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e-bed™ TECHNOLOGY

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“We believe an urgent change in paradigm is needed for our deteriorating feet.”

Presenting the Neurorthotic™ Footwear Revolution

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GENERAL REQUIREMENTS

As we know the joints and muscles of the body function most efficiently when they are in physical balance or equilibrium. Our feet are the foundation of our body. This however is not simply a biomechanical concept (orthotic) but rather a "NEURORTHOTIC™" one, as we shall see later.

Now imagine the full body weight being balanced continuously over our relatively small feet. Apart from the delicate balancing act of our nervous system, this requires a very strong foot structure, flexible enough to adjust to any surface changes and body movements, yet at the same time rigid enough to maintain stability and control so as not to overexert supportive tissues such as joints, ligaments, tendons and muscles **(1)**.

Furthermore the kinetic energy created by the gravitational forces of the body (3-5 g-forces during regular walking) need to be continuously buffered **(dissipated)** in order to avoid tissue damage to the feet or any structures above along the kinetic chain of the human musculoskeletal system. So how do the feet do that?

In simple terms they are made up of three arches (like bridges) creating a tripod-like structure **(1)(see chart 1)**. This is an exceptionally clever design as it provides control, stability and shock absorption all in one.

The design **(tripod through arches) (chart 1)** and the orientation of the foot joints allow for clever **CONTROL** on most kind of surfaces. The tripod design also provides for **STABILITY** even on uneven surfaces. This is further enhanced by various locking mechanisms (e.g. windlass locking mechanism, mid-foot locking (15,16,90-92,94-98)) that come to bear particularly during critical phases such as the push off phase where the weight is shifted onto the fore foot and loaded up in order to propel the bodyweight forward.

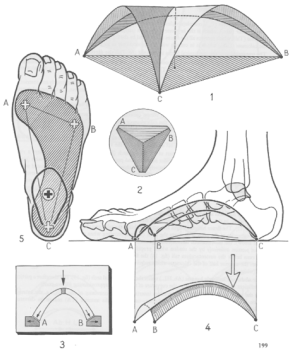

Chart 1: Kapandji. I, A. (1970) The Physiology of the Joints. 2nd Edition. New York: Longman Group Limited

In order to protect the feet from the impact of our body-weight, obviously the full spectrum of joints particularly of the lower extremities are engaged **(2)**. However the tripod structure made up of the three arches in the foot again is very well suited. Like springs, the arches can dissipate **(SHOCK ABSORB)** any remaining forces being transferred through the feet. As you can see, this is an evolutionary structure developed to function on all sorts of natural surfaces, not necessarily to be locked into a shoe all day!!

All these foot qualities and functions are continuously supervised, coordinated and modulated by our **nervous system**, thus the new term **NEURORTHOTIC™**. Unless we understand how our nervous system functions and reacts (Not simply it's anatomy!!), we cannot properly appreciate the required qualities a footbed needs, in order to satisfy the nervous system and improve our present foot crisis.

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NEUROLOGY

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Before we look at the current status quo we have to understand a few simple concepts of neurology. For instance every step that we take requires our brain to make a prediction in terms of surface level, firmness, slipperiness and the like, so as to balance the body properly and allow for adequate joint tension to deal with shock absorption issues etc.

In nature on uneven surfaces this is a very complex process indeed that engages many levels of neocortical (new brain) functions (s.a. memories, emotions etc.). These neocortical processes appear to provide stimulation, which benefits us in many as yet not clearly understood ways **(1,2,4,5-7,93)**.

What we do understand however is, that if we understimulate our feet through constant exposure to flat surfaces and inappropriate shoes, we will create far reaching problems not only in foot structure but also in related neurological function.

Eventually chronic understimulation of our feet will lead to a corruption of proprioceptive uptake from the foot to the brain as well as disturbance of intrinsic foot muscles, which then can compromise our posture and balance **(93,112)**.

Instead of using complex neocortical stimulation for step predictions such as on natural surfaces, the brain will become lazy and rather employ much more simplistic subcortical prediction patterns. In short it will start to get bored and also react with *Neurophysiological Stress Reactions* when exposed to unsuitable (flat, hard, always the same) surfaces **(17,18,93)**. Remarkably this also appears to happen with firm contoured devices (such as hard footbeds or orthotics) since for the brain it is always the same even if it helps aligning a foot distortion!!

