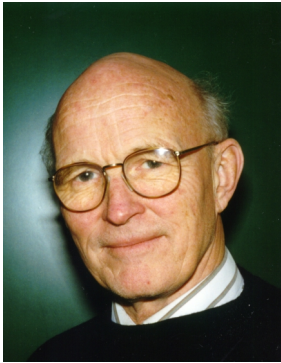


Sensory Massage of the Sole of the Foot by using MEDICOVI's water filled shoe insert



F. Bojsen-Møller
Prof.
dr. med.
Functional
Anatomy and
Biomechanics,
University of
Copenhagen



M. Voigt
Professor Cand.
Scient. PHD
Centre for
Sensory-Motor
Interaction,
Aalborg
University

The foot has a number of important functions relating to standing, walking and running positions. The foot does function as a shock absorber, it does ensure good friction with the base and it does register pressure distribution on the base partly for the sake of balance and partly to ensure that the central nervous system receives vital information about the character and gradient of the base.

Man's upright position entails furthermore that a large hydrostatic pressure rests on the blood vessels in feet and lower legs. With sedentary work this pressure can complicate the return flow of blood through the veins. This can result in swollen legs and feet.

The sole of the foot has a certain capacity to perform the necessary shock absorption in natural, soft surroundings. However, modern man stands and walks more than 95% of the time on hard surfaces: Floors, pavements and tiles. This results in increased load and carries in the long run the risk of an accumulation of jarring and jolting to knees, hips and back. Therefore, in some work situations, in town traffic and in cases where the locomotor system is under load, requirements for added shock absorption may well exist.

The heel pad is the most important shock absorber in the foot. It is placed under the heel bone as a layer of approx. 18 mm. Shock absorption takes place when the heel initially touches the ground and the heel bone settles down slightly in the soft tissue

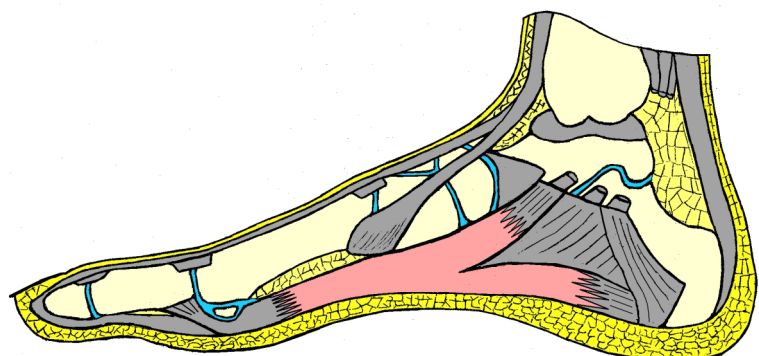
at which stage collision time and collision areas increase. Large forces influence the heel bone during running and walking, up to 4 or 5 times body weight with the increased collision time and the increase of the supporting area assisting in protection of the foot.

The thickness of the heel pad is critical. A reduction of a few millimeter can cause pain such as the so-called heel spur while an increase can cause reduced stability on walking. For the same reason it is a tricky business to improve shock absorption with shoe inserts or through the shape of the heel of the shoe, without reducing awareness of the base or reduced stability.

The firm of MEDICOVI has developed a water filled shoe insert for use with walking and standing work and for relief of the foot as well as for the locomotor system. The sole consists of two especially developed laminates welded together and filled with a specified amount of water which flows back and forth between

heel and forefoot. The movement of the water is partly governed by some longitudinal channels with built-in flow barriers while at the same time the fast movement of the water in the sole is determined by a special production process. It works as the water initially provides the heel pad with one or two extra millimeters of shock absorption, then the water quickly flows away giving the heel unobstructed and stable contact with the base.

The soles have been tested in a number of operations with positive results as the majority of users experienced greater foot comfort thus indicating that their working situation became more pleasant.



The study

At the request of MEDICOVI we have carried out studies on the effects of the influence of the soles on pressure distribution under the feet in the space between the sole and the foot.

Eight people took part in the studies (1 female and 7 males) in the 29-45 age group. All used their own shoes, no one had used the shoe inserts previously. Pressure distribution was examined with the so-called PEDAR-system consisting of a thin and flexible inner sole provided with a total of 99 points of measure. Information from these points were sampled with 30 Hz on the computer, i.e. 2970 measures were gauged per second per sole.

