# Gait parameters of various shoes

## Kinetics and kinematics

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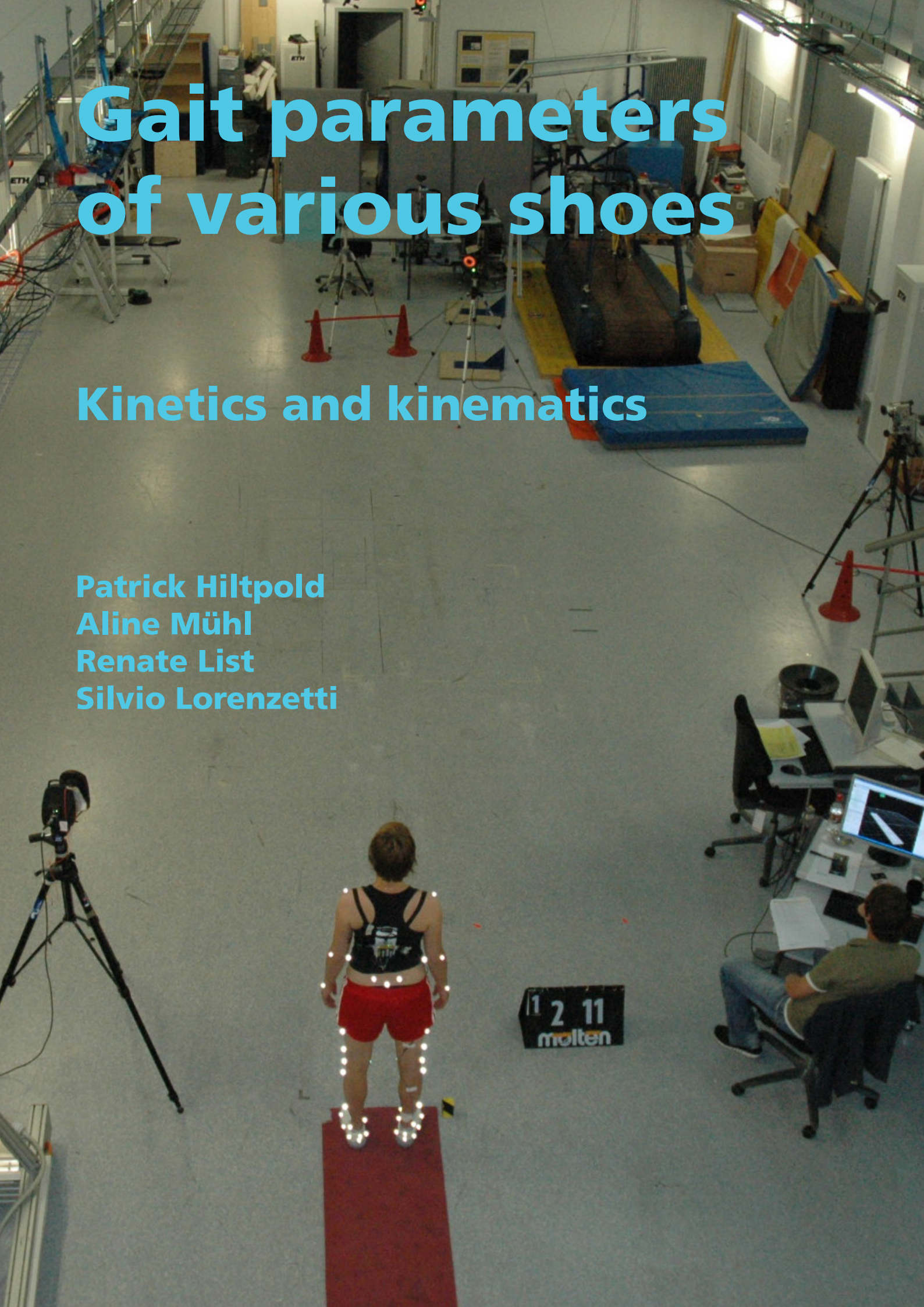


# Comparison of movement and forces for: bare feet - MBT - kyBoot - Joya - Joyssy

## Intro:

To investigate the influence of the ‚kyBoot' and ‚Joya' shoes designed by Karl Müller Sr and Jr on gait when walking and running, and on the forces affecting the feet, the Biomechanics Institute at ETH Zurich (the Swiss Federal Institute of Technology) carried out a study including gait analysis. The study involved 12 test subjects (barefoot, kyBoot, Joya, MBT and 3 test subjects with Joyssy), high-speed videos of the heel strike, kinetic measurements of the ground reaction force and kinematic measurements of the body position and movement.

