DIAGNOSTIC OF THE FOOT IN CHILDREN VIA A TENSOMETRIC PLATFORM

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ABSTRACT

Introduction

The foot disorders in children are a wide-spread problem and the studies in this aspect are very scant.

THE AIM of the research is to assess the symmetry in loading of the foot in children via a tensometric platform.

Methodology

The tensometric platform ISTEP 5000 was applied in 145 children (76 girls and 69 boys) with the average age 8, 66 (from 7 to 10 years) at the School "Jordan Iovkov" – Sofia during the period April – May 2017.

Results

The results were processed through IBMSPSS Statistics v.19 program and MS Excel, using: variation analysis, statistical hypothesis testing, which includes Student's *t*- distribution among the indicators with guarantee probability *P* (*t*). The differences between loading of the left and right foot are statistically significant: in girls $d = -3.974$ with $t_{emp} = 6.65$, *P* (*t*) 100.00; boys $d = -2.710$ with $t_{emp} = 3.98$, *P* (*t*) 99.99. The results demonstrated statistically significant asymmetry in loading of the foot.

Discussion

Methods for the functional diagnostic of the foot are very limited and innovation in this area is essential for the prevention of the disorders.

Conclusions

This study confirmed that the applying of the tensometric platform ISTEP 5000 contribute very important data and give an opportunity to precise the functional diagnostics of the foot in children at primary classes.

Key words: children, foot, tensometric platform

Introduction

The foot disorders in children are a wide-spread problem and the studies in this aspect are very scant. The anatomic architecture of the foot appears related to its primary function of weight bearing and shock absorption arising from ground reaction forces [4]. Tracking and exploration of underweight from the feet is essential for functional diagnosis and prevention of disorders. The use of equipment contributes to the objectivity of the results.

The aim of the research is to assess the symmetry in loading of the foot in children via a tensometric platform.

Methodology

The tensometric platform ISTEP Aetrex 5000 – iStep v 9.0 software was applied in 145 children (76 girls and 69 boys) with the average age 8, 66 (from 7 to 10 years) at the School "Jordan Iovkov" – Sofia during the period April – May 2017. Measurement of the foot load in the three support zones – in the area of: first metatarsal bone (MTB) – first zone; fifth MTB – the second zone and the third zone – the heel/calcaneus.

Results

The results were processed through IBM SPSS Statistics v.19 program and MS Excel, using: variation analysis, statistical hypothesis testing, which includes Student's *t*- distribution among the indicators with guarantee probability *P* (*t*) (Damyanova, Gigova, 2000).

Analysis on the Maximum foot pressure at one point – the results are presented in Tables 1 and 2.

Table 1 Values of the pressure left foot

		Left foot		
		Maximum pressure	Medium pressure	Minimal pressure
Maximum values analysis per area:	I (first MTB)	15	6.8	1
	II (V MTB)	15	5.5	0
	III (calcaneus)	16	15	9

In the analysis of the maximum values in the defined areas, it is noted that: the mean pressure at one point in area I (first MTB) is 6.84 kg / cm², with a maximum pressure of 15 kg / cm² and a minimum of 1 kg / cm².

In area II (fifth MTB) mean values in one point varying about 5.5 kg / cm², the maximum – 15 kg / cm², and the minimum 0 kg / cm².

In area III (calcaneus) there is a significant difference in the values where the compression is highest: 15 kg / cm² is mean value of the maximum pressure at one point where maximum is 16 kg / cm² and a minimum is 9 kg / cm².

Table 2 Values of the right foot pressure

		Right foot		
		Maximum pressure	Medium pressure	Minimal pressure
Maximum values analysis per area:	I (first MTB)	16	6.09	0
	II (V MTB)	14	4.9	1
	III (calcaneus)	16	15.2	7

Analysis of the right foot results, the average pressure in the maximum values at one point in the first area is 6.09 kg / cm², at a maximum of 16 kg / cm² and a minimum of 0 kg / cm².

At area II, the mean value of the maximum right foot pressure is close to 5 kg / cm², with a maximum of 14 kg / cm² and a minimum of 1 kg / cm².

At area III the difference in the mean values of the maximum pressure on the left and right foot is 0.17 kg / cm², with a maximum of 16 kg / cm² and a minimum of 7 kg / cm².

