NOTRAX®
Justrite Safety Group

Standing Smart

Increasing the comfort of standing workers

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Index and Guide

Standing Smart

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Purpose of the Research

The ambition of the research work that we are conducting is aimed at increasing the comfor of users at work by studying the gestural ergonomics and by minimizing the constraints on an articular level in real experimental situations.

How?
Studying the upright postition of the human body, the stability of the body and its ergonomics on the job, the adjusting of its segments to maintain its balance and diminishing muscular problems are the main elements to highlight in order to improve the everyay (working) life of users.

Why?
The difficulties accentuated by the users represent major stakes for companies that want to achieve high productivity.

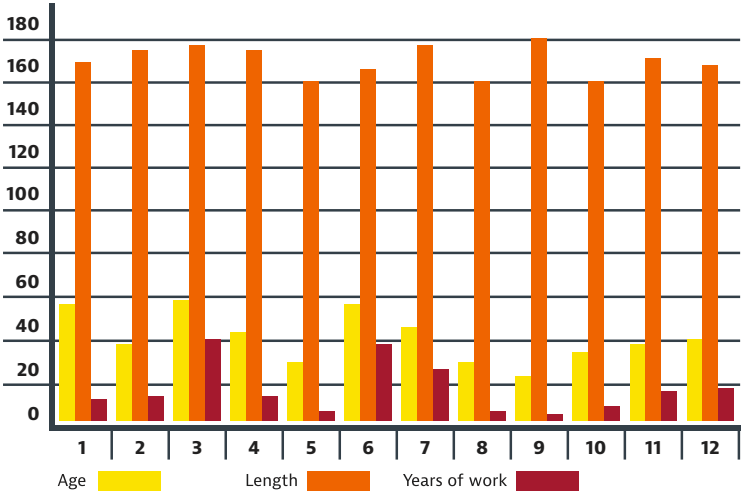
Approach
Based on the optimization of new materials, the projects consists in validating prototypes destined to improve ergonomics at work and to optimize the comfort of users (anti-fatigue mats)

Research Methodology

1. Population
2. Testing Period
3. Testing Equipment
4. Testing Scale
5. Testing Method

1. Population

The population of the study counts 10 male and 10 female subjects



2. Testing Period

There were 3 seperate moments in the testing period

Period 1
2010 - Week 42
Experience of the operators without anti-fatigue mats.

Period 2
2011 - Week 2
Experience of the operators with anti-fatigue mats.

Period 3
2011 - Week 6
Experience of the operators to determine preference for the type of anti-fatigue mat.

Shifts
The shifts involved in the study:
Morning: 8:00 am to 12:00 pm
Afternoon: 13:00 pm to 17:00 pm

Tested after 1, 2, 3, 4, 5, 6 hours of work and at the end of the shift.

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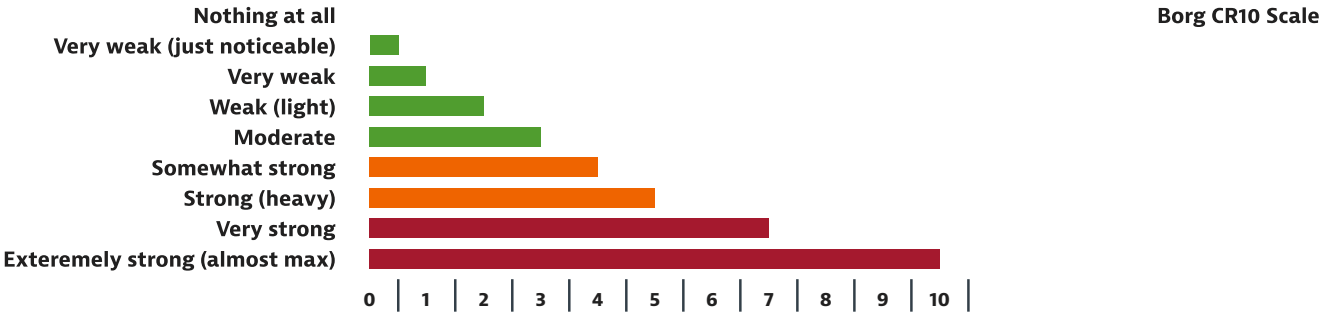
3. Testing Equipment

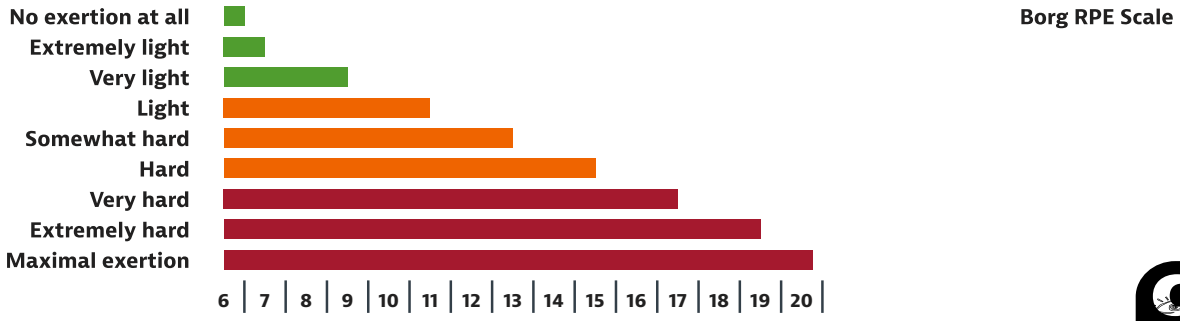
The first measures are done with a pressure platform equipped with 1400 pressure sensors. The platform is placed in front of the workstation.