It appears that what the brain likes is regular stimulation that provides continuous novel experiences, in other words; uncertainty followed by certainty. This is not an unusual concept as it relates to problem solving and survival and can be found throughout our nervous system. Just think of our minds; if constantly exposed to the same stimuli we get bored, if continuously exposed to just uncertainty we stress out **(93)**.

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STATUS QUO

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When looking at the incidence of current foot problems, one cannot help but be gravely concerned. Some groups (Footlevelers)(3) quote the incidence of foot problems at 80% by the age of 20 and even worse at 100% by the age of 40. This begs the question why?

As mentioned our modern urban life has created an ever-increasing mismatch between the currently common use of our feet on artificial flat surfaces and/or in shoes and the evolutionary design and intended use. This is putting untold strains on our feet. How can this lead to such a pandemic in foot disturbances?

Let us examine a few points a bit closer:

It has not been that long since humans **(especially urban)** started to live predominantly on flat hard surfaces. What does that mean for our feet?

For a start most surfaces are very hard which stretches our shock absorption capabilities to the limit. Our arches therefore start to feel the strain. Remember the average person in the "lazy" western world still takes about 5'000 steps a day.

Now one might argue that most people do wear shoes, which tend to provide some shock absorption. Whilst that is true, most shoe manufacturers still are victims of a misinterpretation on how our nervous system deals with shock absorption. It has long been assumed that vertical shock absorption (soft sole) is the key, however this has lead to a vicious cycle of heavier heel strikes during walking requiring ever-softer soles. Why? For the nervous system to make contact with the ground it will "punch" the heel through any soft surface to gain stability. Therefore excess sole softness tends to counteract what it is trying to achieve. What has been recognised is that horizontal or dispe**rsive shock absorption (more along the natural design of our foot arches!!) is CRUCIAL in order to reduce injuries (1,3,113,114,115).**

This brings us to the next more sinister problem that has its seat all the way up in our brain and has to do with brain mapping and brain plasticity **(4-12)**.

As research discovered, the brain is much more malleable even in adult life then was thought. This means the brain will constantly adapt to the environment. One way of doing that for instance in the case of our feet is, that it will constantly update the brain map (picture of a foot in the brain) according to its use or stimulation.

For instance since most of us use our little toes largely in unison the brain map that controls movement of our toes (motor map) becomes very undifferentiated (low resolution picture) resulting in an inability of the brain to move them individually. Likewise as the afferent stimulation of the foot sole (messages from foot sole to brain) become simple due to exposure to constant flat surfaces, the corresponding brain map simplifies. This then will lead over time to a loss of foot arch integrity and a lack of fine motor control of the foot by the brain.

Add to this scenario the current trend of little physical activities and remembering that brain conditioning requires regular stimulation; we can see that we now have a recipe for the current foot problem pandemic.

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e-bed™ CHARACTERISTICS

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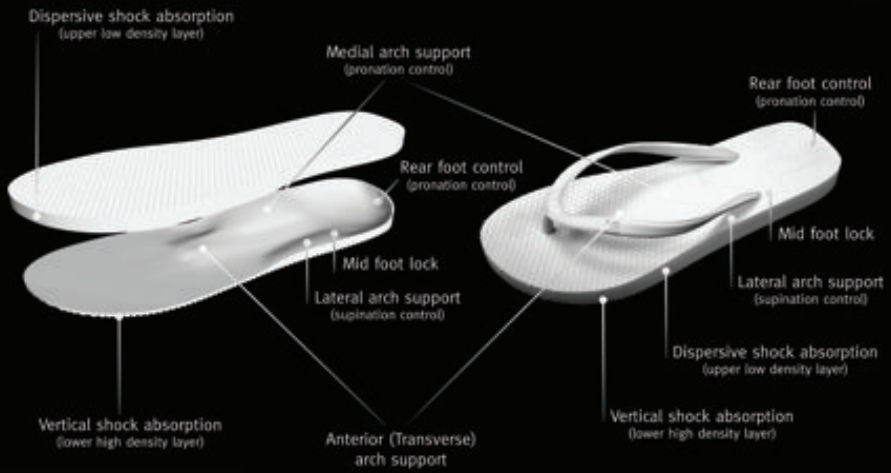
Pronation and Supination support via an invisible inbuilt triple arch with rear foot control, mid tarsal locking and a dual action shock absorption



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Therefore our aim has been to create a foot bed, which has all the characteristics required to combat this current trend of foot deterioration by providing a stable, controlled platform for the foot with adequate protective shock absorption (dispersive and neither too soft nor too hard), appropriate stimulation for a high resolution brain mapping as well as sufficient softness to allow proper windlass locking mechanism (90-108) and last but most importantly nervous system compatibility. *In simple terms we are mimicking the effects of natural surfaces, for which our feet have evolutionary developed and to which our nervous system is most adapted and receptive.*

All these qualities have been packaged invisibly into a **thin flat sole.**
This foot-bed includes Pronation and Supination support via an invisible inbuilt triple arch with rear foot control, mid tarsal locking and dual action shock absorption.
How did we do this and what makes this ***Neurorthotic™*** sole different from other orthotic devises?

a) The major visible difference to all other similar devices is that our footbed is flat, i.e. it has no visible contour - This has various advantages.