A. Any experts in biomechanics wishing to see the entire study can download it via the following link. (http://www.kybun.ch/philosophie/eth-studie.html)

B. For a simplified explanation of the results and the manufacturer's interpretation see the following pages.

## Introduction

Walking is the most important form of locomotion, which is why people spend so much time on their feet. To investigate the influence of the ‚kyBoot' and ‚Joya' shoes designed by Karl Müller Sr and Jr on gait and on the forces affecting the feet, the Biomechanics Institute at ETH Zurich (the Swiss Federal Institute of Technology) carried out hundreds of comparative measurements on 12 test subjects. The aim of the work was to establish what changes occurred to the gait parameters of ground reaction force, maximum force, rate of force increase, length of stance phase, gait speed, and the shape of the angle of the ankle joint, knee, shoulder and elbow. The measurements were carried out for both walking and jogging.

**Explanation of barefoot measurements:**
Barefoot tests are always carried out for comparison. The real point is to make a comparison with ‚normal shoes'. As there is no such thing as ‚normal shoes' a comparison is made with bare feet. It is often thought that bare feet are the best or most natural, but that does not take into account the fact that most people are not used to walking barefoot on a hard, flat surface. This also shows clearly that the aim of walking in shoes is not to get exactly the same measurements as for walking barefoot.
Thus, for example, shock absorption is better with a soft sole than it is with bare feet.

## What was measured and compared

The Biomechanics Institute at the Swiss Federal Institute of Technology took the following measurements:

**1. High speed:** video recordings of foot strike, taken from the side with special ultra-high-resolution slow-motion cameras. These five slow-motion recordings of the same person in various footwear allow viewers to judge visually how bare feet or the shoes strike the ground.

**2. Kinetics:** measuring the ground reaction forces, i.e. the forces acting on the shoe or bare feet in all directions (vertical, right/left and front/back)

**3. Kinematics:** measuring movement of the body and joint angles (all only from the side – saggital plane) (Photos / videos of walking and jogging)

In the kinematic and kinetic tests, measurements were taken for 12 test subjects respectively in all the different shoes (kyBoot, Joya, Joyssy, MBT) and with bare feet. For every discipline the recordings were taken five times, once when walking and once when jogging. With four shoes and bare feet this results in 50 measurements per person (five types of footwear; walking and jogging; 5 repetitions). With 12 people that makes 600 measurements as the basis for the results.

**As more than 90% of the readings for the different products display no differences, or hardly any, we are limiting our comments to the readings which differ.**

## Evaluation of measurements which showed significant differences:

### 1. Visual comparison of high-speed shots

These images reveal to the naked eye that the Karl Müller shoes absorb the shock of impact better than does the natural pad of fat on the heel during barefoot walking.
Compared with barefoot walking, more energy from the impact is absorbed by the soft sole of the Karl Müller shoes.

### 2. A. Posture, walking – B. Forces, walking – C. Posture, running – D. Forces, running

(All results: ETH study, pp. 14–28 / ETH comment, p. 28)

### A) Posture, walking (kinematics) ETH study pp. 15–19)

There are no significant differences between the shoes. However, with all shoes, the angle of movement is greater than with bare feet (with ‚normal shoes').

At the moment of initial contact with the ground all shoes (in particular Joya/Joyssy) are at a sharper angle (dorsal flexion angle) than with bare feet. We interpret this to mean that a greater initial load is placed on the tibialis anterior (muscle in the shin) so that when the foot hits the ground the muscles may provide better protection.