Data from a standing position were collected continuously during one minute and data from walking during ten consecutive steps.

The results showed that when using the sole, the weighted area under the heel remained unaltered or increased, that

maximal pressure likewise remained unaltered or increased on walking and that the pressure especially on the outside of the forefoot appeared as an invariable blast wave. The increased pressure must be interpreted as the result of protection of the foot in such a way that the organism 'saves' on shock absorption further up in the system i.e. knees, hips and back, and allows the foot to cope better with the problem.

Increased pressure under the outer edge of the foot does provide stability against sprained ankle joints and is able to save on controlling muscle activity in the lower leg. All persons tested except one found the soles to be comfortable and stimulating after taking a short period to get used to them. The sole would appear to make the user more aware of what the sole of the foot registers and can therefore stimulate further movement thus avoiding stagnation.

Increased pressure under the outer edge of the foot does provide stability against sprained ankle joints and is able to save on controlling muscle activity in the lower leg. All persons tested except one found the soles to be comfortable and stimulating after taking a short period to get used to them. The sole would appear to make the user more aware of what the sole of the foot registers and can therefore stimulate further movement thus avoiding stagnation.

The increased dynamic pressure to the sole of the foot caused by the water's constant movement in the sole may further assist in emptying this area's predominantly transverse veins, thus contributing to increased local venous pumping activity. It would therefore appear that the effect of the water filled sole can be summarized as being sensory massage of the sole of the foot or water wave therapy.

Sensory Massage or Water Wave Therapy

We define sensory massage or water wave therapy as a type of foot massage consisting of the following three components:

- Continuously variable pressure relief of the area under the sole of the foot
- Constant stimulation of muscular activity and movement of the sole of the foot
- Increased awareness relating to posture and balance

It is the continuous and dynamic interaction between these three elements that cause sensory massage to alter relationships in the locomotor system. Sensory massage stimulates the whole body into spontaneous avoidance of static pressures and thus constant pressure load concentrations which in the short term typically cause discomfort and/or pain and in the long term may cause harmful changes to the locomotor system. ***Sensory massage increases circulation in feet and legs and also cause a constant and positive variation in the distribution of strain on feet, knees, hips and back and with this a reduced risk of chronic problems with the locomotor system.***

The crucial factor in achieving the stimulating effects of sensory massage is the fast movement of water in the sole. The water in the sole must react to all body movements ***which influence pressure distribution under the feet.*** The movement of the water must influence the sole of the foot as one or more pressure points or pressure surfaces which move away from the area where the foot at any given time is the comfortable feeling under the sole of the foot, he or she will keep moving even during sedentary work. It is not only the movement of the

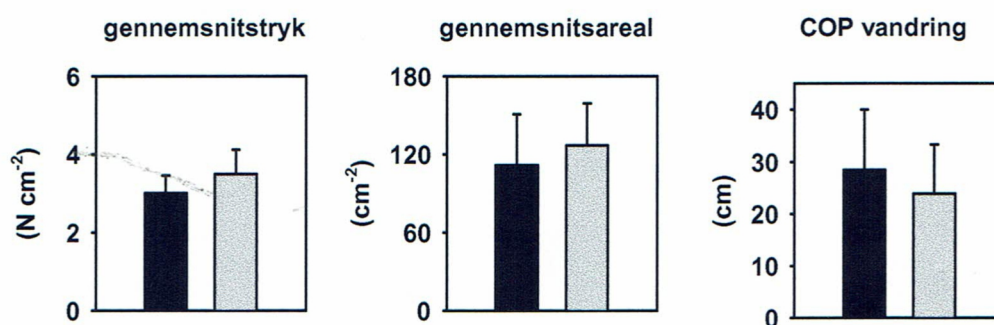
feet that influence the distribution of pressure on the soles of the feet thus activating the water's movement in the sole but any movement of any part of the body has the same effect.

In this way the MEDICOVI-insole does not only maintain foot movements but also movement of all parts of the body.