From this analysis we can see asymmetry with a significant difference in the left and right foot zones: I area maximum pressure – difference 1 kg / cm², average pressure 0.74 kg / cm², minimum – 1 kg / cm²; area II maximum pressure of 1 kg / cm², average of 0.56 kg / cm² and minimum 1 kg / cm²; area III more significant difference is observed in the minimum values of maximum pressure at one point – 2 kg / cm².

Analysis of the Minimum pressure at one point of the foot – the results are presented in Tables 3 and 4.

Table 3 Minimal values of the left foot

		Left Foot		
		Maximum pressure	Medium pressure	Minimal pressure
Minimal values analysis per area:	I (first MTB)	5	1.83	1
	II (V MTB)	5	1.68	0
	III (calcaneus)	5	2.41	1

Analysis of the minimum values in the defined areas, it is noted that: the mean maximum load at one point in area I (first MTB) is 1.84 kg / cm², with a maximum load of 5 kg / cm² and a minimum of 1 kg / cm².

In area II (fifth MTB), means values of minimal pressure at one point varying about 1.7 kg / cm², the maximum is 5 kg / cm², and the minimum 0 kg / cm².

In area III, there was no significant difference in the values of 2.41 kg / cm² for the mean value of the minimum pressure at one point, at a maximum of 5 kg / cm² and a minimum of 1 kg / cm².

Table 4 Minimal values of the right foot

		Right Foot		
		Maximum pressure	Medium pressure	Minimal pressure
Minimal values analysis per area:	I (first MTB)	5	1.71	0
	II (V MTB)	4	1.5	1
	III (calcaneus)	5	2.36	1

Analysis of the right foot results, the average pressure in minimum values at one point in the first area is 1.71 kg / cm², at a maximum of 5 kg / cm² and a minimum of 0 kg / cm².

In area II, the average right foot pressure is close to 1.5 kg / cm², with a maximum of 4 kg / cm² and a minimum of 1 kg / cm².

In area III, the average right foot pressure is 2.36 kg / cm², with a maximum of 16 kg / cm² and a minimum of 7 kg / cm².

Significant asymmetry was no observed in the analysis of minimal values between two feet.

The differences in loading of the left and right forefoot and rearfoot between girls and boys are presented in Table 5 and Figures 1 and 2.

Table 5 Data of the forefoot and rearfoot

Index	Boys			Girls			Difference		Significance	
	n ₁	'C ₁	S ₁	n ₂	'C ₂	S ₂	d	Cohen d	t _{emp}	P (t)
Fore left foot	69	13.25	5.88	76	10.93	5.16	2.32	0.41	2.52	98.72
Rear left foot	69	14.55	1.70	76	14.91	0.70	-0.357	0.28	1.68	90.51
Fore right foot	69	11.99	5.57	76	11.13	5.54	0.854	0.15	0.92	64.35
Rear right foot	69	14.70	0.97	76	14.78	1.10	-0.081	0.08	0.46	35.72

Figure 1 Fore and rear left foot loading Figure 2 Fore and rear right foot loading

The difference between girls and boys loading of the left forefoot is statistically significant $d = 2.32$ with $t_{emp} = 2.52$, $P(t) = 98.72$.

Discussion

The three plantar arches of the foot (medial and lateral longitudinal arches, and transverse arch) are designed to act as shock absorbers and distribute body mass on the feet (Iunes Monte-Raso et al, 2008). There are several studies on changes in the arches in adults (Eke-Okoro, 1989), (Ledoux, Hillstrom, 2002). Some of them discuss changes in foot stability and posture when wearing high heel shoes (Gefen et al, 2002), (Iunes Monte-Raso et al, 2008). On the other hand, there are interesting results about distribution of the plantar vertical force in pes planus feet. (Ledoux, Hillstrom, 2002).

Obviously, the methods for the functional diagnostic of the foot are very limited and innovation in this area is essential for the prevention of the disorders, especially in children. In this aspect our study showed for the first time results from the tensometric platform in children. From the analysis of the maximum values in the defined three zones, it is noted the asymmetry with a significant difference between left and right foot. On the other hand there

is also statistically significant difference between girls and boys in loading of the left forefoot. The results indicate the presence of asymmetry in the loading of the feet in children, requiring more extensive examination and application of physiotherapy for correction of deviations.

Conclusion

This study confirmed that the applying of the tensometric platform ISTEP 5000 contribute very important data and give an opportunity to precise the functional diagnostics of the foot in children at primary classes.

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