European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1174563 Volume 4 | Issue 2 | 2018

INVESTİGATİON OF THE EFFECTS OF FOOTBALL TO SOLE

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Abstract:
The aim of this research is to investigate the effect of playing soccer for a long time in professional soccer players to sole contact area. 15 football players (22,65 ± 2,6 years, 174,2 ± 5,6 cm height, 71,2 ± 4,8 kg body weight, 23,21 ± 1,4 kg / m² BMI) who play in the Sports Betting Super League teams, the top league of the Turkish Football Federation, who has no problem on his foot and 15 male volunteers (22,6 ± 1,6 years, 177,3 ± 5,4 cm height, 72,1 ± 3,3 kg body weight, 23,01 ± 1,9 kg / m² BMI) as control group was included in the survey. Professional footballers' age of starting football was determined as 9 years old. It has been determined that there is no anatomic disorder or discomfort in the foot, waist and knee areas which will affect the results of the foot contact area analysis in the study groups. EMED-SF (Germany) plantar pressure analysis system was used in the study. Statistically significant differences between the study groups were examined using the non-parametric Mann-Whitney U test. According to the results of the research, there was no statistically difference between the experimental and control groups in terms of physical characteristics. However, Significant results were found at (0.01-0.05) level in the beginning and grand total of heel medial, heel lateral, 1.2.3.4.5 metatars in the maximal force comparisons applied to the right and left foot contact area and the floor. Furthermore, it was determined that the values of the control group were higher than the values of the experimental group.

Keywords: football, foot, sole, training

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1. Introduction

The age of starting to sport is approximately 6 in the World (Coté, Horton, MacDonald, & Wilkes, 2009), while the age of starting to football is between 5-12 for elite and non-elite sportsmen. (P. R. Ford, Ward, Hodges, & Williams, 2009). With the number of 265 million members, players that play football systematically, football is one of the most popular sports in the world. While 4,1% of the World population are playing football, approximately, only 0,03% of them, nearly 110000 sportsmen, are professional male football player. (Kunz, 2007). In addition to this taking to up level and to protect that level of the players', that reach to Professional level, tactical adaptation, technical truths, physical demands and speed conditions are important for their further Professional career. (Huijgen, 2013). For this, sportsmen have to part much more time to trainings and matches. It is estimated that elite young football players are making practice approximately for 6500 hours until their 18 ages. (Ward, Hodges, Starkes, & Williams, 2007). It is defined that, for the last 10 year, top level Professional football players are making particular practice for football, for 6328 hours, while national Professional football players are making particular practice for football for 5220 hours. (Ward, Hodges, Starkes, & Williams, 2007). It is also examined on the analyse that the average age of the Professional football players i in the whole Europe is 25.8. (Besson, Poli, Ravenel, Poli, & Ravenel, 2010) Only 6% of them are under 20 years old, 11% of them are above 32 years old and 83% of them are between 20-31 years old. (P. R. Ford & Williams, 2011). The weight on footwell is a major factor for a sportsman's performance, considering how much time this Professional sportsman spares for training, and load intensity in trainings.

The foot is the most exposed part of the body to force, since it carries all the weight. It has been seen that the foot pressure measurements started from the 1980s when the literature was examined, there also has been studies concerning foot biomechanics, diabetic foot, orthopedic surgery and orthosis shoe modifications. External loads have effect on foot pressure. (Özyürek, Demirbüken, Tosun, Okyay, & Angın, 2013) A healthy load distribution depends on the ability of handling the stabilization and mobilization task together. (Sammarco & Hockenbury, 2001). It is known that the ankle plays a very important role in controlling postural stability and walking. In addition to the task of transporting body weight, the foot, which is the primary effect in ensuring balance, has undergone significant mechanical changes during walking. (Cote, Brunet, II, & Shultz, 2005)

With the developments of the current technology, it has been common that the research on muscle-skeleton system and the diagnosis in clinic practice, planning of the treatment and examine to treatments results and the using of the walking analyses to examine. (Simon, 2004). As a complementary of the walking analysis planter pressure measurement (pedabarography), during walking, ground reaction force can be measured pretty sensitively as pointed. It makes that possible to compare of the pressure and evaluate of the feet that touches the ground as dynamically and in objective criterions With the frequency for the clinic, it is used to evaluate that the feet

mechanic is beeing corrupt and as a result of this the pathologies' coming up on the footwell. (Hurkmans, Bussmann, Benda, Verhaar, & Stam, 2003).

