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Dynamics of Judoka´s foot arch

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Abstract

Background and Aim of the study. Many health problems are caused by a poor condition of foot arch. Foot arches of athletes are influenced by injuries. Barefooted walk is recommended as a prevention of foot arch problems. That is why we chose judoka as tested persons because their performance and training is always barefooted.

Materials and Methods. We used drop test to assess the dynamics of judoka´s foot arch. Our control group consists of nonathletic population (25 judoka, 25 nonathletes). We measured the length of the sole, height of os navicular in a sitting and standing position.

Results. The dynamics of Judoka´s right foot (average result of drop test 6.64 mm) is bigger than their left foot´s (6.0 mm). Foot arch´s drop of nonathletes is less than half of judoka´s (2.62 mm of right foot, 3.54 left foot).

Conclusions. Practicing judo formulates the feet arches. There is a difference between right and left foot arch dynamics depending on the preference guard in judo.

Key words: tarsal bones • martial art • drop test • dexterity • barefooted activity

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Introduction

Many athletes suffer from pain of lower limbs´ joints. Apart from pain caused by injuries [1] doctors locate the root of the trouble in a foot, foot arch or position of ankles. As a therapy it is recommended to use orthopedic footwear, specific insoles and other secondary methods of foot arch support. Martial artists, in our case judoka, can follow these recommendations only with difficulties because they practice barefoot.

The present study is focused on the dynamics of judoka foot arch. Judoka´s performance and training is always performed on tatami and barefoot. It is generally known that the root of the trouble with foot arches lies in an inadequate maximal physical demand as well as in inactivity. In judo the maximal physical demand is increased by barefoot performance [2]. The results of the experimental group is compared to the results of the control nonathletic group.

Materials and Methods

Research sample

Our research sample consists of 25 male judoka aged between 18 and 32, whose results are compared to the group of the nonathletic male group of the same size. Selection criteria is specified in the Table 1. The age variance was determined based on the average age of judoka in the Olympic games. [3]

The cross-sectional method of data selection was applied. Data was collected at the end of 2014.

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.

Methods

Similarly to Gardin [4] we used navicular drop test which gives evidence of foot arch dynamics, shortening of muscles and ligaments of the sole. After palpation and marking, the height of the navicular bone was measured twice (Figure 1). 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.

We monitored other variables such as age, height, weight and the length of foot, whose extremes could interfere with the results. The length of the foot was measured with a ruler (Figure 2). We measure the absolute length of the sole from the heel to the longest toe with no pressure on foot.

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 as well as Calculator of Cohen d.

Research questions

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

RQ2: Is there any difference of navicular bone drop between judoka´s right and left foot?

Results

In 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.

Table 1. Specification of the research sample

Judokas		**Nonathletes**	
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 10 years	Time of training	No regular physical activity
Technical degree	min 1. KYU		
Training hours a week	min 6 hours a week	No health issues with feet	

Figure 1. Measurement of the height of the navicular bone

Figure 2. The measurement of the length of the foot

The effect size (using Cohen d) of the differences between the heights of navicular bone while standing and sitting was 1.19 for the right feet, 0.75 for the left feet while comparing judoka and nonathletes. Judoka´s differences between the heights of navicular bone while standing and sitting comparing their right and left foot was not statistically significant ($p = 0.440$) but there was the effect size of 0.21.

Judoka right foot´s dynamic (average result of drop test 6.64 ± 3.33 mm) is bigger than their left foot´s (6.0 ± 2.77mm) with small size of effect ($d = 0.21$).

Foot arch drop of judoka (6.64 ± 3.33mm for right foot, 6.0 ± 2.77mm for left foot) is bigger than in nonathletic group (2.62 ± 3.33mm for right foot, 3.54 ± 4.61mm for left foot). These differences are statistically significant ($p = 0.001$ for right feet,

Table 2. Results of measurements

	Judokas	SD	Nonathletes	SD
	(n = 25)		(n = 25)	
Age (years)	24.64	3.91	30.38	6.74
Height (cm)	177.10		180.10	
Weight (kg)	81.35		82.46	
Length of the right foot (mm)	261.30	14.8	259.90	11.76
Length of the left foot (mm)	264.50	14.65	264.50	10.6
Height of navicular bone while sitting – right foot (mm)	52.08	8.35	52.00	9.26
Height of navicular bone while sitting – left foot (mm)	53.62	5.86	51.69	9.56
Height of navicular bone while standing – right foot (mm)	45.46	9.82	49.38	10.67
Height of navicular bone while standing – left foot (mm)	47.62	7.08	48.15	9.69
Differences between the heights of navicular bone while standing – right foot (mm)	6.64	3.33	2.62	3.33
Difference between the heights of navicular bone while sitting – left foot (mm)	6.00	2.77	3.54	4.61

p = 0.047 for left feet). The effect size of the differences between the heights of navicular bone while standing and sitting was 1.19 for the right feet, 0.75 for the left feet, which means that both differences (left and right foot) are significant.

Discussion

Foot arch dynamics and foot architecture in association with judo or other martial arts seems to be a neglected topic in research. We dealt with the condition of judoka´s foot but only by using plantogram [5], which did not give evidence of foot arch dynamics. That is why we have used drop test in this paper.

We can assume that selection of tested persons was successful. Both groups, judoka as well as nonathletic, consisted of similar tested persons, whose BMIs were between 18 and 25 kg/m^2. It means that no extreme influenced the results. Similarly Kim [6] is comparing athletes with results of nonathletic population.

During measurements we noticed a big difference of navicular bone drop between right and left foot in two tested persons. The difference between their right foot navicular bone drop and their left foot navicular bone drop was 8.0 mm. A medical examination was recommended to these tested persons.

Foot arch drop of judoka (6.64 ± 3.33mm for right foot, 6.0 ± 2.77mm for left foot) is bigger than nonathletic group´s (2.62 ± 3.33mm for right foot, 3.54 ± 4.61mm for left foot). Nonathletic population spends most of time provided with shoes, which influences movements of foot, toes, foot arch and sometime ankles as well [2]. The dynamics of foot arch can also be influenced by judo itself with its characteristic movement patterns. Judoka use their legs not only for locomotion. They use it actively during ashi waza such as for hitching the opponent's leg by heel, sweep or push with a sole, lifting opponent with feet and others [7,8]. These movements are important for maintaining the proper condition of plantar muscles [9].

We were also looking for differences in navicular bone drop between the left and right foot in judoka. All judoka in the research sample were right-handed. The difference in navicular bone drop between the left and right foot in judoka was 0.62 mm in average, which was a small size of effect. The bigger drop of navicular bone was found in the right feet. The preferred guard in right-handed judoka is mostly with the right foot forward. The forward foot in judo performance is employed by fine movements, sweeps or pushes over. The left foot is usually the stronger one. Its task is body support and keeping balance during techniques [10].

Conclusions

We can conclude that at minimum 6 hours a week training on tatami may cause better dynamics of foot arch. Judoka´s front foot dynamics is bigger than their left foot´s. This can be caused by specific techniques of front foot, 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 nonathletic population are notable as well as the differences between left and right foot of each individual person. The border of foot arch drop in the context of physiological extent is another issue [11].

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 other martial arts in particular karate or kick boxing there are much quicker changes of position without an interpersonal physical contact. These changes are made by dynamic push to feet. A comparison of foot arch dynamics and foot condition among different martial arts is a challenge for future research.

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