- Aesthetically when used in an open shoe such as a flip-flop **(e-flip by equilibras™)** it can look like the most popular flip-flops to date without a visible contour.

- Functionally by covering the contour layer with a softer upper layer it creates an ***upper dispersive shock absorption action*** perfect for the arches of the foot **(13)**. It also provides a constant deceptive flat surface providing uncertainty followed by certainty (nervous system compatibility)!

- The flat upper layer also graduates the impact on the firmer contoured layer underneath creating a similar effect to walking say on firm grass with harder densities in the soil. The main difference being that the higher densities are positioned strategically to achieve maximum control and stability. This then provides for a high degree of sensory stimulation maintaining a detailed brain map whilst allowing for smoother gait control.

- A flat upper sole also has the advantage of reducing blisters and sores thus is easy to get accustomed to. This is a very important property especially in cases of diabetes, soldiers or athletes.

b) Many contoured devices whether custom made or generic focus predominantly on alignment and therefore use mostly just a significantly high medial arch support. Occasionally we see a rearfoot controlled heel slant and/or a small lateral arch support, rarely a transverse (anterior) arch support. The problem with this approach is that whilst alignment is temporarily achieved, it also creates instability due to lack of mid foot locking paired with interference of the natural medial arch shock absorption mechanism.

Some researchers **(Dudly More)** also argue that this will eventually lead to muscle atrophy and eventually the loss of the arch structure. It also lacks the necessary contour relief needed for proper brain mapping and thus maintenance of healthy foot structure.

c) In order to impose its specific contour, our bottom layer is much firmer then the top layer. Being a generic device it aims at stabilizing excessive pronation as well as supination. It also aims at giving improved foot stability through the intrinsic mid-foot locking mechanism **(calcaneo-cuboid joint)(15,16)**, not only during the push off stance but also during the mid stance. This calls for an explanation - when walking **BARE-FEET** on uneven ground the foot needs to be flexible in order to adjust to the ground. This however is not required whilst wearing shoes on a flat firm surface.
It is therefore more desirable to maintain stability by activating the locking mechanism during mid-stance. This will minimize the stress particularly on the musculo-skeletal system and joints of the foot. With this clever addition we are able to achieve stability as well as neurological stimulation all at once! The compressible make-up of this layer further adds standard vertical shock absorption **(see dispersive shock absorption of top layer)**. The chosen density of the polyurethane material also acts in the same manner as industrial anti-fatigue matting, by greatly reducing fatigue (up to 50%). The characteristics of our footbed are therefore as follows:

- The rearfoot control consists of a medial to lateral slope placing the heel into a slight inversion **(supination)** assisting in the support of pronation **(14)** as well as the mid-foot locking mechanism **(15,16,27)**.

- The medial arch contour obviously assists in preventing excessive pronation, whilst still allowing for adequate shock absorption through that arch (especially whilst paired with a softer upper layer it creates the natural dispersive shock absorption action). Note that this arch contour is designed to stimulate arch proprioception and thus maintain the natural arch of the foot rather then support it. The misconception of support actually will lead to a gradual deterioration of the arch structure due to the lack of engagement of natural foot support structures as well as understimulated sensory afferentiation **(4-12)**.

- The lateral arch rises early just past the calcaneum under the cuboid. The pressure created by this elevation initiates the mid foot locking **(15,16)**, further assisted by the rear foot control.

- Even though the majority of adults in our society appear to have lost their lateral arch, the maintained ridge still acts as an aid for shock absorption and an important sensory stimulation for the lateral foot structures. It needs to be remembered that this arch is the first one to be activated during normal casual gait **(13)**. Furthermore the elongated lateral ridge of our foot bed also counteracts supination distortions.
- A last small elevation anterior to the medial arch gives stimulation to the transverse **(anterior)** arch of the foot. It is not big enough to create discomfort but just enough to elicit some proprioceptive stimulation for brain mapping.