Besides clinical use of the walking analysis, however, many intraarticular biomechanical studies have been carried out by making kinetic and kinematic measurements and adding pressure measurements to them In particular, studies on walking mechanics of the lower extremity, knee, hip, ankle biomechanics and mechanics of reconstructions applied to these joints are increasingly being studied. Especially today, pedobarography is widely used for researching normal foot mechanics. (Kanatlı, Yetkin, Songür, Öztürk, & Bölükbaşı, 2006)

Pedabarographyic measurement is an objective and functional technic which measures the plantar pressure and also can be used in foot analysing. In the static and pedabarographic estimation of foot, maximal pressure measurement of six parts (back feet, middle feet, inside-middle-side of the front feet and fingers), maximal pressure values on the hind paw and back feet (total pressure on the foot, percentages of pressure values on the hind paw and back foot are obtained by total contact area and percentage distribution values of total contact area for hind paw and back foot. The length of the part which is in a contact with ground during the movement, pressure change in the position of varus and valgus, the factor like fingers functions are extracted in the dynamic measurements.(Tuna, 2005).

It is estimated that the contact to ground of the footwell is always in different loads and different types so that will make some changes on the footwell. Especially the performance of the player depends on even the type of the shoe. So that, it makes more important to make firm of the effects of the football on the footwell, for comfort and healthy ways. The aim of this study is also to explore the effects of the football on footwell.

2. Material and Method

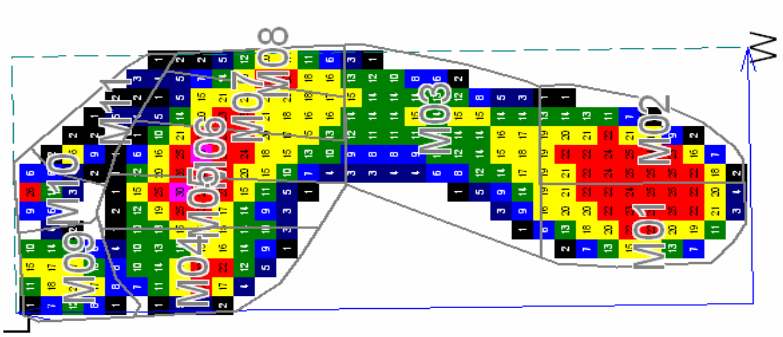
This study; the consent that T.C. Gazi University-Faculty of Medicine Local Ethics Commission's gave with the date of 25th February 2008 and with decision of 074 without drug for clinic studies has been done. All of attendants were informed with oral and written about purpose of study and evaluation methods to be applied. Approval forms were taken from all of attendants. Fifteen players (22,65 ± 2,6 yaş, 174,2 ± 5,6 cm boy, 71,2±4,8 kg body weight, 23,21±1,4 kg/m² BMI) who play in Super League teams which is the highest league of Turkish Football Federation and fifteen volunteers(22,6 ± 1,6 age, 177,3 ± 5,4 cm height, 72,1±3,3 kg body weight, 23,01±1,9 kg/m² BMI) for control group counted in to the study. It has been specified that soccer players approximately start the football at the age of nine.

The participants who had lower extremity injury during last 6 months, supine hypotensive syndrome, gestational diabetes mellitus, rheumatoid arthritis, hypertension, foot impairment, foot or ankle operation and neurologic dysfunction are not included to research. The participants who had dizziness, nauseation on the day of research are not included to research and participants are tested out pain. None of the

participants has the symptom above. Right leg is dominant extremity for all participants. Right leg is dominant extremity for all participants. To specify the dominant extremity all participants are wanted to hit the ball and the extremity they choose to hit to ball specified as their dominant extremity.

