

A comparison of karateka's and judoka's foot arch dynamics

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A - Study Design
B - Data Collection
C - Statistical Analysis
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Abstract

The benefits of barefoot walking is widely known. Our purpose was to examine the foot arch dynamics of sportsmen, who perform barefooted. The research sample consists of 25 skilled male judoka and 25 karateka (age 18-32 years, minimum 6 hours of training a week). We used navicular drop test to determine the level of foot arch dynamics. Results showed the significant differences between left and right foot of judoka and karateka and between two groups of participants as well (judoka's foot arch dynamics is bigger than karateka's). The differences could be caused by different way of shifting, different softness of the mats and different dynamics of each performance.

Keywords: judo, karate, martial art, drop test, dexterity, barefooted activity

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INTRODUCTION

We can recognize a tendency of people to care more about their life style in the past few years: spending more time in the nature, ecology thinking, and passion to organic food, etc. One of the thing which attend this phenomenon is using minimalistic or barefoot shoes and walking or running without shoes following Dr. Samuel Shulman statement "Footgear is the greatest enemy of human foot" [1].

Barefooted walking on different types of surface is considered to be the prevention of flat foot and other problems connected with this issue [2]. That is why we focused on barefooted sportsmen. The previous study shows, that judoka's foot arch dynamics is bigger than non- athletes' [3]. For this paper we choose two barefooted sportsmen: judoka and karateka. For these athletes barefoot walking is natural and they spent lot of time exercising without shoes. On the other hand the biomechanics of their motions are different enough [4] to arise the interest for comparing their foot dynamics. The biggest difference is in the way of move.

Judo performance is based on moving with opponent using one's own strength, staying in a steady position with lowered center of gravity which is connected with a solid support by lower limbs. In karate there are much quicker changes of position without an interpersonal physical contact. These changes are made by dynamic push to feet. Judoka move with lower position of center of gravity than karateka. This is also connected with the type of locomotion. Judoka moves more by sliding the feet on the tatami (mat) [5, 6], on the other hand karateka's locomotion is more characteristic with steps and jumps especially in kumite (fight). Even the surface used by martial arts practitioners is different, judo is performed always on 4 cm high tatami which is softer than 2 cm high tatami for karate practicing. More over karateka often practice on other type of sport floor without using tatami. This widely different way of shift effects the foot dynamics which is closely connected with another health foot issues such as flat foot, shortened ligaments and tendons of the sole resulting in the high foot arch, cramps or dysfunctions of foot. [2]

There are lots of studies focusing on the dynamics of foot arch, nevertheless none of them is dealing with combat sportsmen. [7, 8, 9]

MATERIALS AND METHODS

Research sample

Our research sample consists of 25 male judoka and 25 male karateka. Selection criteria are specified in the Table 1. The age variance was determined based on the average age of judoka in the Olympic Games. [10]

The cross-sectional method of data selection was applied. We measured the anthropological extends of foot such as the length of the right foot, the length of the left foot as well as body height, body weight, body mass index and the age of the tested persons.

Table 1. Selection criteria

Judoka		Karateka	
Age (years)	18-32	Age (years)	18-32
Sex	male	Sex	male
BMI	18-25 kg/m ²	BMI	18-25 kg/m ²
Time of training	min 8 years	Time of training	min 8 years
Training hours a week	min 6 hours o week	Training hours a week	min 6 hours o week
Preferred hand	Right-handed	Preferred hand	Right-handed

METHODS

For the dynamics of foot arch is often used navicular drop test [7,8,9,11] which gives evidence of foot arch dynamics, shortening of muscles and ligaments of the sole.

We used the same navicular drop test methodology as others researchers [8, 9, 11, 12]: after palpation and marking, the height of the navicular bone was measured twice (Figure 1, 2). First while sitting without any pressure on the foot then while standing with legs apart and with the body weight distributed equally to both legs.

Some variables such as age, height, weight, BMI and the length of foot, whose extremes could interfere with the results, were monitored. The length of the foot was measured with a ruler. The absolute length of the sole was measured from the heel to the longest toe with no pressure on foot. These additional variables were monitored because of stratific selection, gaining homogenous research sample and removing the extremes only.

All measurements were done in the morning hours, when the feet were relaxed after sleeping period. The tested persons were asked about the medical history of their feet to prevent the influence of injury or other foot issues on the results and the usage of medication which could influence muscular tonus.

We use Statistica Cz software to analyze the data (Mann-Whitney U test and Wilcoxon t-test) as well as Calculator of Cohen d for effect size.

Research question

RQ1: Is there any difference of navicular bone drop between judoka and karateka?



Fig. 1. Measuring the height of marked navicular bone while sitting and standing



Fig. 2. Measuring the difference between the height of navicular bone while sitting and standing

RESULTS

In the Table 2 you can see average results with its standard deviation for all measured variables. The most important variables are differences between the heights of navicular bone while sitting and standing at the bottom of the table.

