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RELATION BETWEEN THE HALLUX STABILITY IN STANDING POSITION AND 1ST RAY POSITION IN ATHLETES OF TWO DIFFERENT SPORTS

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Informações do artigo

Keywords:
HALLUX STABILITY;
1st RAY; FOOTBALL;
JUDO.

Abstract

The main goal of this work is to establish a connection between the position of the *1st* Metatarsal (Mtt) bone and the hallux stability with regard to the effective activation of the windlass mechanism in soccer and judo athletes. To assess whether the position of the *1st* Mtt affects the structure through which propulsion is performed while walking, and finally whether the position of the *1st* Mtt affects which Mtt is more congested at the time of calcaneal elevation while walking will compare all soccer players and judo athletes. The statistical analysis was developed according to the SPSS software and we used a survey that included some instruments such as the Manchester and the VAS (Visual Analogic Scale), a Gurney, the Ultralight Podoscope and a Pressure Platform. Physical tests were performed to assess the position of the *1st* Mtt (pressure ulcer), the stability of the hallux (standing position) and the lung test. The results showed that the dorsiflexion position of the soccer players, isolated from each of the sample groups, soccer players and judokas, was more common and that there was also a higher incidence of hallux instability. The results were more consistent among judo practitioners, since the number of athletes with hallux instability was

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higher in the dorsiflexion position than among those who showed stability; in the plantar flexion position, the situation was reversed, i.e. more athletes with stability outweighed the fractional analysis. However, in the fractional analyzes by mode, the relationships lose the statistical significance. In the relationship between the stability of the hallux and the last structure that leaves the ground on final propulsion, it has been found that in the presence of stability, the last structure that leaves the ground is the *2nd* finger. Regarding the relationship between the position of the *1st* Mtt and the structure that is most heavily overloaded at the heel lift, the overload is mainly on the *5th* Mtt, regardless of the position of the *1st* Mtt.

Background

The athletes of two different modalities perform technical movements that require an effort that can endanger their well-being and physical condition. Football and judo are two modalities that register a large number of injuries that can affect their performance in the short and long term. For them, the stability of the feet and the first ray are of crucial importance not only in practice, but also in everyday life.

Research questions

1. Does the position of the *1st* Mtt determine the hallux stability in relation to the efficient activation of the windlass mechanism?
2. How many athletes have proper hallux function in terms of activating the windlass mechanism?
3. Does the position of the *1st* Mtt influence the structure through which the drive takes place? and
4. Does the position of the *1st* Mtt affect the metatarsus, which overloads when the heel leaves the ground?

Methods

The population of this study consisted of 56 athletes, of whom 26 were soccer players and 30 were judokas. The sample was selected from a few exclusion criteria that excluded those from the study those who had, viz.

1. Suffered an injury with more than 3 points in the Visual Analogic Scale (VAS);
2. A surgical background of the foot;
3. Neuromuscular pathologies;
4. Fracture history in the *1st* ray of the dominant; and,
5. Support foot.

The athletes of the sample underwent numerous visual and technical tests, which required the use of some materials such as the VAS, the Ultralight Podoscope and a printing platform. The results were statistically processed using the SPSS software.

Results

The results suggest that the athletes, viz.

1. Mainly had a plantarflexed *1st* Mtt, which is associated with higher hallux stability;
2. Show that the last structure to leave the ground in the tunnel is the second toe;
3. Expose that the overworked metatarsus was the fifth; and
4. Indicate that the lack of stability is more common when the first Mtt is mainly bend dorsally within the soccer player.

Significance

The study included analysis of important data in the context of sports podiatry, as it indicated that the position of the *1st* Mtt (PF or DF) is critical to determining hallux stability with regard to the effective activation of the windlass mechanism.