The pedobarographic measurements of the foot volunteers were performed using the plantar pressure analysis system EMED-SF (Novel GmbH, Munich, Germany) in the walking laboratory of GÜTF Orthopedics and Traumatology AD. This system is mounted on a 7x1 m wooden platform and includes a platform of 44.4x22.5 cm which is covered with thin skin and has a sampling rate of 71 Hz and two receivers in cm². Participants walked freely before pressing the foot pedobarogram in the 7-meter walking band, and the region where the measurement was made is not specified. Measurements are measured with bare feet collecting the measurements of dynamic and static for each foot.

Separating to 11 zones, it is evaluated in these ways that each zones' contact area (cm2) maximal power (N/cm2). Footwell, called mask, (image 1) taking each foot apart and evaluated two data' average.



Picture 1: The view of foot mask in pedobarography (M01: Medial Heel, M02: Lateral Heel, M03: Medial Foot, M04: 1st Metatarsal Head, M05: 2nd Metatarsal Head, M06: 3rd Metatarsal Head, M07: 4th Metatarsal Head, M08: 5th Metatarsal Head, M09: Thumb, M10: 2nd toe, M11: 3rd, 4th, 5th Toes)

2.1 Statistical Evaluation

The analysis of the data has been done in SPSS 18 package. Averaging two measurements of subject and control groups; if there is a statistically significant difference among the averages or not, the Mann Whitney U test. In the measurements 95% confidence interval and $P < 0.01 – 0.05$ relevance levels have been accepted.

2.2 Findings

Table 1: Physical properties of the subjects of the study (1) and control group (2)

Variables	Group	Mean	S.D	X1 - X2	Min.	Maks.	t.	P	Mann-Whitney U	P
Age (year)	1	22,650	2,641	0,050	19,00	27,00	,072	0,29	199,00	-,978
	2	22,600	1,602		20,00	26,00				
Height (cm)	1	174,20	5,671	-3,100	169,00	187,00	-1,763	,725	110,00	,0150
	2	177,30	5,449		164,00	183,00				

Body Weight (kg)	1	71,200	4,829	-,900	68,00	75,00	-,682	,158	138,000	,0920
	2	72,100	3,385		64,00	76,00				
BMI (kg/m²)	1	23,211	1,415	,201	21,00	26,20	,375	,264	186,000	,705
	2	23,010	1,935		19,11	26,39				

There are no meaningful differences between on the ages, heights, body weights and body indexes' averages (0,01>P) that belongs to football players and control groups. (Table 1). Being not meaningful of the differences between the groups shows that dispersion is homogeneous.

Table 2: Comparison (cm²) of the male football players' (1) and control groups' left and right feet contact areas (cm²)

		Right Foot (N/cm2)				Left Foot (N/cm2)			
Variables	**Group**	**Mean**	**S.D**	**Mann-Whitney U**	**P**	**Mean**	**S.D**	**Mann-Whitney U**	**P**
Foot - Total	**1**	150,50	13,26	103,000	**,009	149,72	11,85	102,500	*,023
	2	164,35	16,85			160,35	16,73		
MO1: The medial part of heel	**1**	19,60	1,818	122,500	*,035	19,80	2,044	112,000	*,046
	2	21,10	2,204			21,10	1,895		
MO 2: The lateral part of heel	**1**	19,55	2,038	125,500	*,042	19,66	1,571	101,000	*,020
	2	20,92	2,369			21,17	2,312		
MO 3: Midfoot	**1**	30,12	5,263	157,000	,244	29,91	5,366	123,000	,095
	2	32,25	8,346			32,17	8,352		
MO 4: The 1st metatarsal head of foot	**1**	14,05	1,677	107,000	**,012	14,11	1,967	105,000	*,028
	2	15,77	2,478			15,65	1,828		
MO 5: The 2nd metatarsal head of foot	**1**	11,17	1,695	94,000	**,004	10,77	1,457	102,000	*,022
	2	12,95	1,700			12,17	1,914		
MO 6: The 3rd metatarsal head of foot	**1**	12,30	1,584	74,000	**,001	11,97	1,398	71,000	**,001
	2	14,12	1,467			13,67	1,515		
MO 7: The 4th metatarsal head of foot	**1**	10,35	1,193	75,500	**,001	10,20	1,341	90,500	**,008
	2	11,70	,879			11,35	,727		
MO 8: The 5th metatarsal head of foot	**1**	6,95	,998	69,500	**,000	7,02	,962	99,000	*,017
	2	8,12	,723			7,87	,958		
MO 9: Pollex	**1**	12,62	1,512	154,000	,221	12,69	1,912	130,500	,145
	2	13,57	2,838			13,45	2,181		
MO 10: The 2nd finger of foot	**1**	4,95	1,422	197,000	,935	4,63	1,348	164,500	,647
	2	4,75	1,261			4,32	,949		
MO 11: The 3.4.5. fingers of foot	**1**	8,90	2,648	180,000	,587	8,80	1,918	135,500	,192
	2	9,05	4,189			7,37	3,516		