- Overall the two layers are soft enough to allow for proper windlass locking mechanism **(91-109)** and the combined densities of polyurethane act like industrial anti-fatigue mats.

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RESEARCH / COMPARISONS

When we analysed the data from our double blind studies of neurophysiological stress response comparing walking barefoot vs walking on ordinary flip-flops vs walking on e-flips™ (17, 18)(New Flat-Sole Orthotic Flip-Flop vs Standard Flat-Sole Flip-Flop), it showed that not only did e-flips™ out perform the other two categories, but to our surprise they even did better then the control group which was tested at rest!

This is quite remarkable and we realised we were onto something special here. Whilst we have not been able to explain with confidence this outcome it sounds plausible that the riche and clever neurological stimulation of the foot-sole by our footbed is producing a very beneficial afferentiation into the nervous system which can create a detailed brain map **(4, 24, 25)**. Most likely the above-mentioned **(e-bed™ CHARACTERISTICS)** anti-fatigue properties contribute to this effect as well **(42-50)**.

We also know from studies with orthotics of similar characteristics to ours, that foot proprioception, pelvic rotation and stride length all improve. Remembering that the entire body acts as a kinetic chain network **(2,13,14,17-23, 28-37, 40, 41)**, we know that any distortions from the ground up need to be compensated for, thus requiring further effort and dexterity. This exposes us to a higher risk of injury, fatigue and poorer performance.

From our experience we now postulate at least five ***Neurorthotic™*** key areas that need to be satisfied by a footbed in order to avoid detrimental neurophysiological stress reactions:

- ***ALIGNMENT***
- ***STABILITY (CONTROL)***
- ***APPROPRIATE SHOCK ABSORPTION***
- ***(Adequate) SENSORY AFFERENTIATION (BRAIN MAPPING)***
- ***NERVOUS SYSTEM COMPATIBILITY.***

It is interesting to note that all five categories need to be addressed in order to get the best possible results and avoid neurophysiological compensations **(17, 18)**.

- For instance a good supportive contour without adequate shock absorption will create a neurophysiological stress reaction during locomotion, causing generalised transient muscle inhibition. This will then over time lead to compensatory biomechanical misalignments anywhere along the body's kinetic chain.

- On the other hand a soft footbed without stability and alignment will create the same neurophysiological tress reaction through the resulting amplification of existing foot distortions.
- Also some researchers **(Dudly More)** argue that exaggerated shock absorption (such as in many new expensive running shoes) can create proprioceptive misinformation thus leading to heavier and modified running styles causing higher risk of injuries as well as earlier fatigue.

Any of those scenarios will ultimately lead to a distorted or inadequate brain mapping with all its future implications.

Many shoe products only deal with some of these features! As we now understand this is a ***significant shortcoming***, and if inadequacies are maintained over prolonged periods of time, they can, through compensatory mechanisms, lead to substantial health issues **(19 - 23)**.

It should also be mentioned that disturbing the bodies' kinetic chain **(2,13,14,17-23,28-37,40,41)** might not be as benign as expected. Any of these changes if maintained can greatly affect existing injuries or weaknesses further up the body **(29,34-40)**. Particularly if affecting the nervous system for instance through subtle functional disturbance of the vertebral column, the resulting effects can range from mechanical over organic to neurophysiological problems.
Our research also suggests that proper footbeds not only have a role in injury prevention for all ages, genders and activity levels, but they also aid in enhancing body performance, be it during every day activities as well as during sport, as well as enhanced posture and balance.

When doing an extensive literature search on the subject of orthotic foot devices and their impact on various health issues it has been noted that in many areas studies have been rather inconclusive or often unsubstantiated. Could it be possible that many products tested did not offer the full spectrum of requirements discussed above in order to yield clearer outcomes?

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INCREASED PRODUCTIVITY IN THE INDUSTRY


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The damage caused to our bodies from prolonged standing is staggering, as it rivals other serious diseases such as cancer, stroke or heart failure. Current research (42-50) has shown that anti-fatigue matting (as in e-beds) can reduce fatigue in 100% of cases by as much as 50%. These are astonishing figures and have a major impact on diminishing this damage to the body and thus increasing productivity and profits at work (44-46).