For this test I used a 'Zebris' foot pressure platform. This platform which contains a large number of sensors will enable us to transcribe the dynamic and static pressure executed by the feet. This pad is equipped with 32 x 47 sensors totalling 1504. One sensor is 1cm², has a precision of 0,5N/cm² and an acquisition frequency of 60Hz.

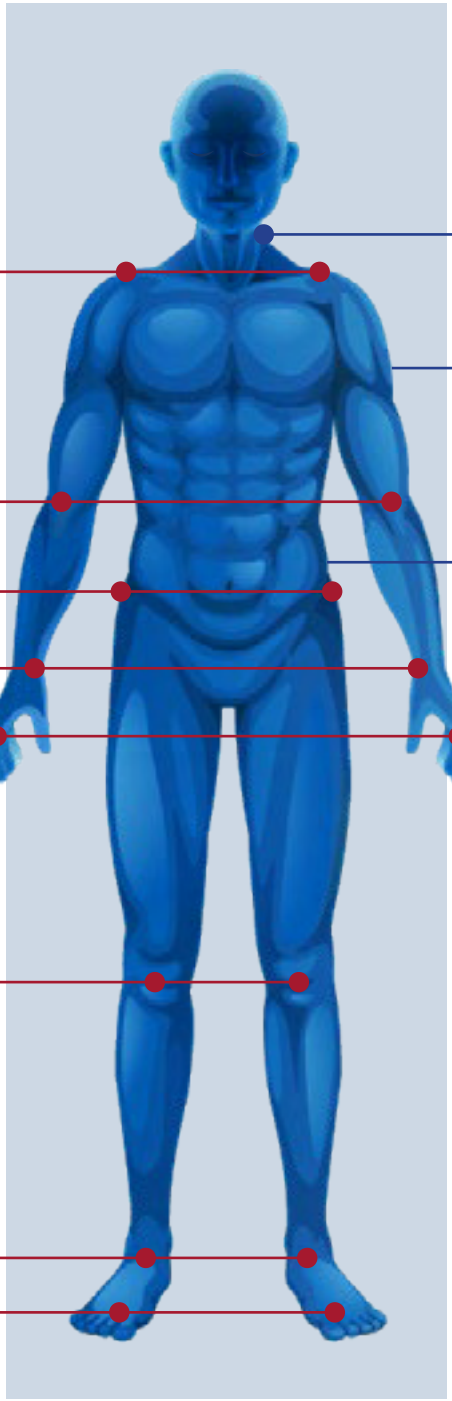
4. Testing Scale of Measurement

The Borg scale to quantify the intesity of the pains.





5. Testing Method



Joint pains

Rachis pains

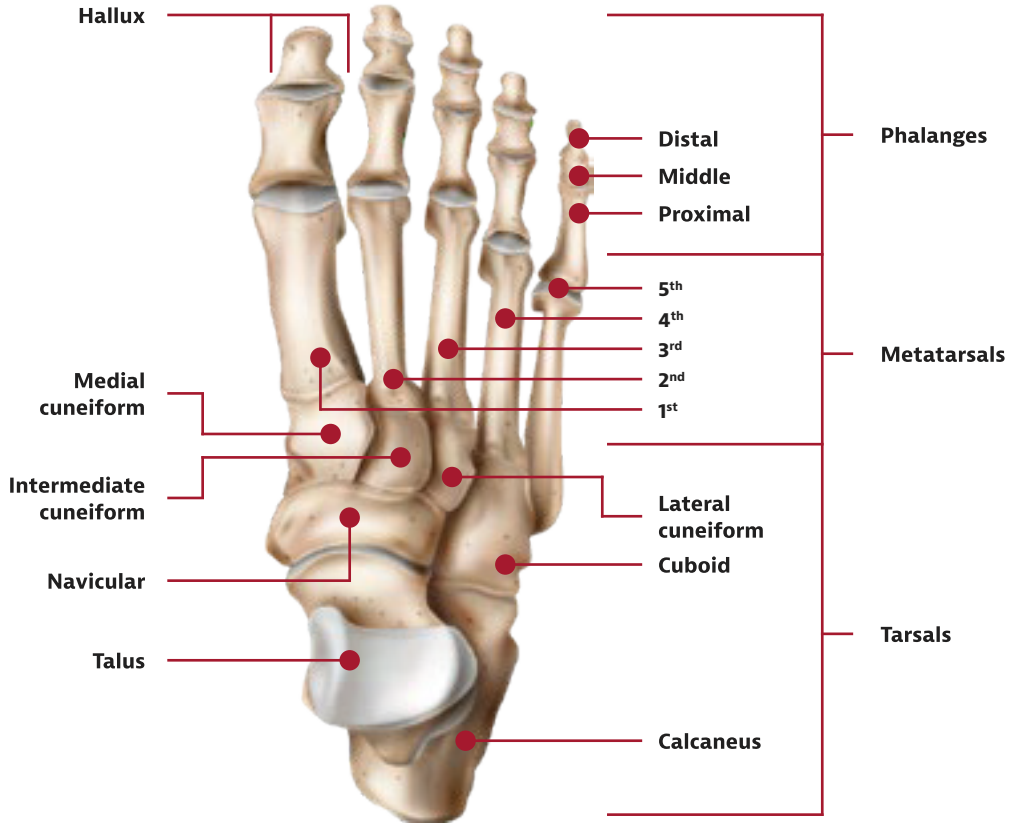
Other pains:

- Headaches
- Eyes
- Ears
- Stomach
- Legs
- Stress

How we stand: Pressure on the Foot

1. Anatomy of the Foot

The form of the foot can be compared to a semi-dome with internal muscles.
20 intrinsic muscles (one more than in the hand). 26 bones > big mobility



Bones of the foot from above.