Introduction

Football is a sport that is practiced at the highest international level, where athletes have to resort to skills such as cognitive, motor or perception (Williams, 2000). Given the popularity of football, it is natural to point out this sport as the most injured one (Keller, Noyes & Buncher, 1987). High intensity and competitiveness require a range of movements such as sudden acceleration or deceleration, rapid changes in direction, torsional forces in rotational movements, jumps and kicks that can lead to concentric and eccentric forces in flexion and ankle muscles, as well as joint overload, which can result in potential injuries. In this sense, although the dominant lower limb is not always the only one at risk, a study by Lopez-Valenciano et al. (2017) found bilateral differences in the dominant and non-dominant limb of football players, which is precisely explained by the asymmetrical and repeated kicking and technical gestures and control of the ball using mainly the dominant limb. This tends to be the most susceptible to injury (Rahnama, Bambaeichi, & Daneshjoo, 2009). Some of the football injuries happen in the first ray, which differs from the others due to their position and importance. This is related to the support of body weight. Because it is a critical structure in foot formation, these injuries may be responsible for critical changes in foot biomechanics, culminating in disabling gait in certain cases (Maskill, Bohay, & Anderson, 2006).

In martial arts there are hard and soft ones. Those who are classified as "hard" are fast, powerful and dynamic in movement, so they focus on maximum power, like karate. An example of the soft ones is Tai Chi, which is characterized by relaxed movements, which are usually slow and aim to regulate posture along the way of movement (Gorgy, Vercher & Coyle, 2008). In judo, the struggle itself is characterized by unexpected, fast, repetitive, and high-intensity movements and efforts that can expose certain body structures to overload (Tegner, 2002). Given the technical component of judo, athletes should develop some characteristics such as agility, balance, static strength and aerobic and anaerobic capacity (Carazzato, Cabrita & Castropil, 1996), as well as speed, explosive power, endurance, neuromuscular reactivity and coordination (Santos, 2016). In addition, the stability of the lower limbs, more than any other part of the body, is of course very important. Based on this question, a study was created in which the stability of the *1st* Mtt in Judokas was compared with that of the footballer, whose sport is practiced with the feet as a basic support and without protecting their shoes.

1st ray and hallux

The first ray is a functional unit or a segment of the foot, which is composed of the bony structures of the *1st* Mtt and the *1st* cuneiform (Hicks, 1954). The *1st* Mtt joint, which consists of the head of the *1st* Mtt and the base of the proximal phalanx, allows progression in the sagittal plane when walking, running, jumping and in other situations. In addition, it enables good alignment and foot stability and also contributes to efficient movements (Splichal, 2015). In a static posture, the *1st* Mtt carries about 40% of the body weight, which is a considerable burden (Greisberg, 2007).

Due to its constitution and functions, the importance of the functional stability of the first ray and its influence on muscle balance is recognized (DuChenne, 1949). The movement of the first Mtt is about an axis which is approximately 45 ° with respect to the frontal and sagittal planes. The position of the stem enables relatively high dorsal and plantar flexions as well as inversions and eversions. Therefore, the *1st* jet is generally responsible for resisting the ground reaction forces, maintaining the integrity of the medial longitudinal arch, accepting the body weight during propulsion without stabilizing the forefoot, and an engine for stabilizing the medial phase through the windlass mechanism (D'Amico, 2016). Regarding stability, in conjunction with this author's study, the absence of stability was considered in this study in cases where hallux showed resistance to force during the maneuvers used, did not dorsiflex, and rendered the windlass mechanism ineffective. On the other hand, it is believed that people who do not show this resistance and easily perform finger flexion, arch congruence, and external tibial rotation before they reach 15 ° degrees of finger flexion.

According to D'Amico's understanding (2016), there is a connection between the *1st* Mtt dorsiflexion with a higher hallux overload, which does not lead to instability of the hallux in relation to the lower load, but in terms of the resistance to the activation of the mechanism. In contrast, in a flexed position of the *1st* Mtt, the hallux is more stable, which means that the mechanism is easily activated when the toe is bent dorsally. That was the concept we followed in this study. Therefore, we considered a stable hallux that activates the mechanism easily without generating resistance, as well as a slight diffraction. Analysis of the hallux flexion at the orthostatic position and the values considered normal show that the values that indicate the absence of pathology regarding the dorsiflexion amplitude in young adults, are approximately 6 mm (4 to 9 mm).

Propulsion

Gait is defined as the set of motor behaviors composed of integrated and cyclic movements of the human body, which allow the establishment of objective criteria that distinguish normal and abnormal movements (Silva, et al., 2014).

It is a repetitive sequence of lower limb movements that propel forward body movement while they simultaneously maintain the stability in the support. In walking, a limb acts as a moving support in contact with the ground while the contra lateral limb advances in the air. Thus, the set of body movements is cyclically repeated until the members reverse their roles, forming a simple sequence of support and advancement of a single limb, called the gait cycle. This is defined as the interval elapsed from the heel support of one foot to the heel support of the next step. These temporal events and their consistent repetition define the different phases of the gait cycle (Barbosa, 2011).