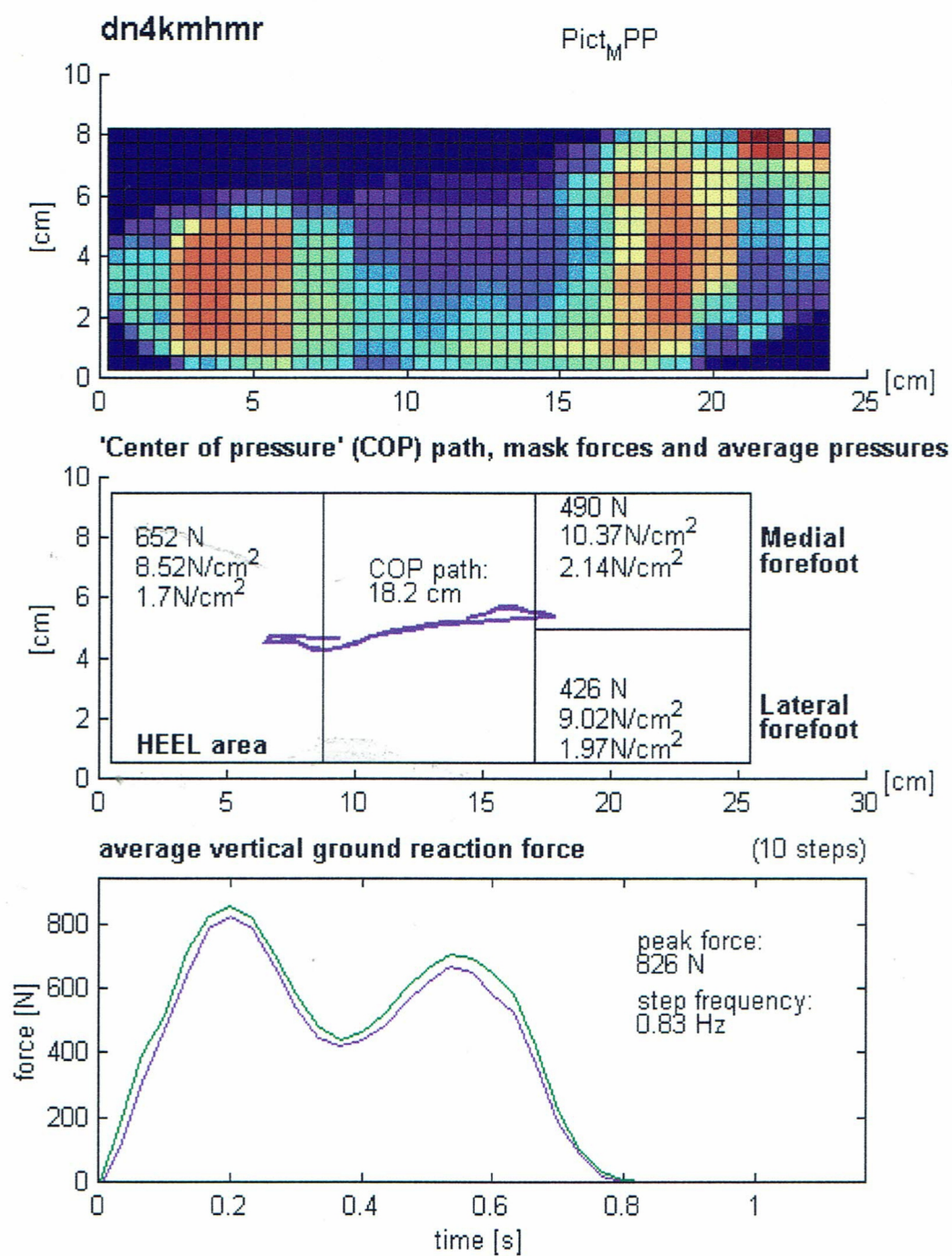
8 pers.