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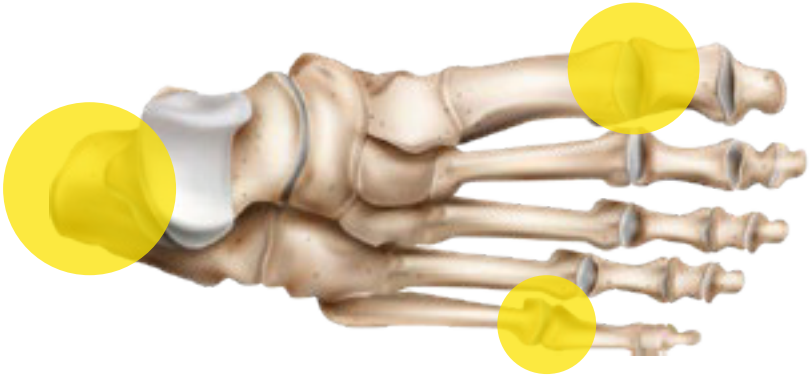
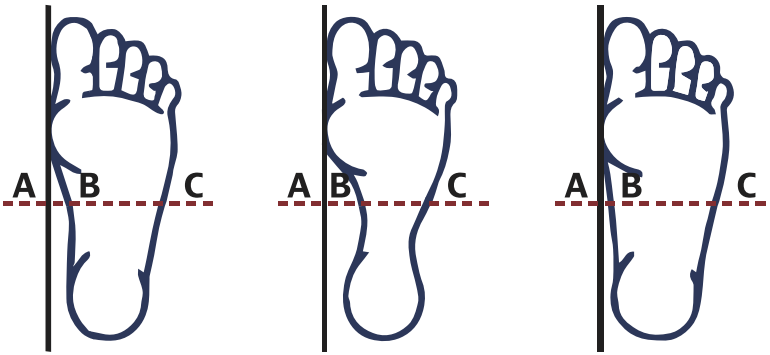
2. Ground contact points

This 3 point grip system together with the arches allows contact with the ground on any type of surface (top of the first and the fifth metatarsal and the calcaneus). Very good transmission of weight and the efforts of the body.



3. Shapes of the foot



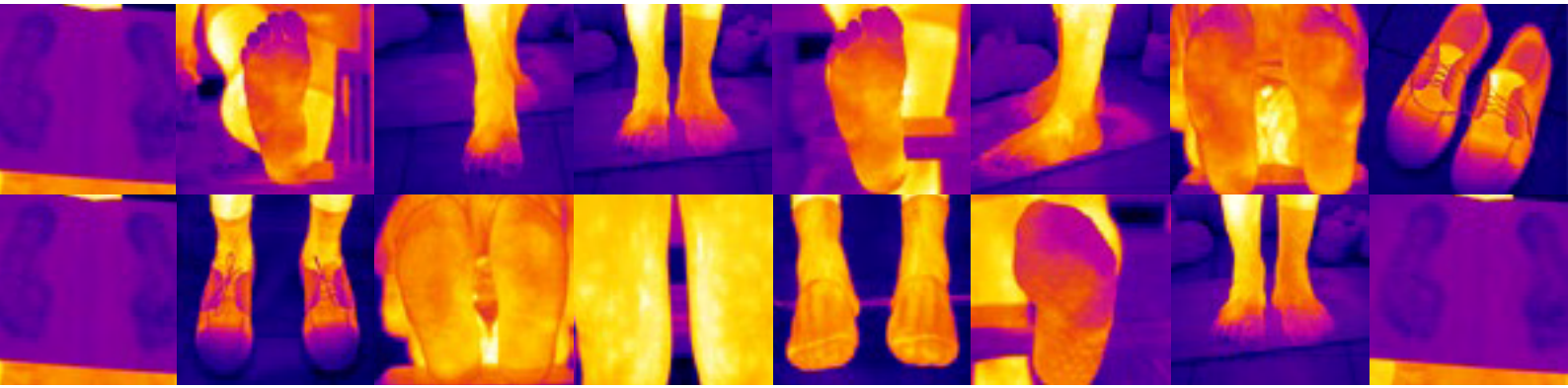
1. Normal foot
Has no major biomechanical problems

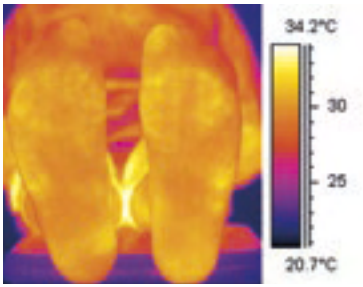
2. Cavus foot
Characterized by a very high arch

3. Flat foot (pes planus)
Characterized by a collapsed arch

Testing

1. **Measurements while Standing**
2. **Static without and with Mats**
3. **Dynamic with Mats**



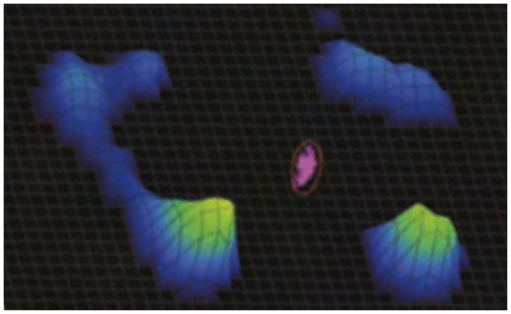


This experiment will allow us to observe the evolution of the foot pressure after a defined movement. The subject will keep an upright position on the 'Zebris' platform. We observe at the same time through a colour gradient the evolution of the different pressures made by the foot surface in contact with the machine (from blue to red, the pressure is growing). The results are obtained in a static position representing the keeping of an upright position and in a dynamic position characterized by the actual working situation in front of the production tool.