The gait cycle is a repetitive pattern and consists of two major phases: the support phase and the swing phase. The first is the one that occupies a large part of the gait cycle, about 60%, while the balance phase represents the remaining 40%.

The propulsion is one of the five sub-phases of the gait cycle, it is actually a support phase (pre-swing) which is subdivided into heel-off and toe-off. The first case refers to the moment when the heel loses contact with the ground, initiating the push off. The second expression refers to the final phase of support in which the foot takes off from the ground (Vaughun, Davis, & O'Conner, 1999). This phase begins when the heel leaves the ground, and hallux is usually the last segment doing it. In this phase when the foot leaves the ground, it is normal to be the first radius that which propels when the heel lifts, since it is there, in the metatarsal zone, that most of the forces or load are concentrated, as Greisberg (2007) had aleready pointed out. At the beginning of propulsion there is a hyperextension in the hip that varies between 10° and 13°, and a knee flexion between 0° and 5°. Here the ankle is in plantar flexion. Then, when the body weight bends only over the metatarsal heads, the knee flexes a little more, reaching 35-40°, and the plantar ankle flexion increases to 20° (Maia, 2013).

Methodology

Methods and procedures

To evaluate the athletes, it was used a form with a table to record the exclusion criteria used, which aimed to assess the pain level through the VAS. It takes into account the pain level between 0 and 10, in which 0 is classified as mild or painless and 10 as severe (DGS, 2011). Another parameter of the survey was hallux stability, which was rated as stable or unstable, for which an ultralight podoscope was used. This material was used to perform a soles examination on the athletes' feet, highlighting the points of greatest and lowest stress with a real view of the foot. The survey ended with podoborametric analysis aimed at identifying the metatarsus that was most congested according to the height of the calcaneus, considering options from *1st* to 5th Mtt. Then the last finger to leave the ground was identified, represented by the *1st* to 5th fingers. A printing platform was used in this evaluation. To conduct the study, some maneuvers were performed to assess the hallux stability and the position of the first Mtt.

To assess the hypermobility of the first *Mtt*, the maneuver consisted of examining the front or medial visual aspect of the foot. With the heel supported, the examiner positions himself in front of the patient's toes and holds the *2nd* Mtt head between the thumb and index finger with one hand. With the other hand, the head of the *1st* Mtt was stabilized and moved in a dorsal or plantar plane. The first radius was measured in millimeters and rated as rigid if it moved very little and showed plantar flexion. The first meter did not reach the level of the others (Glasoe, Yack & Saltzman, 1999); hypermobile if it shows more mobility and dorsiflexion and therefore the lower surface of the head of the *1st* Mtt rises above the plane of the smaller metatarsus; or neutral if dorsiflexion and plantar flexion do the same (Hebert et al., 2015). In the case of the first radius stiffness, there is an influence on the load acceptance mechanisms and there may be a risk of injury (Hamill, Bates, Knutzen, & Kirpatrick, 1989).

In the case of a rigid first ray under a plantarflex force, the consequence is blockage to calcaneus eversion and a decrease in the absorption capacity of impact forces (Gill, 1997).

Objectives

This work started from a descriptive, correlational and qualitative analysis, thus constituting a retrospective study. Its elaboration was based on the outline of some objectives, which guided the way how the theoretical part and the empirical part of the work were carried out. Given the context of football and judo practice, the aim was to study the stability of these athletes' anatomical structures at the dominant foot level. As such, the main objectives were to relate the stability of the hallux in standing to the position of the 1^{st} ray in athletes of two different sports, football and judo; relate the hallux stability to the last structure to leave the ground (propulsion) at one step in the walking cycle; and identify the most overloaded Mtt after elevation of the calcaneus (propulsion).

Population and sample

The population of this study includes a total of 56 athletes, of whom 26 were soccer players and 30 were judokas. All soccer players were men, but the judo players showed some differences in this as there were female and male athletes. The age of the athletes involved was between 16 and 18 years old. This population was chosen in order to bring together a group of athletes whose sports practice was performed with appropriate footwear, that is, footballers, and another group whose athletes practiced barefoot, in this case, judokas. Regarding the sample, it was made up of all athletes who did not meet the exclusion criteria, such as those who no longer presented pain level 3 on the (VAS), those who had no clinical history of fractures, either in the dominant or in the support foot, and those who neither have not had injuries recently nor underwent any surgical intervention of the foot to the 1^{st} ray.

