Foot Baropodometry Regarding on Body Weight

Budimir Mijović[1], Suzana Lencur[2]
[1] TTF, ZAGREB, CROATIA
[2] School of Fashion and Design, ZAGREB, CROATIA

E-mail: budimir.mijovic@ttf.hr, suzana.lencur@skole.hr

Proffesional paper
UDK: 685.34.017:[617.586:531.78]
DOI: 10.34187/ko.68.3.7

Abstract:

While standing, we used baropodomerty to measure pressure on foot area. Human foot cause force reaction while making contact with the base. We also used plantogram and a special foam to measure foot size pressure and force as well as pressure and force that is appearing between the foot and the surface. In this work, we compared pressure between normal and deformed men and female foot against their body weight. With this analysis, we found that deformed foot makes bigger pressure on heel spur. In this research, we had 10 male and 10 female candidates. We were measuring weight, height and foot area as well as pressure and force that foot produce while walking. At the end, we concluded that the candidates with bigger body weight, made more pressure and force on their feet. We are hoping that this research will contribute in shoe factory to decrease weight on feet.

Keywords:

Baropodometry,biomechanics,foot physiology

1. Uvod

Feet has 26 bones,33 links and about 100 muscles,ligaments (connects bones with other bones) and tendons (connects muscles with bones) along with blood veins and nerve supply.Foot root, asso tarsi, is made out of 7 bones that takes load of lower leg. [1] Big part in walking has feet dome and foothold that transfer mechanic force to the surface. While we stand,our body weight is transfered through the middle of our lower leg and down to the foot ankle. Forces that occured, go into two dirrections. One goes into the tarsal bone, and the other one goes to the tip of the toes. [5]

The foot statics is different if the body weight is not balanced, so that is the reason of many deformed feet (Figure 1 and Figure 2.) [3].

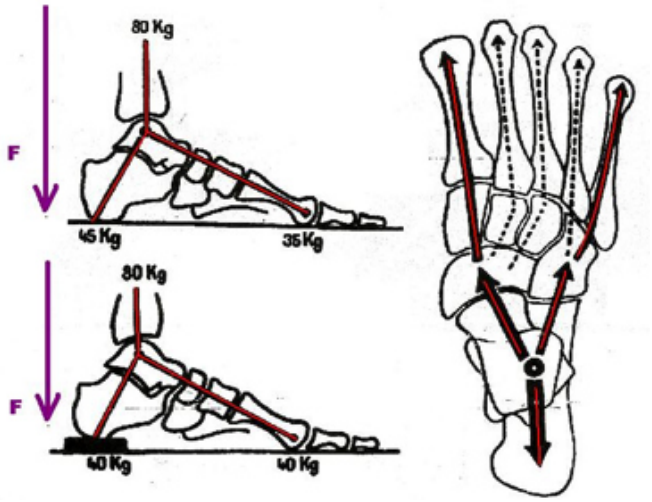
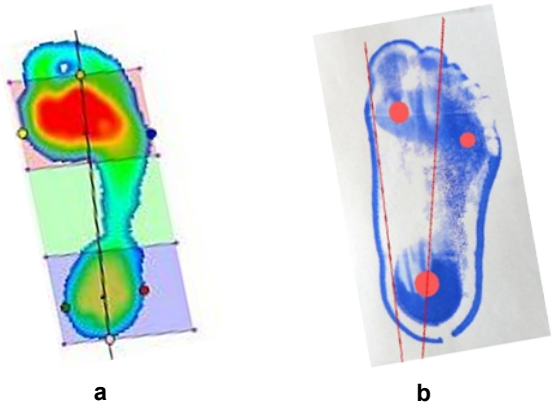


Figure 1: Schedule force of body weight

The soles of the foot are maintained by the very arrangement of the bones of the feet, by the use of joint connections and by the strength of the muscles of the lower leg and the foot. The vault is comparable to vehicle dampers because it alleviates the weight forces of our body acting on the foot in statics and dynamics. The mechanical function of the feet is of particular importance to the upper and lower toes, which together form a complex unit and act as an anatomical, functional and clinical unit, Figure 2. Static function of the feet depends on the bones of the foot, the ligamentous apparatus, and on the function of the muscles of the lower leg and the foot [2 -4].