** P < 0.01 * P < 0.05

The results which show a meaningful fixing(0.01-0.05 > P) that Left and right feet's totals that belong to football players and the average differences between the

comparisons of the contact area, left and right heels' medial and lateral, left and right feet 1.2.3.4. and 5. metatarsal's head. (Table2)

Table 3: Comparison of Male football players (1) and control group's left and right feet maximal power

Variables	Group	Right Foot (N/cm2)				Left Foot (N/cm2)			
		Mean	S.D	Mann-Whitney U	P	Mean	S.D	Mann-Whitney U	P
Foot - Total	**1**	937,91	103,546	59,000	**,000	912,94	102,45	34,000	**,000
	2	1150,83	179,60			1170,05	176,28		
MO1: The medial part of heel	**1**	318,97	47,77	66,500	**,000	318,72	65,82	60,000	**,000
	2	428,90	97,55			431,86	120,27		
MO 2: The lateral part of heel	**1**	272,03	40,41	93,000	** ,004	280,44	47,42	109,500	*,039
	2	336,77	77,50			328,80	71,72		
MO 3: Midfoot	**1**	164,82	74,84	163,000	,317	156,97	60,17	131,500	,156
	2	180,67	68,59			185,48	75,06		
MO 4: The 1st metatarsal head of foot	**1**	145,35	48,43	90,500	**,003	144,55	67,38	105,000	*,028
	2	213,23	84,63			194,73	69,48		
MO 5: The 2nd metatarsal head of foot	**1**	198,36	40,37	65,500	**,000	191,26	38,68	79,000	**,003
	2	259,96	54,69			252,66	64,21		
MO 6: The 3rd metatarsal head of foot	**1**	212,47	48,02	120,500	*,032	214,44	52,09	88,000	**,007
	2	251,36	57,72			270,46	64,14		
MO 7: The 4th metatarsal head of foot	**1**	139,07	42,46	154,000	,213	136,16	48,18	104,000	* ,026
	2	157,65	40,41			166,91	47,33		
MO 8: The 5th metatarsal head of foot	**1**	78,16	44,52	156,500	,239	74,36	37,00	106,000	*,031
	2	84,90	27,96			105,07	48,30		
MO 9: Pollex	**1**	155,97	61,19	166,000	,358	154,90	53,83	136,500	,203
	2	185,81	91,35			197,21	85,40		
MO 10: The 2nd finger of foot	**1**	37,88	16,41	196,500	,925	32,26	15,67	160,500	,568
	2	39,01	21,93			29,50	13,05		
MO 11: The 3.4.5. fingers of foot	**1**	43,77	28,54	189,000	,766	33,29	17,86	144,000	,293
	2	49,40	36,48			28,20	22,55		

** P < 0.01 * P < 0.05

Totals of the left and right feet that belongs to football players and control groups. And the differences between the averages of the comparisons of the 11 contact area maximal power, totals of the left and right feet, medials and laterals of the left and right heels, right feet 1,2,3 left feet 4. and 5. The results belong to the metatars heads. 0.01-0.05 > P) are meaningful.

3. Discussion

The human foot has a complex structure containing 26 bones and more than 30 joints There are 3 arches of foot and they show more structural change than any other part of the body (Standring, 2008).Contact area and pressure distribution of foot are affected by many factors such as anatomical structure and VKI (Yılmaz, Erdeo, Tat & Alp 2017). It is not seen as important statistically that the difference between age, height, weight and body mass index of the ones participated in research. This situation indicates that there is no physical property affecting sole of foot of sportsmen except football.