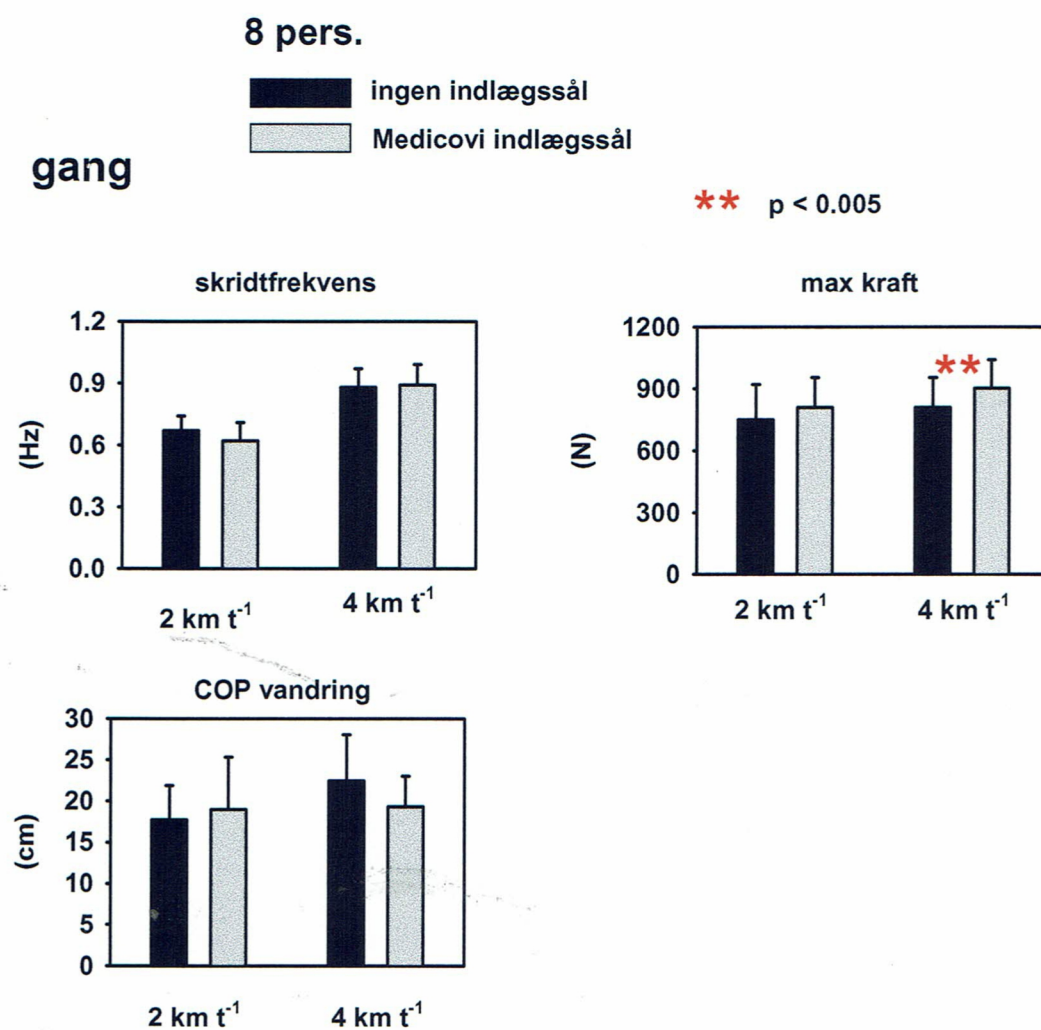
stående stilling



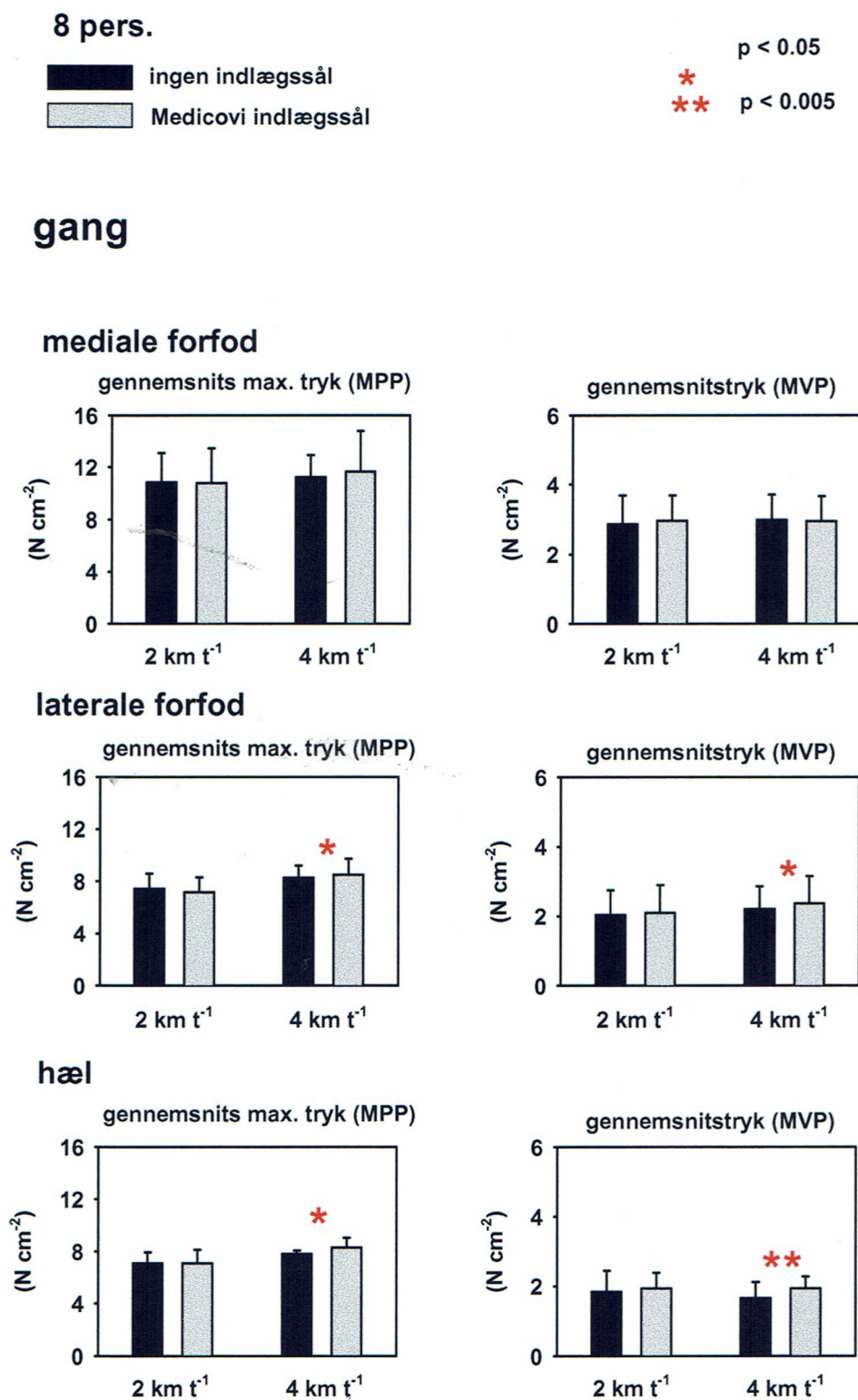