During this experiment the platform was positioned on each anti-fatigue mat. The test was to stand upright for 3 minutes.
We record the evolution of foot pressure in function of the appearance of fatigue and we quantify the impact of 7 working hours on the mechanical behaviour of the user.
To increase reliability of the results, multiple tests were done.
The same experimental procedure was used for the dynamic analysis.

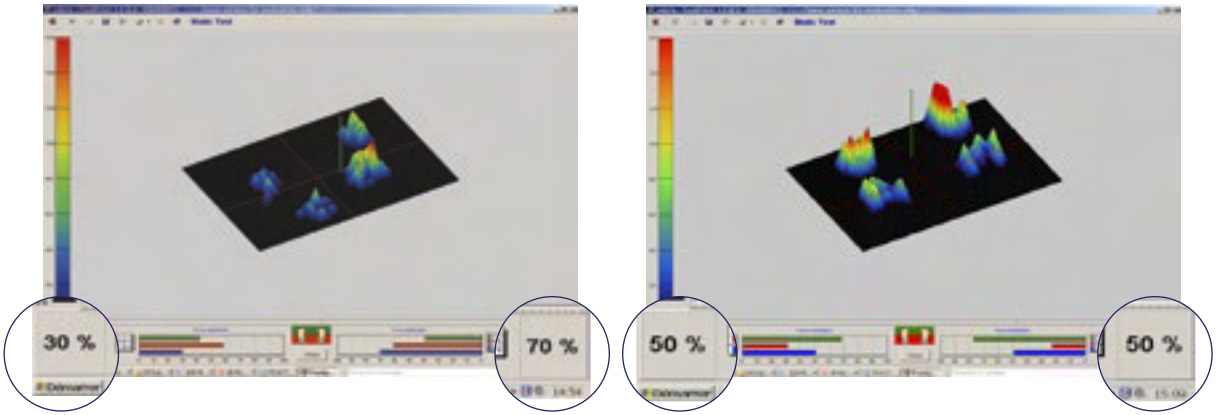
1. Measurements while Standing

The figure shows the distribution of pressure underneath the foot in an upright position. I have made a recording of one minute to determine the evolution of the pressure centre. The red circle shows how the latter has evolved. We notice that the pink coloured points are distributed in the interior of this circle. This means that the body has moved to maintain its balance. The smaller the circle the lesser the body moves to maintain its balance.

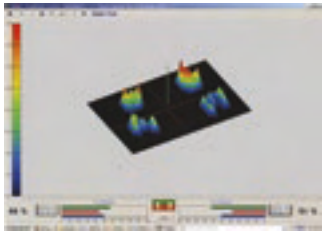


2. Static without and with Mats

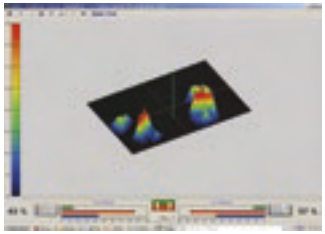
Left without a mat
Right with a mat



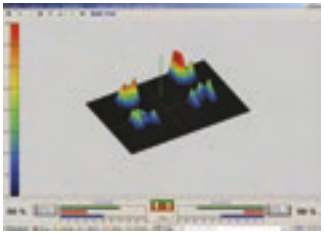
Test with preference for type of mat:



Static ERI C
479 Cushion Trax®

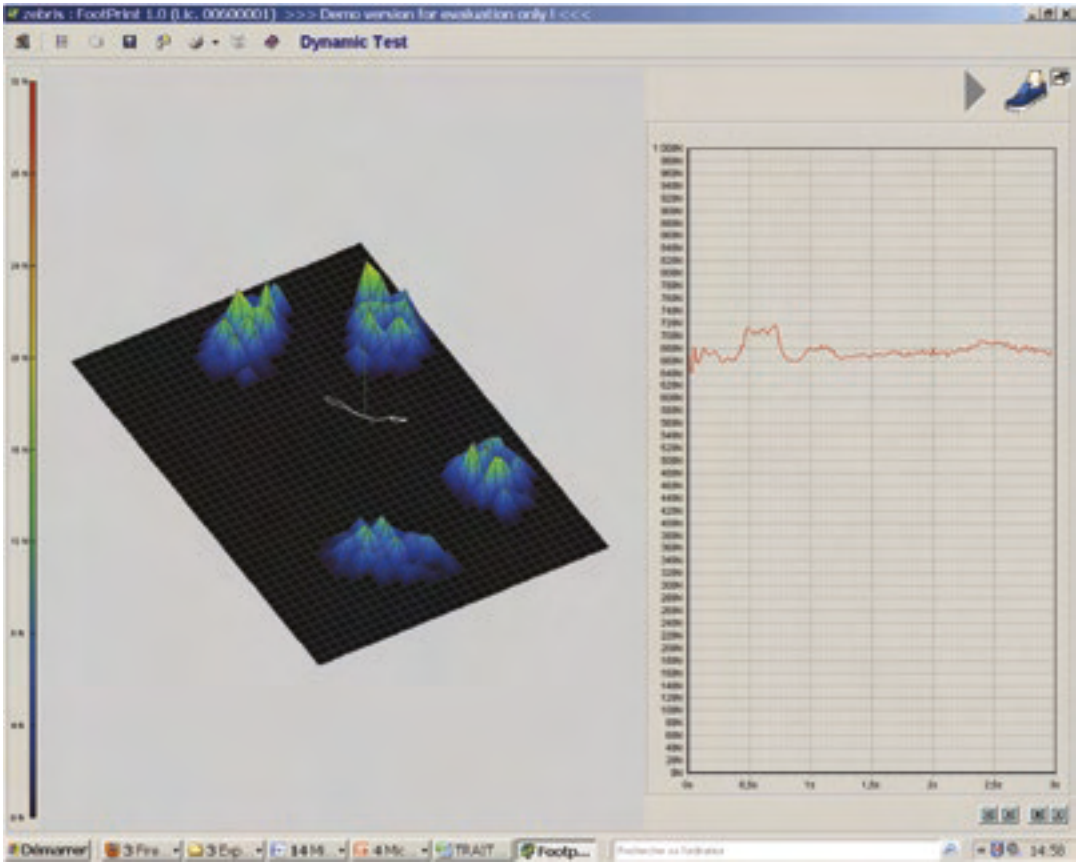


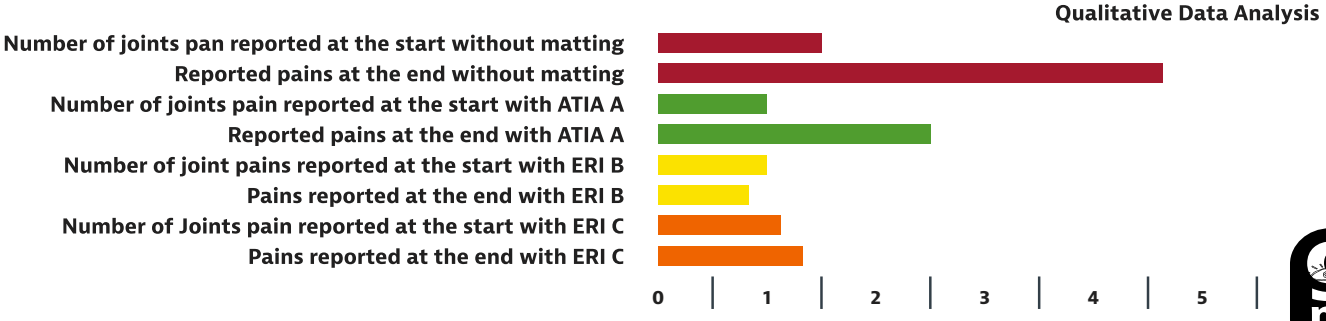
Static AITA A
451 Skywalker™ II PUR



Static ERI B
556 Cushion Ease Solid™

3. Dynamic with Mat





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‘‘WITHOUT A MAT
THERE IS A DYSFUNCTION
IN THE BALANCE OF THE PERSON’’

Results

The obtained results show that in any test duration the feet and therefore also the body moves to keep its balance necessary to maintain upright position.

Without a Mat
We remark that without a mat there is a dysfunction in the balance of the person which can cause pathologies or repetitiveness and other work constraining factors which can accelerate the process. We observe here that with a distribution of foot pressure (30% and 70%) the weight of the body is mainly on the right side. This imbalance is very harmful for the human body.

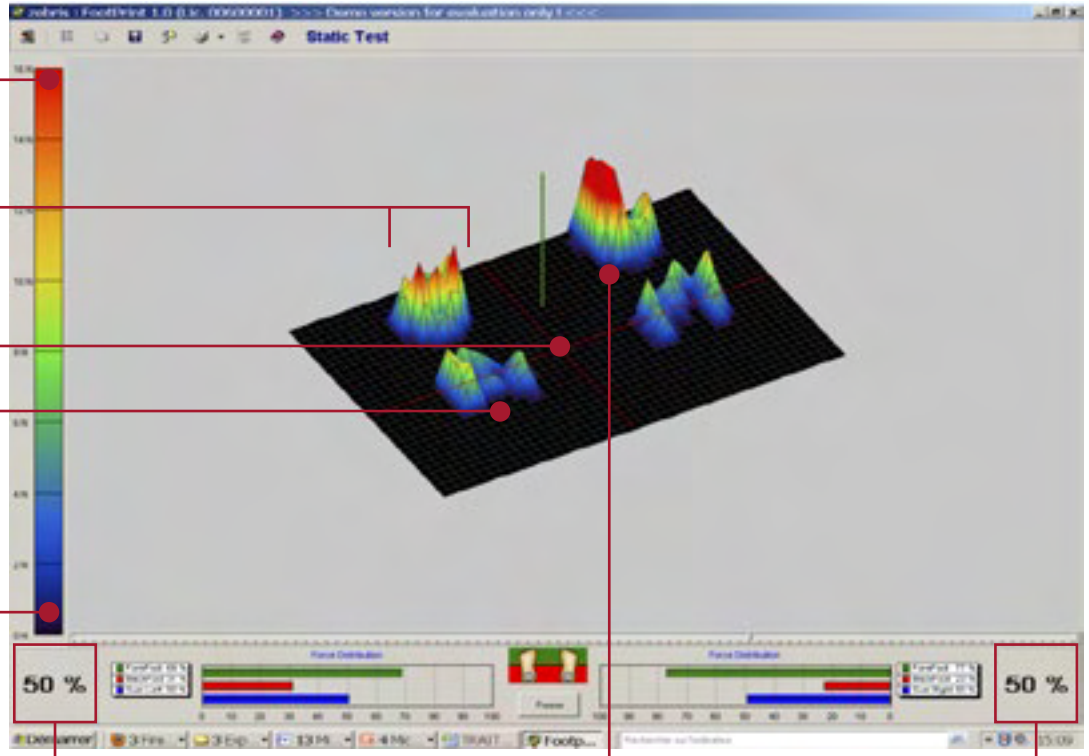
With a Mat
We observe that in working situations where people make small movements constantly, the anti-fatigue mats that we tested show properties that give a muscular-skeletal comfort in upright working positions.
This can be verified by the constancy of the force evolution curve during the movement.