It's commonly known that increased force on foot may cause changes on stance, joint movement gaps and plantar walk patterns. (Henning, Staats, & Rosenbaum, 1994). And this research indicates the differences on walking characteristics between football players and the other people. It's been thought that football changes sportsmen's walk paterns because it's a branch which is chosen in pre-adulthood. Tuna's and his friend's(2004) research on 50 healthy adolescents shows that static measurements indicate high rates on heel, while dynamic measurements indicate high rates on toes. (Tuna, Yildiz, Celtik, & Kokino, 2006) Considering these results, we can assume that during different activities, different parts of our foot gain priority. In a research which is done on 25 female football players aged averagely 18,80 +- 2,2, the effect of football to foot's contact points with ground is researched. It's found that it caused significant changes on left foot's 1st and 2nd metatars tops, and right foot's 2nd and 3rd metatars tops. (Uzun, Kaya, Aydos; Kanatli, & Esen, 2012) But for the Professional football players in our research, total of right and left foot, heel medial, heel lateral, 1,2,3,4th metatars tops are all effecting the both feet. We can see that football players' findings on "contact with ground" points are less than control group's findings. (Table 2) This must be understood as football players have this difference because of their special trainings on specific moves and body parts. Especially when female football players' feet are observed, we can see that female players use the back of their heel more actively than male players. And the most important reason for that is male players do their trainings on turf while female players do it on synthetic grass. And again, in another research, significant results were found between 17 male football players who were challenged with slalom on turf and synthetic grass, observing the changes of effect on their feet. It's found that playground affects the pressure dispersion on feet and the highest rate of relative load happens on synthetic grass, on medial foot's front parts. And most of the injuries happen at turfs. Stress fractures, Jones fractures which are results of repeating eversion movements usually happen in turfs. (K. R. Ford et al., 2006)

Researches focused on the relationship between shape of movements, kicking the ball, preferred shoes and injuries and disorders, showing there are considerable intersections.(2004) Eric and Eils did some research and found that specific trainings do change pressure dispersion on footwell but no relationship was found between playground and pressure dispersion on foot. (Eils et al., 2004).

In comparisons of players' contact points and their maximal forces, differences were seen on total of feet on both two footwells, heel medial, heel lateral, 1,2,3rd

metatars tops' areas.(Table3). Football player Robin M. Queen (2007) and his friends did some research with speed tests observing pressure dispersion on footwell while barrier inner side pass, outer side pass, and accelerating trainings were performed. Research's results were, while barrier inner side pass, inner side of footwell is under more pressure, outer side pass, outer side of footwell is under more pressure, and while accelerating, middle part of footwell is under more pressure. (Queen, Haynes, Hardaker, & Garrett, 2007) In pedobarographic analysises on 23 rugby players and 17 healthy people, M. Rippani and his friends explained that pressure on rugby players's footwells were considerably higher.(Ripani, Ciccarelli, Morini, Riccardi, & Michielon, 2006) In the research which focused on the effect of female football players' contact to ground points to their maximal forces, right foot 2, 3rd metatars tops and left foot total indicates a great deal of change on 3,4,5th toes, 2,3,4th metatars tops. (Uzun et al., 2012),

These researches demonstrate that changes in sole can be caused by several reasons. It is seen that in the force professional male footballers applied to in 11 areas both their contact area, and also in their maximal force values, while only the 2nd finger had values above the control group's values, in other all parameters they had lower values. This quirky situation can be thought as a reason of force application into the ground to use this area more properly or for greater speed development.

4. Result

As a result, athletes from childhood to professional footballer currently playing for time until the long-term training and matches the soles on their feet touch the ground moves, compelling, and the soles of the feet by the force is applied to the floor, consequently, it can be said that decreases the amount of time their feet touch the ground. Football players as a result of their training, especially at the beginning of the soles of the feet touch the ground and applied to the available force is caused by changes in terms of the different regions in the base of the feet with more active use. It was observed that this result. However, one of the sports that require explosive force branches is considered to be very repetitive and short distance traveled in football often composed in the soles to force running gathered since the metatarsal heads where the foot area reduces the duration of staying.

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