Results

Relationship between the hallux stability and the *1st* ray position in athletes of two different sports

For this purpose, the hallux and the position of the 1^{st} ray of the dominant foot were analyzed. The hallux was considered stable if it showed no resistance to the hallux dorsiflexion maneuver and slightly activated the windlass mechanism. On the other hand, the hallux showed instability in patients with resistance to dorsiflexion and the resulting ineffective activation of the mechanism. In general, the dorsiflexion position was found to have higher hallux instability values, while in the plantar flexion position, more athletes had hallux stability. The relationship was statistically significant ($p = 0.029$).

Table 1 - Position of the *1st* ray in the dominant foot and hallux stability on the dominant foot.

In general		Hallux stability of the dominant foot		Total
		No	Yes	
Mobility of the *1st* ray of the dominant foot	Neutral	8	3	11
	Dorsiflexed	26	10	36
	Plantarflexed	2	7	9
Total		36	20	56

In a separate analysis, each of the sample groups showed a higher prevalence of dorsiflexion position among soccer players, and there were also higher instability cases. Despite the tendency towards greater instability in the dorsiflexion positions of the *1st* ray, the relationship between the position of the 1^{st} ray and the hallux stability was classified as statistically insignificant ($p = 0.127$) when analyzed only in soccer players.

Table 2 - Position of the *1st* ray on dominant foot and hallux stability of hallux on dominant foot - football.

Football		Hallux stability of the dominant foot		Total
		No	Yes	
Position of the *1st* ray of the dominant foot	Neutral	6	1	7
	Dorsiflexed	12	6	18
	Plantarflexed	0	1	1
Total		18	8	26

The results were more consistent among judo practitioners, since the number of athletes with hallux instability was higher in the dorsal position than in those who showed stability, and the situation was reversed in the plantar flexion position. Despite this tendency, the relationship between the position of the *1st* ray and the stability of the hallux in judo practitioners is not considered to be statistically significant (p = 0.155).

Table 3 - Position of the *1st* ray on dominant foot and hallux stability of hallux on dominant foot - judo.

Judo		Hallux stability of the dominant foot		Total
		No	Yes	
Position of the *1st* ray of the dominant foot	Neutral	2	2	4
	Dorsiflexed	14	4	18
	Plantarflexed	2	6	8
Total		18	12	30

Relationship between hallux stability and the last structure leaving the ground (propulsion)

In general, athletes with hallux instability of the dominant foot had the *1st* toe to be the last to leave the floor, while those with stability had the *2nd* toe to leave the ground.

Table 4 - Hallux stability in the dominant foot and Podobarometry Analysis. Last finger to leave the ground.

General		Podobarometry Analysis. Last finger to leave the ground.			Total
		1st toe	*2nd* toe	*4th* toe	
Hallux stability of the dominant foot (Activation of the windlass mechanism)	No	30	6	0	36
	Yes	6	13	1	20
Total		36	19	1	56

This difference is statistically significant when using the linear-linear association test (p <0.001). This situation persisted among football players, but with minor differences. In this case, the verified results were no longer considered to be statistically significant (p = 0.051).

Table 5 - Hallux stability in the dominant foot and Podobarometry Analysis. Last finger to leave the ground - Football.

Football		Podobarometry Analysis. Last finger to leave the ground.		Total
		1st toe	*2nd* toe	
Hallux stability of the dominand foot (Activation of the windlass mechanism)	No	14	4	18
	Yes	3	5	8
Total		17	9	26

In judo athletes, those with hallux instability showed that the last finger to leave the floor was usually the *1st*. Among those with stability, in general, the last finger to leave the ground was the *2nd*.

Table 6 - Hallux stability in the dominant foot and Podobarometry Analysis. Last finger to leave the ground - Judo.

Judo		Podobarometry Analysis. Last finger to leave the ground.			Total
		1st toe	*2nd* toe	*4th* toe	
Hallux stability of the dominand foot (Activation of the windlass mechanism)	No	16	2	0	18
	Yes	3	8	1	12
Total		19	10	1	30

This difference is statistically significant (p = 0.001).