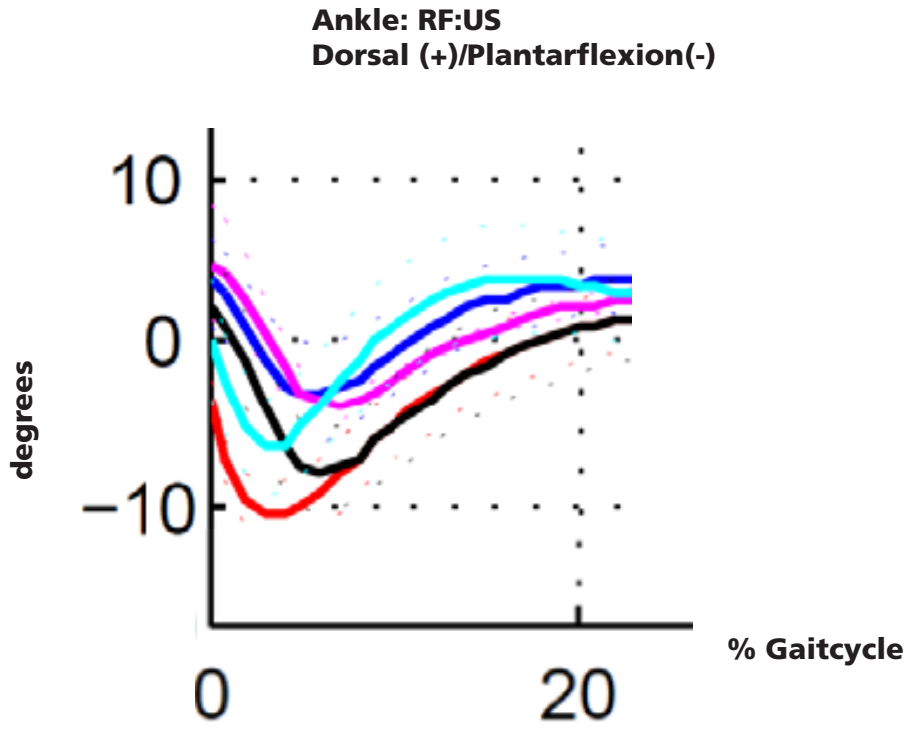
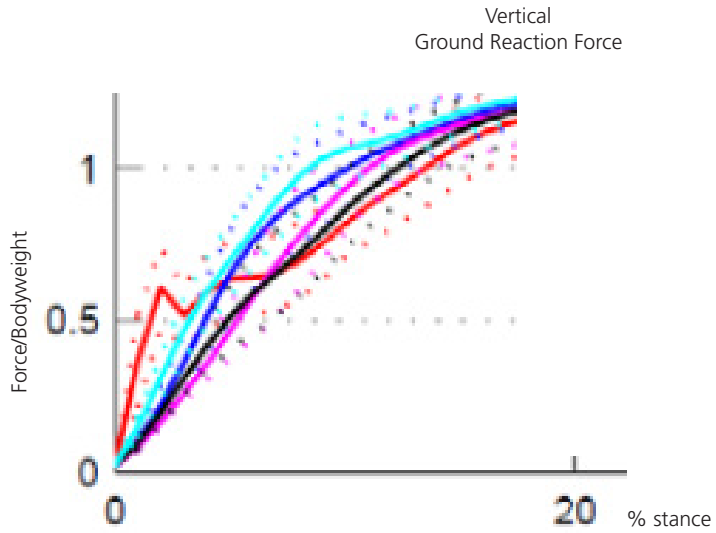


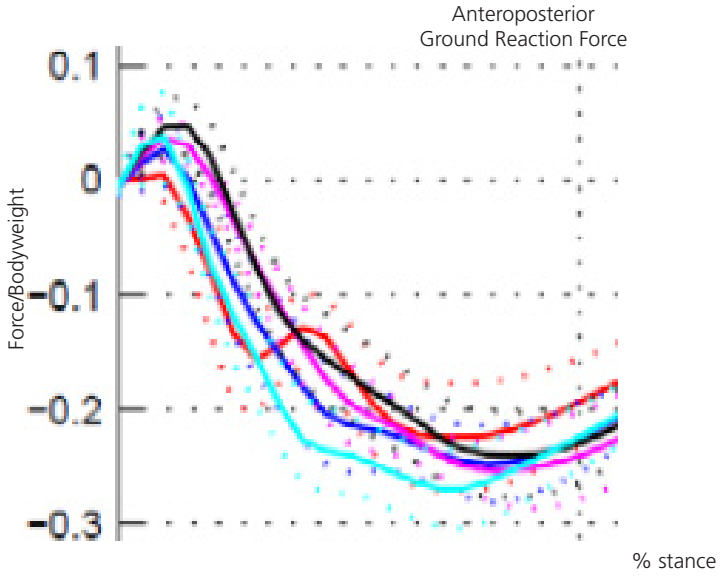

**Figure 15: walking. the shape of the angle of the ankle joint, red: barefoot; blue: Joya; magenta: Joyssy; black: kyBoot; cyan: MBT.**