Figur 2.



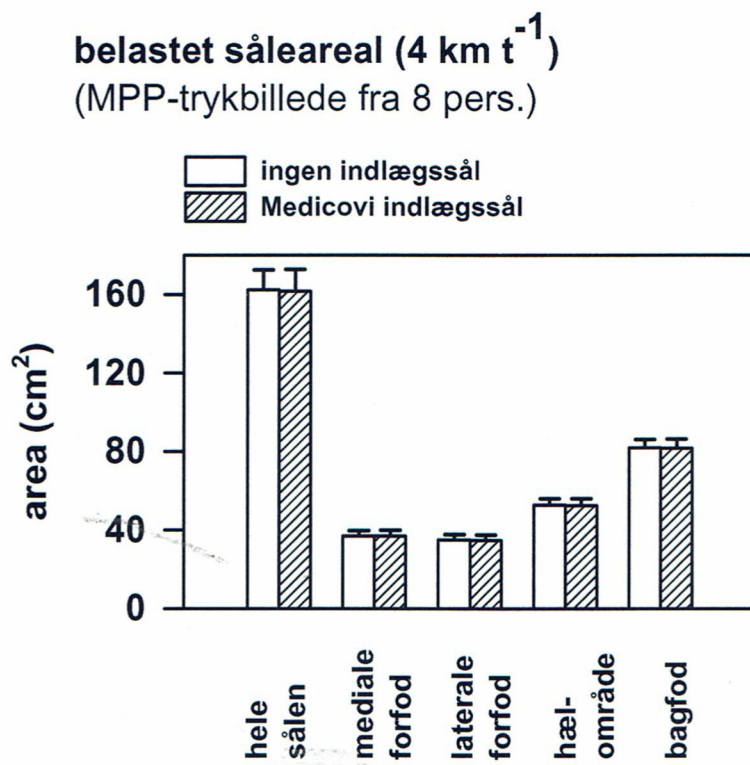
Figur 3.