Identification of the most overloaded Mtt after calcaneal elevation (propulsion)

As a rule, it turns out that in the neutral position the overload occurs more on the *5th* Mtt, but also on them *1st*,*2nd* and *3rd* Mtt. In the dorsiflexed position, there is a predominance in the 5th Mtt. In plantarflexion, an overload is maintained at 5th Mtt, although there are also some cases on the first three Mtt. The results presented are not considered to be statistically significant (p=0.935), but it can be checked that there is a load distribution for all other metatarsals in the dorsiflexed positions of the first metatarsus, which indicates that the first target is ineffectively supported. Creates a load distribution.

Since both variables are ordinal, it is possible to examine them using the Spearman correlation coefficient. However, the determined coefficient value (0.172) does not suggest a statistically significant association (p = 0.206). The results are not statistically significant for both soccer players (p = 0.742) and judo players (p = 0.166).

Table 7 - Position of the *1st* ray on the dominant foot and Podobarometry Analysis + overloaded Mtt on the calcaneal elevation.

General		Podobarometry Analysis + overloaded metatarsal on the calcaneal elevation					Total
		1st Mtt	*2nd* Mtt	*3rd* Mtt	*4th* Mtt	*5th* Mtt	
Position of the *1st* ray of the dominant foot	Neutral	4	1	1	0	5	11
	Dorsiflexed	4	8	7	4	13	36
	Plantarflexed	2	1	3	0	3	9
Total		10	10	11	4	21	56

Football players show that in the neutral position the overload is more concentrated on the *5th* Mtt. There was only one player in the plantarflexed position, whose overload was on the *1st* Mtt. In the dorsal position, the *5th* Mtt predominates, which is distributed over the remaining four Mtt in some athletes.

Table 8 - Position of the *1st* ray on the dominant foot and Podobarometry Analysis + overloaded Mtt on the calcaneal elevation - Football.

Football		**Podobarometry Analysis + overloaded metatarsal on the calcaneal elevation**					Total
		1st Mtt	*2nd* Mtt	*3rd* Mtt	*4th* Mtt	*5th* Mtt	
Position of the *1st* ray of the dominant foot	Neutral	2	0	1	0	4	7
	Dorsiflexed	3	4	2	2	7	18
	Plantarflexed	1	0	0	0	0	1
Total		6	4	3	2	11	26

The results are not considered statistically significant (p = 0.340).

For judo practitioners in the neutral position, the overhead is at the *1st*, *2nd* and *5th* Mtt. In the plantar flexion the *3rd* and *5th* Mtt predominate. The *5th* Mtt predominates in the dorsiflexed position, with some elements being distributed over the remaining four Mtt.

Table 9 - Position of the *1st* ray on the dominant foot and Podobarometry Analysis + overloaded Mtt on the calcaneal elevation - Judo.

Judo		**Podobarometry Analysis + overloaded metatarsal on the calcaneal elevation**					Total
		1st Mtt	*2nd* Mtt	*3rd* Mtt	*4th* Mtt	*5th* Mtt	
Position of the *1st* ray of the dominant foot	Neutral	2	1	0	0	1	4
	Dorsiflexed	1	4	5	2	6	18
	Plantarflexed	1	1	3	0	3	8
Total		4	6	8	2	10	30

The results are not considered statistically significant (p=0,319).