Judoka right foot arch's dynamic (average result of drop test 6.60 ± 3.01 mm) is bigger than their left foot arch's (6.0 ± 2.31 mm) with small size of effect ($d = 0.22$; $p = 0,140$). Karateka right foot arch's dynamic (average result of drop test 4.64 ± 3.01 mm) is smaller than their left foot arch's (5.48 ± 2.84 mm) with small size of effect ($d = 0.28$; $p = 0,095$).

Foot arch drop of judoka (6.60 ± 3.01 mm for right foot, 6.00 ± 2.31 mm for left foot) is bigger than in karateka group (4.64 ± 3.01 mm for right foot, 5.48 ± 2.84 mm for left foot). These differences are statistically significant ($p = 0.017$ for right feet, $p = 0.618$ for left feet). The effect size of the differences between the heights of navicular bone while standing and sitting was 0.64 for the right feet, 0.2 for the left feet, which means that only difference between foot arch drop of judoka's and karateka's right foot is significant.

Table 2. Average results with its standard deviation for all measured variables

	Average of JUDOKA N=25	SD	Average of KARATEKA N=25	SD
Age (years)	24.64	3.91	23.00	5.88
Height (cm)	179.08	7.79	177.76	7.65
Weight (kg)	82.28	12.16	72.80	10.74
Length of the right foot (mm)	261.28	14.80	263.24	16.47
Length of the left foot (mm)	264.48	14.65	265.60	15.32
Height of navicular bone while sitting - right foot (mm)	52.08	8.35	55.84	5.26
Height of navicular bone while sitting - left foot (mm)	53.60	5.86	55.92	6.53
Height of navicular bone while standing - right foot (mm)	45.48	9.62	51.20	5.54
Height of navicular bone while standing - left foot (mm)	47.60	7.22	50.44	6.73
Differences between the heights of navicular bone while standing - right foot (mm)	6.60	3.01	4.64	3.01
Difference between the heights of navicular bone while sitting - left foot (mm)	6.00	2.31	5.48	2.84
Difference between the heights of navicular bones while sitting - both feet (mm)	6.30	2.67	5.06	2.93

DISCUSSION

Previous research showed significant differences between foot arch dynamics of judoka (performed barefooted) and non-athletic population (using shoes most of times) [3], that is why we focused on the comparison of two groups of athletes, who perform their activity barefooted. These groups were karateka and judoka as both of them are Japanese combat sports with different performance.

Our results show the judoka's foot arch dynamics between 3.63 and 8.97 mm (average 6.3 mm) and karateka's foot arch dynamics between 2.13 and 7.99 mm (average 5.06 mm). According to Sae Yong Lee [11] both our tested samples would stay in „normal” extend (navicular drop between 4 and 10 mm). Karateka more incline to be in hypo mobility. On the other hand Eslami, Damavandi and Ferber [8] suggest the average drop of navicular bone 7.13 mm with the variance between 6.1 to 7.5 mm. This standard is nor fulfilled by judoka in our research neither by karateka, who mostly stay under the average. Most of studies are examining the influence of different footwear on runners [7, 13, 14]. Hoffmann for example [7] used the x-ray method which can be considered to be the most precise kind of measurement. Their average results of navicular drop were: for bare footed runners was 4.4 – 9.0 mm (average 6.7 mm), for runners in minimalistic footwear 4.6 – 8.9 mm (average 6.8 mm) and for runners who train in running shoes 4.4 – 6.6 mm (average 5.5 mm). According to this study our tested persons seem to have similar foot dynamics as runner in minimalistic foot wear for judoka and as runners in running shoes for karateka), but the results cannot be compared this way.

The key result of our study is the significant difference between judoka's and karateka's right foot arch dynamics. All tested persons were right-handed which results in using their right leg as dominant and prepared for quick action of technique during the fight. In judo, there are specific techniques performed by front foot of the stance, which requires the work of plantar muscles [4]. That is why right-handed judoka adopt right stance with right foot front. In the opposite, karateka keep their more dexterous leg behind to be ready for kicks and quick starts which begin with strong push to the back foot. Therefore right-handed karateka prefer left stance with right foot front. Our results confirm this practice. The foot arch dynamics of preferred foot is bigger in both groups of athletes.

Overall judoka's dynamics of foot arch is bigger than karateka's. It is valid for both legs (left x right, preferred x non-preferred). This can be caused by different movement patterns, especially the way of shifting. Judoka push more to the inner edge of feet, their feet load is more static then in karate performance. [6] Karateka way of shift is more dynamic, they use steps, jumps and strong pushes to the mat which results in strengthening their muscles and tendons of the sole. [2]

CONCLUSIONS

We can conclude that at minimum of 6 hours a week of judo training on tatami may cause better dynamics of foot arch. Judoka's right foot dynamics is bigger than their left foot's. This can be caused by specific techniques of front foot of preferred stance, which requires the work of plantar muscles. It would be worthy to verify our results in a larger sample of tested persons.

The differences between judoka and karateka are notable as well as the differences between left and right foot of each individual person. The surface and the movement patterns play the crucial role in forming the foot arch. No extreme of foot arch is caused by performing barefooted on tatami mats. The border of foot arch drop in the context of physiological extent is another issue [2].

A comparison of foot arch dynamics and foot condition among different martial arts is a challenge for the future research.

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