Figur 4.



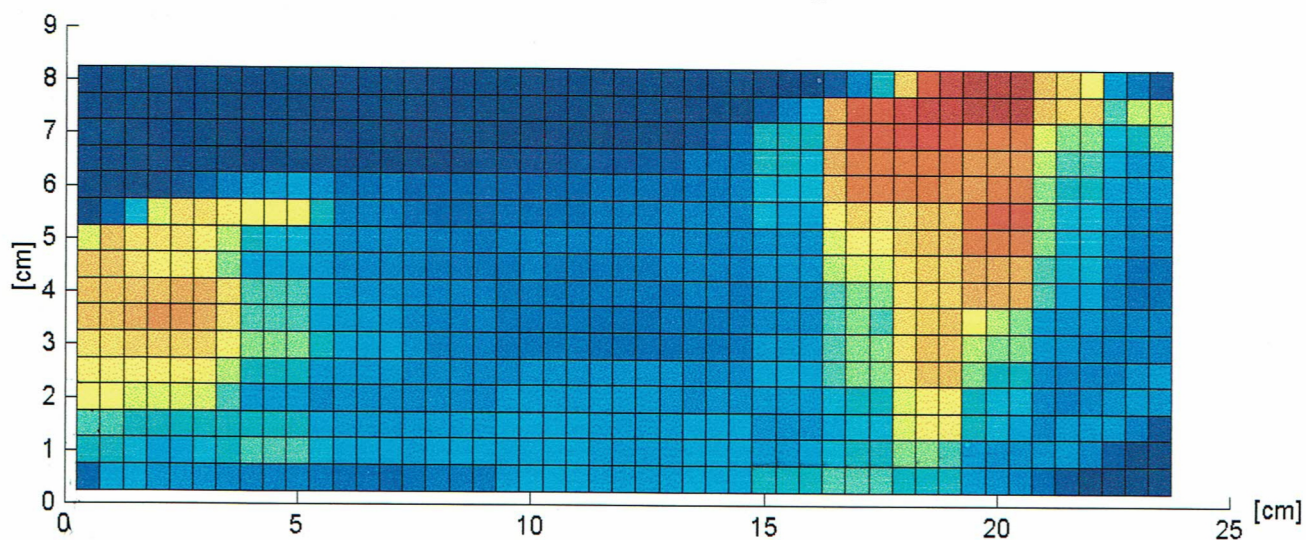
Figur 5.



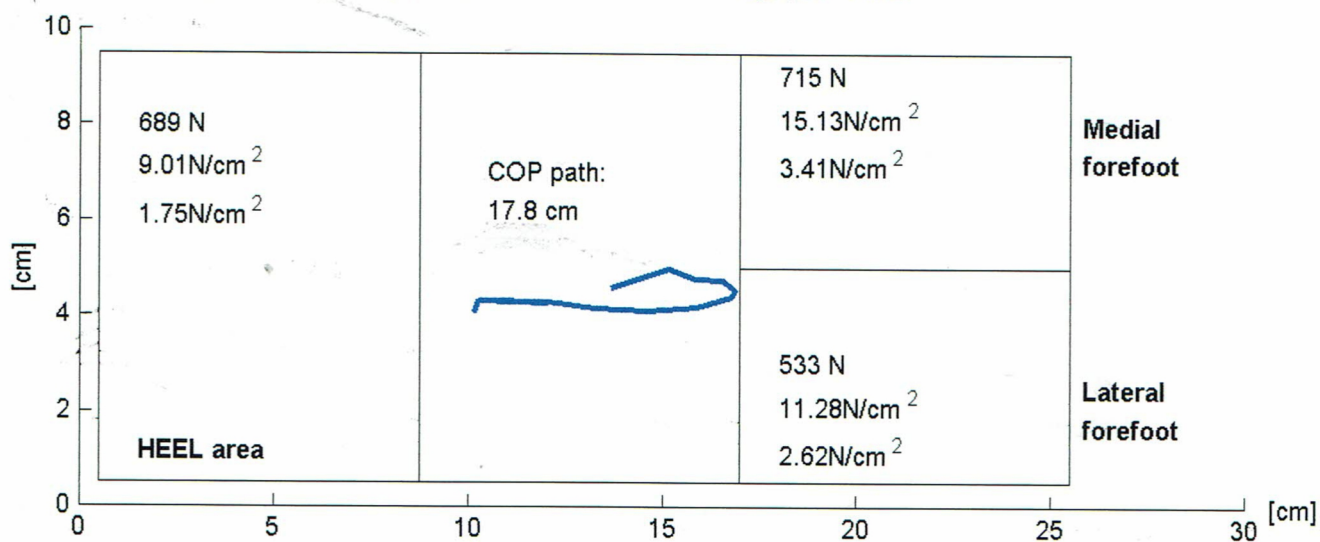
Figur 6.