## B) Forces, walking (kinetics) (ETH study pp. 20–21)

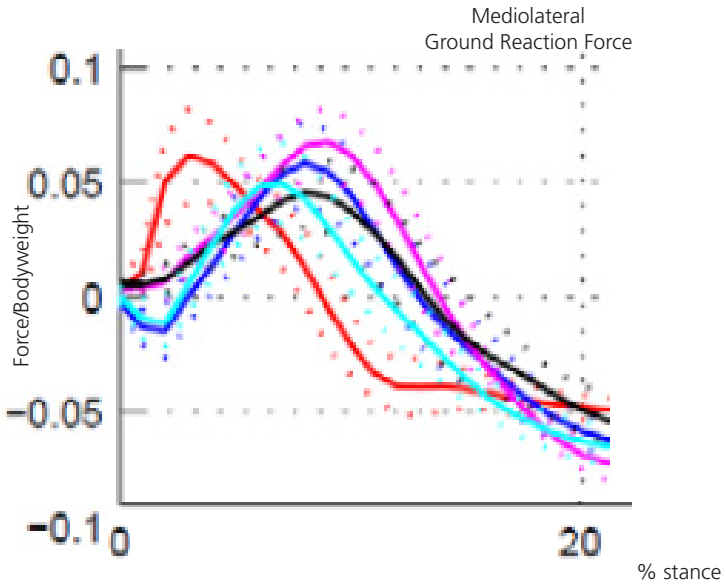
Top diagram on p. 20: the vertical forces show that in Karl Müller shoes it takes two or three times longer for half of a person's body weight to be transferred to their joints. Compared with MBTs, the load is still up to roughly 30% lower. We interpret this to mean that significantly less pressure is placed on the joints at the moment the foot hits the ground.




Central diagram on p. 20: it is noticeable that Karl Müller shoes smooth the braking force out the best, making braking more even. This could have a positive effect on the Achilles and patellar tendons.




Lower diagram on p. 20: on a hard surface, all shoes provide a smoother transition from pronation to supination and vice versa than do bare feet; it is a well-known fact that this can cause problems with the Achilles and patellar tendons.



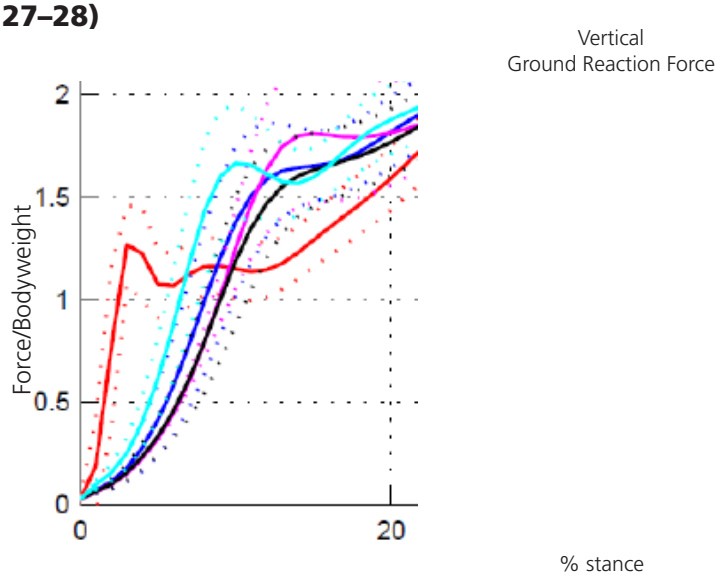

**Illustrations: ground reaction force when walking: red: barefoot; blue: Joya; magenta: Joyssy; black: Kyboot; cyan: MBT.**

## A) Posture, running (kinematics) ETH study pp. 22–26)

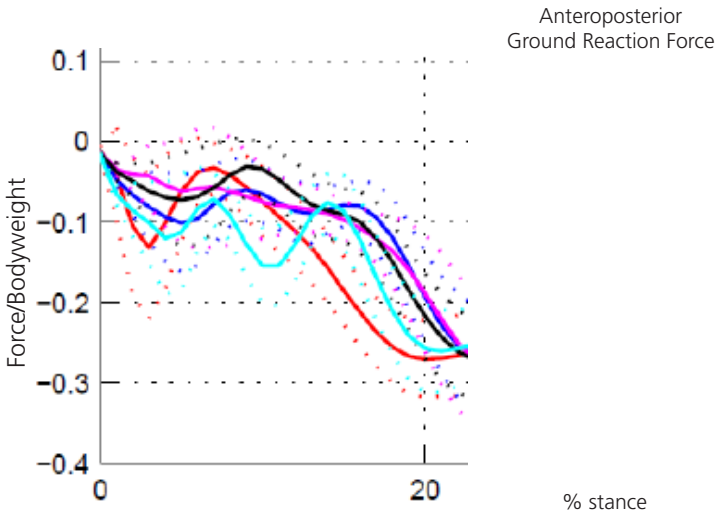
Basically, exactly the same applies as under ‚A) Posture, walking'.