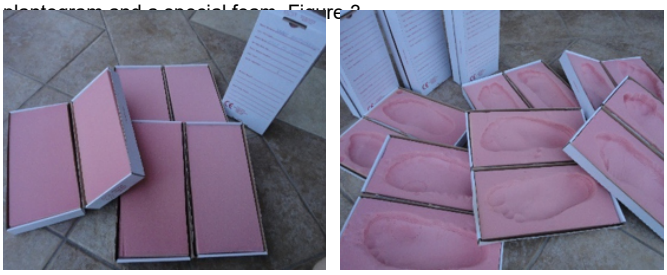
a b

Figure 2: Showing footholds with (a) scanner and (b) plantograf

Upper and lower foot joint, has big meaning in mechanical function of the feet, and like that, they make complex unit that works like anatomic, functional and clinical unit. Statical foot function depends on feet bones, ligaments and lower leg and feet muscles. [2], [4]

2. Methods and materials

The candidates were 10 male and 10 females with different kind of feet (age 22 – 75, height 160cm – 191cm,weight 60kg – 130kg). For the research, we used tape measure that is common in shoe manufacture, plantogram and a special foam. Figure 3



a b

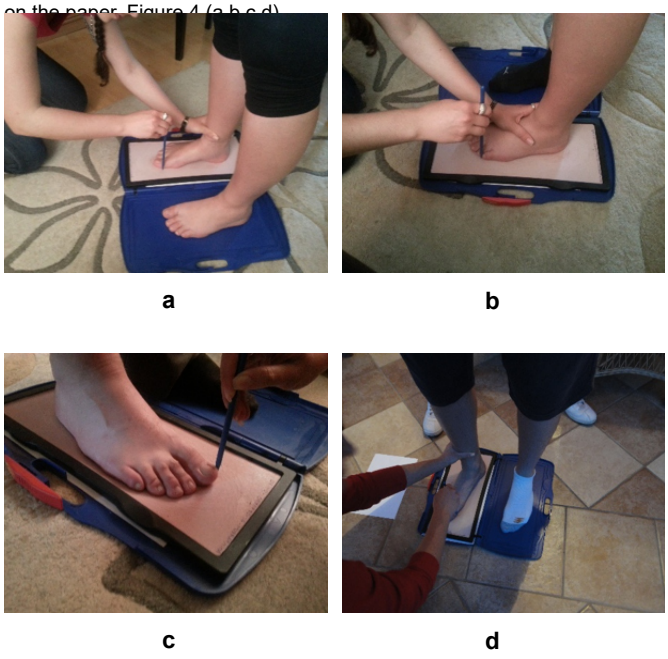
Figure 3: Example of using foam for taking foot prints

We took the foot print from the candidates by steping into the foam, and after that on the plantogram. The weight and height was recorded also. Measuring lenght and width, we got foot area from each person. Foot pressure against the surface was calculated after that. Complexity of calculating foot area is based on anthropometry measures and there are

lots of measures in shoe manufactory that are mutually related, but every has their own flaws and advantages. International standard for size and labelling ISO/TC 137 was brought by international chamber for shoe quality ISO 9407:1991. Croatian anthropometry system harmonized body weight measures with this standard. With making the shoe size system, they want to achieve that international standard will be the only one in measuring the foot, which is the base of the shoe size. That measuring system is based on 2 measures, lenght and width of the foot. Girth of the foot and other measurements are used in different phases of the foot researches. Foot lenght is horizontal distance between the most prominent toe and the back of the heel, measured in standing position so that the body weight would be evenly distributed on the horizontal surface [7], [8].

3. Eksperimental part

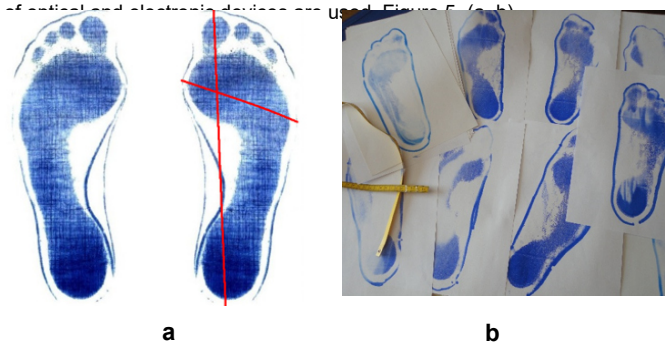
To use a plantograf device, you have to smear an ink all over the rubbery obverse of the device. Under the obverse is a paper for shoe print, and on the top is the foot. The rule is to stand upright, with body weight evenly distributed on both feet, and by stepping on the area, we get the print on the paper. Figure 4 (a,b,c,d)



a b c d

Figure 4. Measuring feer with plantograf (a, b, c, d)