HJWm3j2R

Pict_MPP

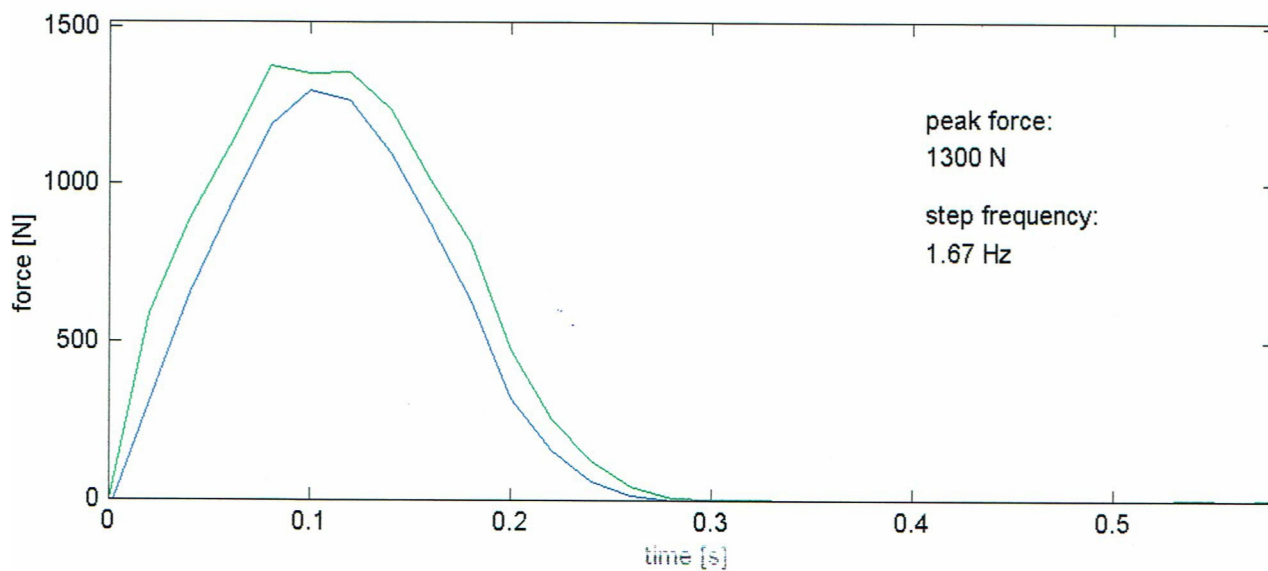


'Center of pressure' (COP) path, mask forces and average pressures



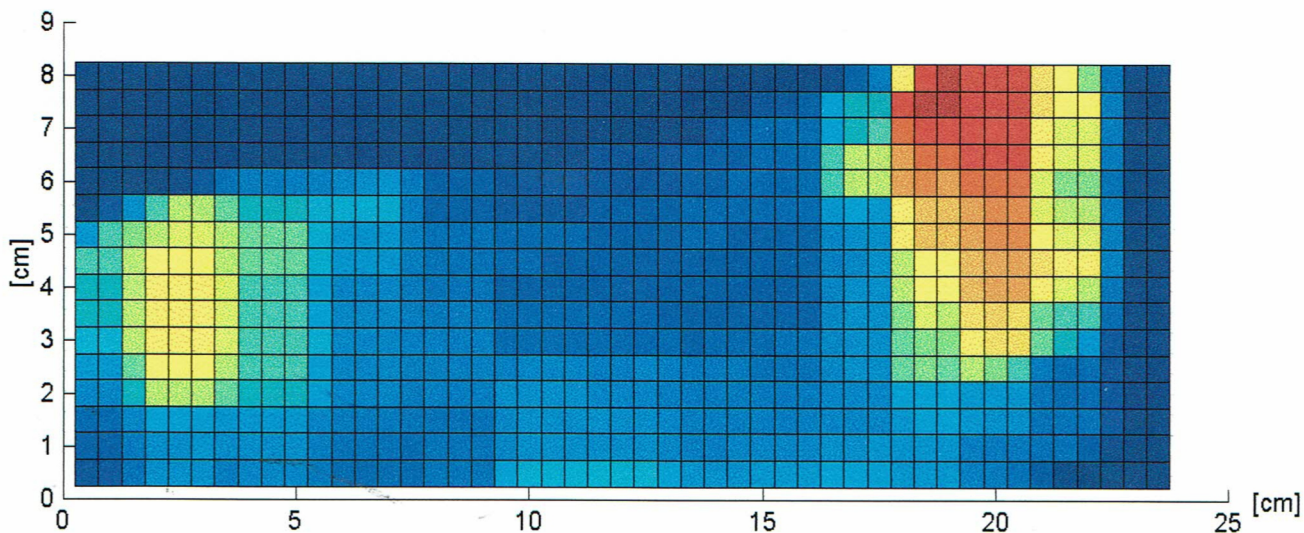
average vertical ground reaction force