Actually to maintain an upright position it is necessary to have a well-adapted postural balance to decrease pathologies and their consequences in the everyday work of the users.

We have shown in this study that in a static position the body of the subject moves in order to maintain its balance.
This first handling 'variations in foot pressure' has made it possible to highlight the body's movements in a static position.

Results

Standing on an Anti-Fatigue Mat:



Maximum Pressure

Left foot

Projection centre of gravity

Forefoot (points)

Minimum Pressure

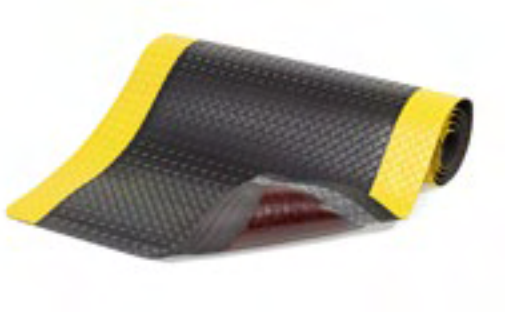
% of weight on the left foot

Backfoot (heels)

% of weight on the right foot

''USING AN ANTI-FATIGUE MAT ELIMINATES PRESSURE POINTS FROM THE FLOOR AND SPREADS WEIGHT EVENLY TO CORRECT BALANCE''

Testimonies



479 Cushion Trax®

Bestselling anti-fatigue mat with ergonomic benefit derived from a 14-mm thick worker platform comprised of a long wearing top surface laminated onto a resilient microcellular vinyl base for maximum durability, comfort, and insulation from hard floors and vibrations.
Diamond plate pattern provides traction while allowing easy twist turns. The design and material composition make this the most versatile matting solution for fatigue relief in both static and dynamic working positions.

André: Very good but I think it is a too soft, I have the impression to fall asleep on it, but on I feel no fatigue on this mat.

Dolorès: I like it, because it relaxing for the feet and I felt the fatigue much later than usual, when I leave work I no longer have pain in my legs.

Adeline: Is comfortable and well adapted: I feel less fatigue in my legs at the end of the day.

Estelle: The softest one, but the diamond plate top surface is cumbersome for the support of the foot.

Ghislaine: **The best.**

451 Skywalker™ II PUR

High quality polyurethane foam anti-fatigue mats are reputed for their ultimate comfort in stationary standing positions.
Its key characteristic of high thermal insulation performance is owed to a uniform closed cell structure wherein gas remains trapped. Integral skin adds to the compression force deflection properties (>120 according to ASTM 3574C), provides resistance to wear and is non-porous.

André: Too hard. I still have pain on the soles of my feet.

Dolorès: -

Adeline: This one is the worst. It's not adapted at all. I still have the same intensity of pain in my legs as before.

Estelle: **2nd place. It absorbs less, more pain in the calves and thighs.**

Ghislaine: Less comfortable: feels harder in the foot support.

556 Cushion Ease Solid™

Heavy duty rubber tile of 91 cm x 91 cm can be easily assembled for coverage of large areas or individual workstations, wall-to-wall or as islands. Ergonomic benefit derived from a 19-mm thick worker platform with a closed anti-slip pebble structure surface for maximum anti-fatigue comfort in dry industrial environments.

