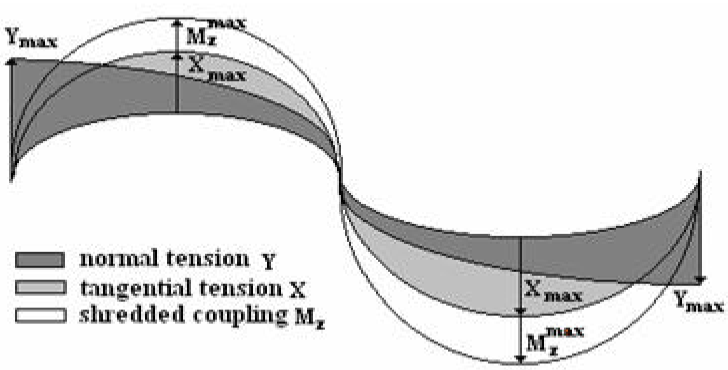

Fig. 4. The diagram of mechanical action into clavicle

In the central points of the two arcs, which models the clavicle in biomechanical terms, is the higher danger of break – due to the maximal values of shredded coupling M_z. The maximal values for intern mechanical components are:

$$X_{\max} = 6{,}5\ kN$$
$$Y_{\max} = 2{,}6\ kN \qquad (3)$$
$$M_z^{\max} = -0{,}35\ Nm$$

The obtained values shows the high possibility of these accidents.

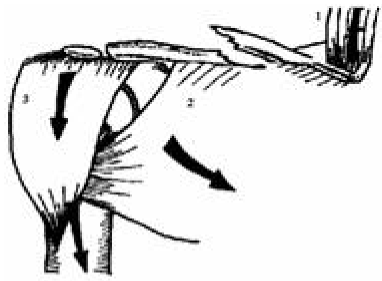

Fig. 5. The fracture of clavicle

6. CONCLUSIONS

The propose study - very large comparative with the presented ones in this paper - is a first study in this domain. This is demonstrated by the few publicized dates about the numerical values of implicated parameters, specially the biomechanical limits of resistance *in vivo* for some components organs of motion system.

Obvious, because this study is completely new, the methods and the results may be criticized; but these models can be directions for future studies. It remarks that our results are in concordance with the experience. On this base, it is possible to solve problems like these, from medicine and sport.

These results were used for a study, made by the people implicated in judo, at local level. This study tries to avoid the accidents in judo and to develop by training the alternative movements of come out from analyzed techniques. If we know the possible accidents, by using biomechanical models we can know the reason. In this way, the recuperations from medicine will be most rapidly and the treatments have a right target. At the limit, in grave accidents, it is possible to develop some artificial limb, based on this study.

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