After that we use plastic pen to mark the edges of the foot. By transfering dynamically body weight, brace from one leg to another, we get the balance. People with deformed feet are big scientific, economical and social problem in community and to measure force on the foot, different kind of optical and electronic devices are used. Figure 5. (a, b)



a b

Figure 5. Prikaz dužine i širine stopala i otisci stopala

In this research, we used plantogram and foam which is great, because you can get negative foot prints. Getting the foot measures, we got realistic foot length from the prominent toe till the back of the heel and the width at the toe bend. With normal foot in upright position, the body weight stretches from toes, over the metatarsal bones and middle part of the foot, back to the heel. At the deformed foot, all the weight is based on the metatarsal bones and middle part of the foot, which brings deformations and not be able to walk. We examined the foothold and decide that people with bigger weight produce higher foot pressure, bigger force on the surface no matter male or female.

4. Results

Figure 7 shows the measurements data of height, weight, foot area, pressure and force for means

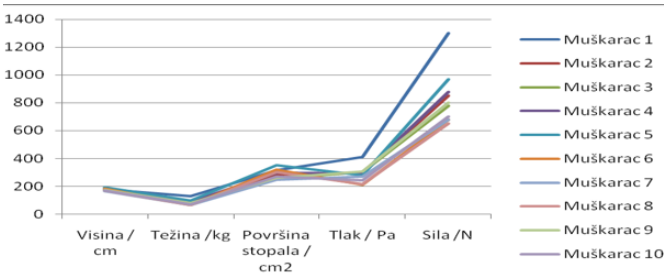


Figure 6: Graphic display measures in mans

Figure 8. shows the measurements data of height, weight, foot area, pressure and force for womans.

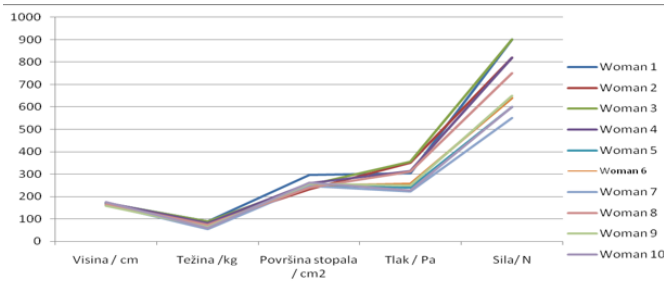


Figure 7: Graphic display measures in womans

Figure 8 - 9: Imprint in PUR foam - deformed feet that create higher pressure than healthy feet

5. Conclusion

We decided, that people with bigger body weight, produce higher foot pressure, making bigger force on the surface no matter male or female. Appropriate shoes have big meaning in human life, and for that, shoes has to be remodeled to avoid places with high contact pressures, places inside the foot with concentrated strain [6]. Places like that are with blisters, swells, wounds, uneven geometric foot form because biomechanics on goings while walking are very complex. With mechanical on goings such as gravity force, inertia and pressure, we are able to walk and keep our balance [9].

6. References

[1] Keros P., Matković B.: Anatomija i fiziologija, Lijevak, 2006.
[2] Krmpotić-Nemanić J., Marušić A.: Anatomija čovjeka, Zagreb: Medicinska naklada 2007.
[3] Ruszkowski I, Normalan i poremečen hod čovjeka, Jumena, 1981.
[4] Mandić V., Građa i funkcija stopala, Zagreb, 1971.
[5] Cvjetičanin M., Priručnik o stopalu, Zagreb 1991.
[6] Mika A, Oleksy L, Mika P, Marchewka A, Clark B. The influence of heel height on lower extremity kinematics and leg muscle activity during gait in young and middle-aged woman. Gait & Posture 35 (2012), 4: 677-680
[7] Sato M, Ikeuchi H, Yamashita T. A. correctiong method for outputs of large force plate to study human walking. Transactions of the SICE: 1993; 29 (8):976-978