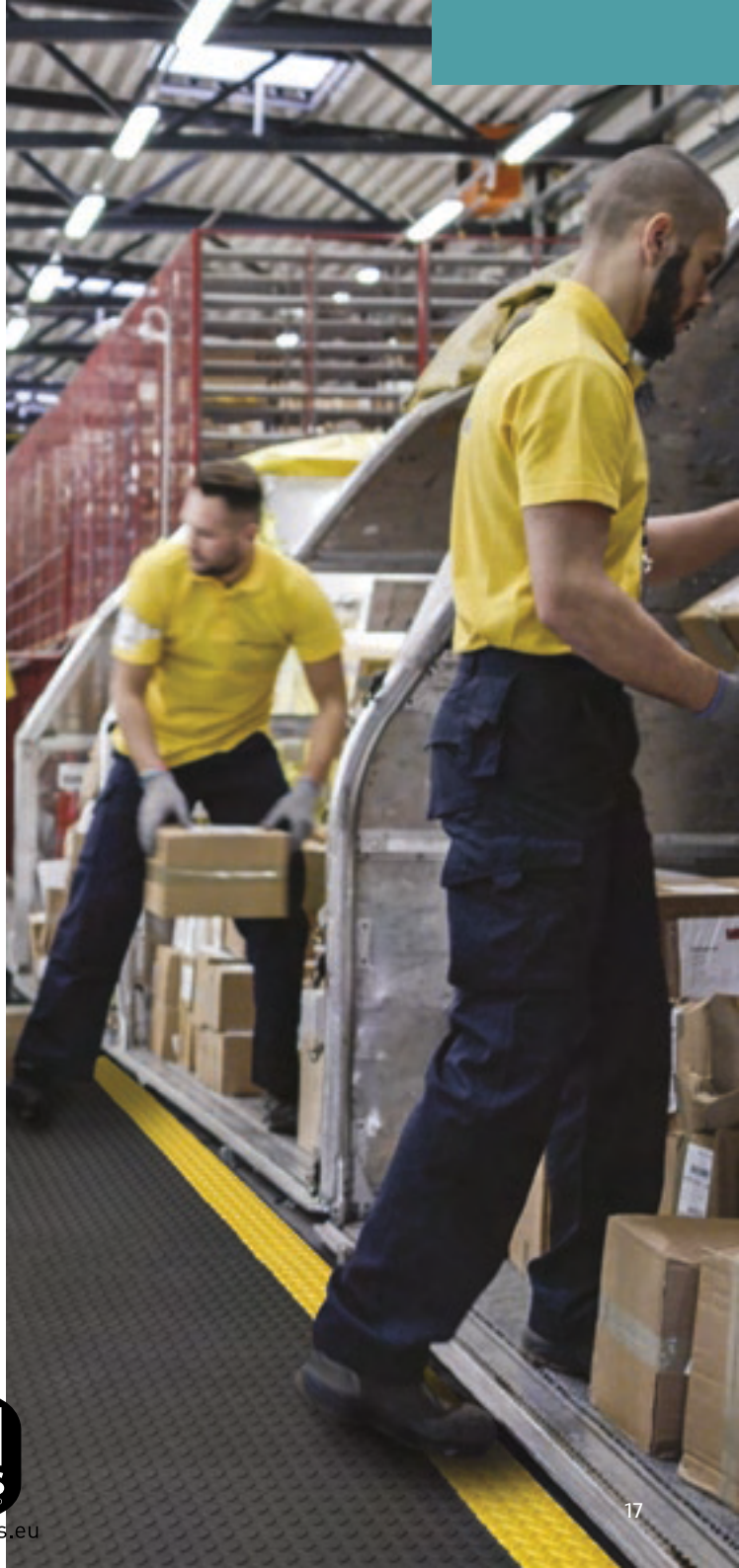
André: **Perfect, this is the best, I have hardly any pains.**

Dolorès: I also like this mat, the warming up of the soles of my feet and the pains in my legs are much later than before.

Adeline: It's the best: without any doubt this is because of the thickness of the mat, I feel better; I have less pain in my legs.

Estelle: Is the best: it seems quite hard in the beginning, but this disappears later. There are no irregularities, less fatigue in the legs at the end of the day and less muscular and articular troubles, better absorption of weight.

Ghislaine: The worst mat: impression that the support is more on the right side, I am not balanced, lower back pain and pain in the legs.



Conclusion

1. Explanations Bio Mechanics

The muscles keep the segments of our skeleton vertical and constantly correct the balance of the whole. The two feet are the starting point of the balance.

The pressure zones of the sole of the foot on the ground translate the different strategies we all use to stay upright: more pressure on the rear part or on the front part of the foot; more on the right foot or more on the left foot.

2. An Automatic System

This posture state (upright) is encoded in our neuromuscular program, and each time we use the same muscles to do the work, without being conscience about this. This 'automated' muscular functioning is recorded in the brain and will be systematically applied in every situation (even outside the working environment).
The muscular fibres involved in this programming are also called « Cinderella fibres », because even if they are tired they do their job . . . that's the start of muscular-skeletal troubles (pain, contractures, tendinitis etc.).