## B) Forces, running (kinetics) (ETH study pp. 27–28)

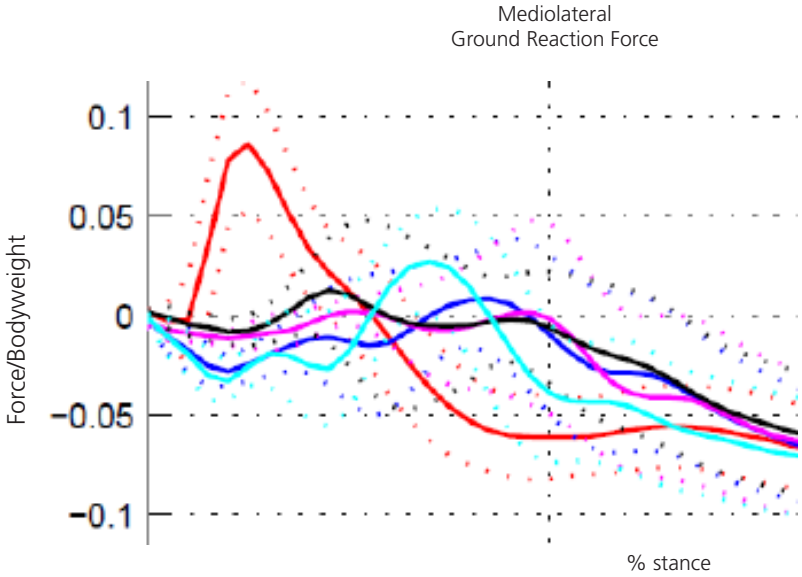
Top diagram on p. 27: the vertical forces show that in Karl Müller shoes it takes two or three times longer for a person's entire body weight to be transferred to their joints. Compared with MBTs, the load is still up to roughly 30% lower when the full body weight is placed on them. We interpret this to mean that significantly less pressure is placed on the joints at the moment the foot hits the ground.




Central diagram on p. 27: here the same basically applies as with the central walking diagram.




Lower diagram on p. 27: again, the same applies as was described for walking.




**Illustrations: ground reaction force when running: red: barefoot; blue: Joya; magenta: Joyssy; black: kyBoot; cyan: MBT.**

### 3. Summary of conclusions:

1. kyBoot/Joya trigger greater movement. This is a predictable result, as the soft, supple design of the sole makes it extremely yielding. When we walk barefoot on an uneven, natural surface (in sand, uphill, downhill, etc.) the angles of movement are naturally greater, of course. With the soft, supple design it can be assumed that more effort is required, more energy is used and the muscles get more exercise.

2. With Karl Müller shoes the movement curves are generally smoother (less jerky).

3. In the initial heel-strike phase the force acting on the body is considerably lower (by a factor of 2–5) than during barefoot walking/running due to the shock-absorbing properties of the Karl Müller shoe soles.

4. No differences were established between the Karl Müller shoes and those with rounded soles regarding upper body posture.

## Manufacturer's note:

Both the slow-motion video and the force curves show – prove – that the muscles of our feet and lower legs are too slow to stabilise our joints using muscles alone. It makes you wonder what the creator of mankind was thinking when he made human muscles so slow to react.

- does it make no difference if a joint gets out of control for 20 milliseconds?
- or are our feet not built for walking on a hard, flat surface?

I would say the latter, as our muscles do actually react quickly enough as long as the surface on which our feet are walking is not hard but instead yielding; i.e. as long as our feet are walking on a natural, yieldiong surface. However, in modern life, people rarely have the opportunity to walk on a soft, natural surface. That is exactly where Karl Müller shoes come in. Their soles simulate a natural, yielding surface and slow down the heel strike phase, so to speak, from 20 to 60–100 milliseconds, giving our muscles time to stabilise the joints and protect them using muscle power.

### Key to technical terms:

| | |
|---|---|
| anterior | front |
| posterior | back |
| dorsal | relating to the back |
| plantar | relating to the sole of the feet |
| plantar flexion | toe-down ankle motion |
| dorsal flexion | toe-up ankle motion |
| dorsal/plantar flexion | moving foot up and down from ankle |
| medio-lateral | elating to the middle and one side |
| anteroposterior | front–back |
| cyan | blue/green |
| magenta | purplish-red |