Workers that are tired or in pain become a liability at their work place in many ways:

- Costly mistakes happen from diminished mental acuity, dexterity and physical agility.
- Reduced productivity and quality due to decreased attention to detail.
- Increased injury rates
- Increased absenteeism
- Decreased employer morale

A recent U.S. study found that common pain conditions (back pain, arthritis, and musculoskeletal disorders) among active workers cost approximately $61.2 billion per year in lost productivity. This equates roughly to 5.5 hours loss of productivity per week per worker. Considering the low cost and longevity of **e-beds™** against a loss of almost 1 day per week per worker it becomes an economic "non-brainer"…the money saved is staggering.

Many products have since moved into this market niche. These economic realities have in many companies around the world forced anti-fatigue matting to become a standard requirement for their workforce with the following results:

1. Reduced fatigue and resulting damage to feet, legs back and neck.
2. Decreased venous pooling in lower limbs (leading to circulatory congestion and complications) resulting in lower workload of the cardiovascular system (heart & circulatory system).
3. Retention of better ability to perform routine tasks.
4. Dramatic results especially from the third and fourth hour of standing.
5. Decreased musculo skeletal disorders (MSD) and decreased neurogenic fatigue problems (NFP) such as headaches, visual fatigue and concentration difficulties.
6. Better work force moral
7. Less absenteeism

A good anti-fatigue mat does essentially 3 things: it insulates against temperature extremes, it absorbs shocks to the body and it creates subtle leg movements preventing blood pooling and myospasm in the lower extremities. However it does NOT replace proper footwear.

e-beds™ go a lot further: their bilaminated polyurethane construction has the same qualities as good anti-fatigue matting (reducing fatigue by as much as 50%) **(42-50)**, but in addition they also provide all the qualities of a top orthotic foot bed, namely:

- Proprioceptive **stimulation** (support) and **alignment** (via the firmer bottom contour)
- Control via engaging the natural ***mid-foot locking mechanism*** **(15,16)** resulting in lower biomechanical stress of the foot support tissues. This also includes characteristics encouraging proper windlass ***(and reversed windlass) locking mechanism*** **(90-108)**
- Proper **sensory afferentiation** for quality brain mapping, which will lead to superior fine motor control and combat structural foot deterioration.
- Protection against **temperature** extremes
- Water resistant
- Anti-bacterial, fungicidal

As a result they significantly decrease in MSD and NFP, which is a major factor not only in productivity but also profitability, as sick days and the associated massive costs to employers are greatly reduced! **(44-46)**. They are also cost effective and since inbuilt in the shoes they are conveniently mobile anywhere anytime.

All these factors considered,* e-beds™ *are the best solution for industry available to date.

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INCREASED SPORTS PERFORMANCE


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Gymnastics

Much has been written in support of orthotic devices in sport. Foot orthotic devices are used in injury prevention, injury management as well as performance enhancement (17,18, 30-43, 47-49, 57-64). With the increased commercialisation of sport, the above factors have become essential in the management regime of athletes. Our extensive experience with elite professional athletes over the last 25 years certainly supports this view. There appears to be however a few discrepancies in the approach of therapeutic footbeds:

Firstly when should orthotic footbeds be used? Secondly what kind of footbeds should be used?

From all the evidence presented in this document so far it appears obvious that every serious athlete, professional or not, should take advantage of orthotic devices. - Why? – To recapitulate proper orthotic devices can support existing injuries or biomechanical distortions, help prevent negative kinetic chain reactions and their resulting injuries, can delay the onset of fatigue and last but not least can also improve performance by improving proprioception, fine motor control and range of motion **(30-50)**. Therefore it makes no sense, as often practiced, to prescribe them only when dealing with an existing injury. However an orthotic device needs to contain all the characteristics (see **e-bed™** characteristics) to be able to achieve all the claims made above. Here is where in our experience many devices fall short. – So what type of footbeds should be used? – Let's look firstly at the rigid, semi-rigid vs soft orthotic devices. There is growing evidence now that orthotic devices should preferably (with a few exceptions) be of a soft nature. Three points appear crucial in this view:

1. Only devices with appropriate shock absorption can prevent NSR (neurophysiological stress reactions). As we know NSR cause significant muscle inhibitions throughout the body, leading to poorer performance and higher risk of injuries or injury aggravations **(2,13,14,17-23, 28-37, 40, 41).**
2. Appropriate shock absorption is also necessary to combat fatigue **(42-50)**, which can overload the cardiovascular system and cause poor performance or training results.