Discussion

Based on a descriptive analysis to characterize the sample consisting of 56 athletes, an average age of 17 years was determined. An initial evaluation showed that approximately 60% of athletes had an injury history, which is consistent with the conclusions of Keller, Noyes and Buncher (1987), which refer to the high frequency of injuries among soccer athletes and Dorta (2015), that injuries among judo practitioners are common. Regarding the relationship between hallux stability and *1st* ray position in this study, in which, as we have seen, hallux is not stable if it shows resistance to the force applied, is not dorsiflexed and makes the windlass mechanism ineffective and stable. Those who did not show this resistance, who showed slight finger dorsiflexion, arch congruence and external tibial rotation before reaching 15°, were considered stable. It has been found that hallux instability is generally more common when the *1st* ray is bent dorsally, especially in soccer players where the relationship was more apparent and the results more symmetrical. Although we have no literature that supports or denies this relationship in either modality, we can conclude that this data is consistent with what Splichal (2015) says about the ratio of dorsiflexion with a higher hallux overload on the *1st* finger, which in D. 'Amico's opinion (2016) is unstable, not in the sense of more stress, but in the sense of greater resistance to the activation of the windlass mechanism. Regarding hallux stability and its relationship to the last structure to leave the ground, the athletes in the present study generally presented the *1st* finger as the last to move forward. More specifically, those who showed poor stability, i.e., those whose *1st* ray position was in DF showed that the *1st* finger was the last to leave the ground. On the other hand, those whose *1st* ray was PF and therefore had greater hallux stability, showed that the *2nd* finger was the one who last left the ground upon propulsion. This confirms the data from Frankel and Nordin (1980), that state that the *2nd* Mtt joint is an important combination with the *2nd* cuneiform, because it restricts the movement of the *2nd* ray, which becomes more stable than the others. From a biomechanical point of view, this effect is critical during the later phases of the gait cycle support phase when the load is transferred to the forefoot, since an increased load can be transferred through the stable *2nd* Mtt (Frankel & Nordin, 1980). Considering the analysis of the Mtts that are most overloaded when the heel is raised, the overload is mainly on the 5*th* Mtt. Especially at position *DF* the overload is predominant at the *5th* Mtt. In the *PF* positions, the *3rd* Mtt is the one that has the highest overload at the height of the heel bone. Regarding the first neutral Mtt, the results are split between the *1st* and *5th* meters. These results are consistent with the statements made by Orendurff and his colleagues (2009) who see injuries in the *5th* Mtt as a result of the cumulative effect of bending moments, resulting from greater weight overload in the lateral area of the foot. Nery, Carpes and Azevedo (2017) agreed that when examining the prevalence of fractures in the *5th* Mtt, they showed that this is actually one of the most common fractures related to the foot, due to repetitive stress or traumatic events can be traced back like sprains, especially among soccer players.

Conclusions

After the examinations all the data, for which there was a statistically significant connection, it is generally concluded that the plantar flexion of the *1st* ray is associated with a higher hallux stability. In a separate analysis of each of the sample groups, i.e., soccer players and judokas, we found a higher prevalence of dorsiflexion position in the soccer player group, where there were also higher cases of instability. The results were consistent among judo practitioners. In the dorsal position, the number of athletes with hallux instability was higher than those who showed stability.

In the relationship between hallux stability and the last structure that leaves the ground during propulsion, it was found that in the presence of stability the last structure that leaves the ground is the *2nd* finger. Regarding the relationship between the position of the *1st* Mtt and the structure that is most heavily overloaded at the heel lift, it is found that the overload is mainly at the *5th* Mtt regardless of the position of the *1st* Mtt, but it is possible to verify that there is a tendency to have a greater load distribution on all other Mtts in the dorsiflexion of the *1st* Mtt, which could indicate that the ineffective support of the *1st* Mtt produces a load distribution that is affected by all other Mtts. This is more consistent among football practitioners and therefore answers each of the original research questions accurately, viz.

Answering each of the research questions

1. Is the position of the *1st* MTT determinant to the hallux stability in relation to the efficient activation of the windlass mechanism? Yes, the results showed with statistical significance that the *1st* dorsiflexed Mtt unveiled higher hallux instability values, while in the plantar flexion position more athletes exhibited hallux stability.

2. How many athletes have a right function of the hallux in relation to the windlass mechanism activation? Of the 56 athletes evaluated, only 20 had a stable hallux, so only these had an effective activation of the windlass mechanism, and in the case of judo practitioners, hallux stability was checked in 12 out of 30 athletes, while among the footballers 8; there were over 26 athletes.

3. Does the position of the *1st* Mtt influence the structure through which the propulsion occurs? Yes, the results showed that in the athletes who presented hallux instability of the dominant foot, they presented the *1st* toe as the last to leave the ground, while the ones that presented stability had the *2nd* toe as the last to leave the soil. This was most significant in judo practitioners.

4. Does the position of the *1st* Mtt influence the metatarsus which overloads when the heel leaves the ground? No, the results were not statistically significant and showed that the overload is mainly on the *5th* Mtt, regardless of the *1st* Mtt position. However, it is possible to recognize a tendency that suggests when *1st* Mtt is dorsiflexed, the load tends to be more equally distributed to all other Mtts

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