(10 steps)

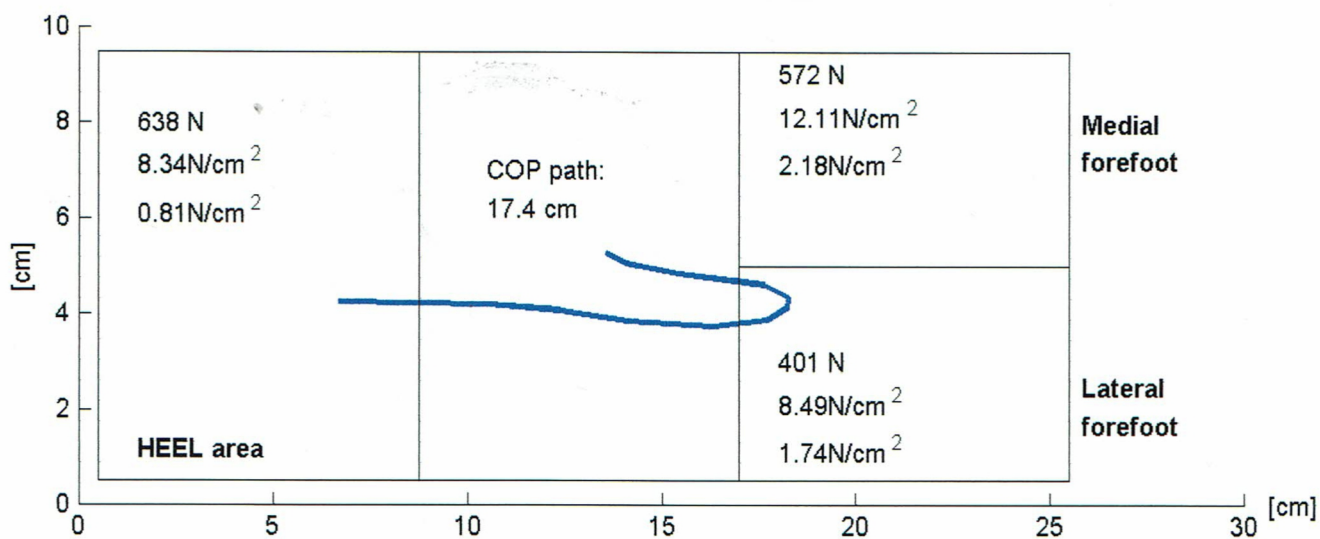


HJWujo2R

Pict_M PP



'Center of pressure' (COP) path, mask forces and average pressures



average vertical ground reaction force

(10 steps)