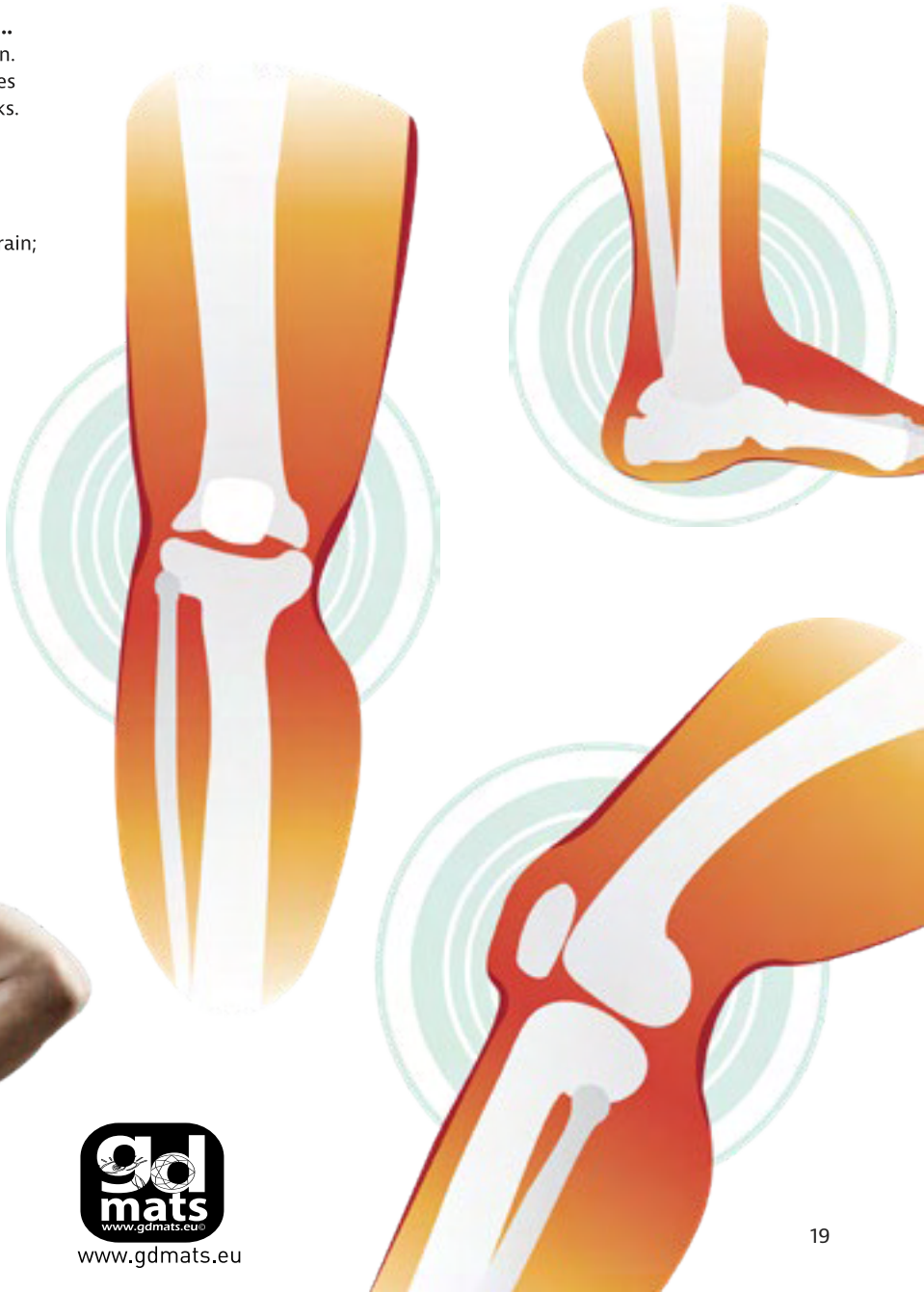
Foot pressure on the floor can give indications on the functioning of the muscular chains used.
We can observe that our footprints are marked by higher or lower pressure levels (either our support is more in the back (the heels) or on the front (the points of the feet); or on the outside, the inside, left or right).

3. Changin the Automatic Functioning

It is possible to change this automated functioning...
by retaking control of the muscle commands in the brain. The learning of a new gestural or postural model requires special attention and concentration during several weeks. The old model will then be replaced by the new one and will also function and in an unconscious and automatic way.

Every gestural or postural system is controlled by the brain; this allows a compromise between quick execution and saving energy. When the system is out of balance, the quick reaction speed is maintained at the cost of energy spending (fatigue). In a nutshell, to regain balance 'quick reaction/energy saving/effectiveness', it is necessary to become aware of the different foot pressures on the ground and the most proper muscle action (from feet to head).

This can be done easily by changing the foot pressure on the floor : by forcing oneself from time to time to move the pressure to the front of the foot or towards the back of the feet; or from the inside to the outside of the foot or more to the right and after that more to the left.



Advice to Workers

1. **Vary Foot Pressure**
2. **Use Anti-Fatigue Mats**

Proposition of a method to rebalance the muscular functioning.
The explanation of the biomechanics and the visualisation of the foot pressure on the floor will allow proposing and justifying the usefulness to change foot pressure in an upright position. It is recommended to change regularly (during a period of 1 month) the pressure point inside the shoe.

1. Vary Foot Pressure

The variation in pressure is the first stage in improving the upright standing position, initiated by the person itself:

- Push forward (bend the toes slightly by scratching the sole of the shoe)

- Push backwards on the heels (slightly lift the points of the feet by touching the shoe with the toe nails)

- Push on the outside border of the foot

- Push to the inside border of the foot

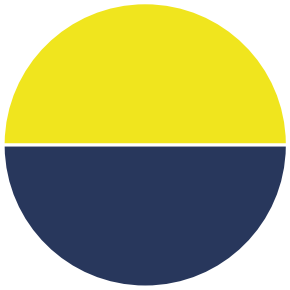
- Push more to the left

- Push more to the right

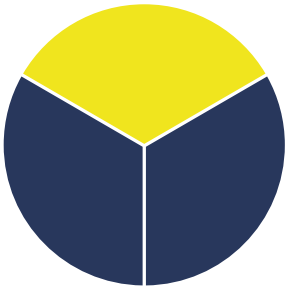
2. Use Anti-Fatigue Mats

The second stage of improvement will be the floor, by using anti-fatigue mats made from the latest technological materials. An anti-fatigue mat provides an ergonomic benefit for your feet as they provide cushioning, reduce pressure points on your feet, and they can mould to your feet to provide maximum comfort.

Further, an anti-fatigue mat stimulates very subtle micro-movements in your muscles to keep you balanced. This muscle engagement keeps the blood flowing through your lower limbs increasing circulation which reduces fatigue.



50%
Fatigue Reduction



1/3
Less Absenteeism

24/7
Upscale Productivity

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Justrite Safety Group

Since its humble beginnings as a small family-owned company in 1948, our commitment has been to make quality products and to continue looking for innovative ways of serving our customers. Notrax® operates manufacture facilities in Mississippi and Illinois in the United States and Barendrecht in The Netherlands. Now, as part of the Justrite Safety Group, we excel in the design and manufacturing of anti-fatigue and safety matting for industrial and commercial applications.

Ergonomic, Anti-fatigue & Safety Matting

- Anti-fatigue matting
- Anti-slip mats
- Welding mats
- Electrostatic discharge mats
- Food processing and food service mats
- Hygienic mats

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