3. Many scientists are also beginning to recognise that stimulation rather than support of the arches of the foot is required for lasting effects. This appears mostly to be borne from the observation that *supported arches* cannot act naturally, namely dissipate forces according to their design. This will then cause the support tissues of the feet to atrophy or deteriorate due to understimulation **(4-12, 51- 54).**

The next question relates to custom made versus generic supports. Most studies performed on the subject so far are inconclusive **(53-55, 64),** which then begs the question why spend much more money on a custom made device if a generic device can yield equivalent results and comfort. This debate is further clouded by the fact that many custom made devices are of a more rigid nature and do not necessarily posses all the pertinent requirements (see four core qualities – **e-bed™** characteristics) in order to achieve acceptable results for an athlete.

The e-bed™ again ticks all the boxes. It is of a soft nature with superior dual action shock absorption. It contains all the four core qualities (and more) needed to minimise NSR, NFP and MSD as well as delay fatigue and improve performance. It protects from temperature extremes, has anti-bacterial and fungicidal properties and is cost effective and convenient when inbuilt into your sports shoe.

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POLICE / ARMED FORCES


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The men and women of the Armed Forces and Police Corps have always been subject to tremendous physical strains. In the past flat feet (pes planus) and extreme high insteps (pes cavus) were rejected in the service. Two factors have since changed these requirements in many armies around the world: 1) The incidence of partially or completely flat feet has dramatically risen even in the last few decades to the point where many people consider it normal not to have transverse (anterior) or lateral arches. 2) Many Armed Forces and police Forces are experiencing low recruitment rates and are thus lowering their eligibility requirements. This has meant that many people with unsuitable foot conditions are now being subjected to serious long-term problems or have to drop out due to persistent foot disorders.

Few people on earth put their feet through more than a soldier does. Whether it is marching mile after mile carrying heavy gear, or manoeuvres through all types of terrain and temperatures, a soldier's feet must function at a high level in order for them to be successful.

Police personnel too spend long hours on asphalt or other hard flat surfaces, wearing heavy belts loaded with equipment. These conditions place untold strains on these people's feet resulting in:

- Poor performance
- Increased dropout
- Higher rates of MSD (musculo skeletal disorders) and NFP (neurogenic fatigue problems)
- Lower troop morale

Obviously adequate physical conditioning and correct footwear are a must **(65)**. As far as the footwear is concerned this is not as easy, as it sounds as changing conditions and conditioning of the feet changes the requirements **(65)**. However when it comes to the selection of footbeds various factors are paramount when considering soldiers or police personnel. Footbeds need to:

- Help protect feet and reduce /prevent MSD even when carrying heavy loads
- Delay fatigue
- Be durable and tough
- Provide adequate sensory stimulation to maintain foot health and fine motor control (dexterity)
- Protect against temperature extremes
- Have anti-bacterial & anti-fungal properties
- Be water resistant
- Be comfortable to wear
- Be cost-effective

At this point we need to stress that it is important for a footbed to be providing support for the arches via appropriate stimulation without excessive rigidity. This will prevent long-term problems such as support tissue atrophy and arch deterioration. In other words the footbed should not counteract the natural adaptive conditioning process, which people experience from prolonged physical stress.

Bearing this in mind, the **e-bed™** again is ticking all the boxes.

- The specific invisible inbuilt contour creates all the support, stimulation and foot locking needed for safety and high performance (by stimulating arches, supporting excessive pronation/supination distortions and providing stability through engaging mid-foot locking and windlass locking, reverse windlass locking respectively) **(15,16,32-49,54-63,90-108)**.
- Through its bilaminated polyurethane construction it delivers a dual-action shock absorption, providing protection from the damaging impact of weight bearing under heavy loads as well as significantly delaying fatigue **(42-50).**
- This dual-action shock absorption paired with the flat sole design provides great and immediate comfort without the need to wear them in.
- The polyurethane is a high quality insulator
- It also is very durable and robust, with an excellent memory lifespan **(4-10 times longer then normal rubber or EVA compounds)**
- It is water resistant, anti-bacterial and fungicidal
- Importantly **e-beds™** also are generic, meaning that one footbed fits all different foot types and can thus be worn by different people. Provided the shoe is right, fitting is no issue.
- And finally these qualities make **e-beds™** very cost-effective **(see INCREASED PRODUCTIVITY IN INDUSTRY / 42-45)**

On a side note: As many Navies require their personnel to wear flip-flops on board, the **e-flip™** would be the perfect solution as it is based on the **e-bed™** but comes in a flip-flop format.

When considering all these factors it becomes obvious that e-beds™ (e-flips™) should be the footbed of choice for Armed Forces and Law Enforcement Agencies around the world.

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DIABETES / HEALTH

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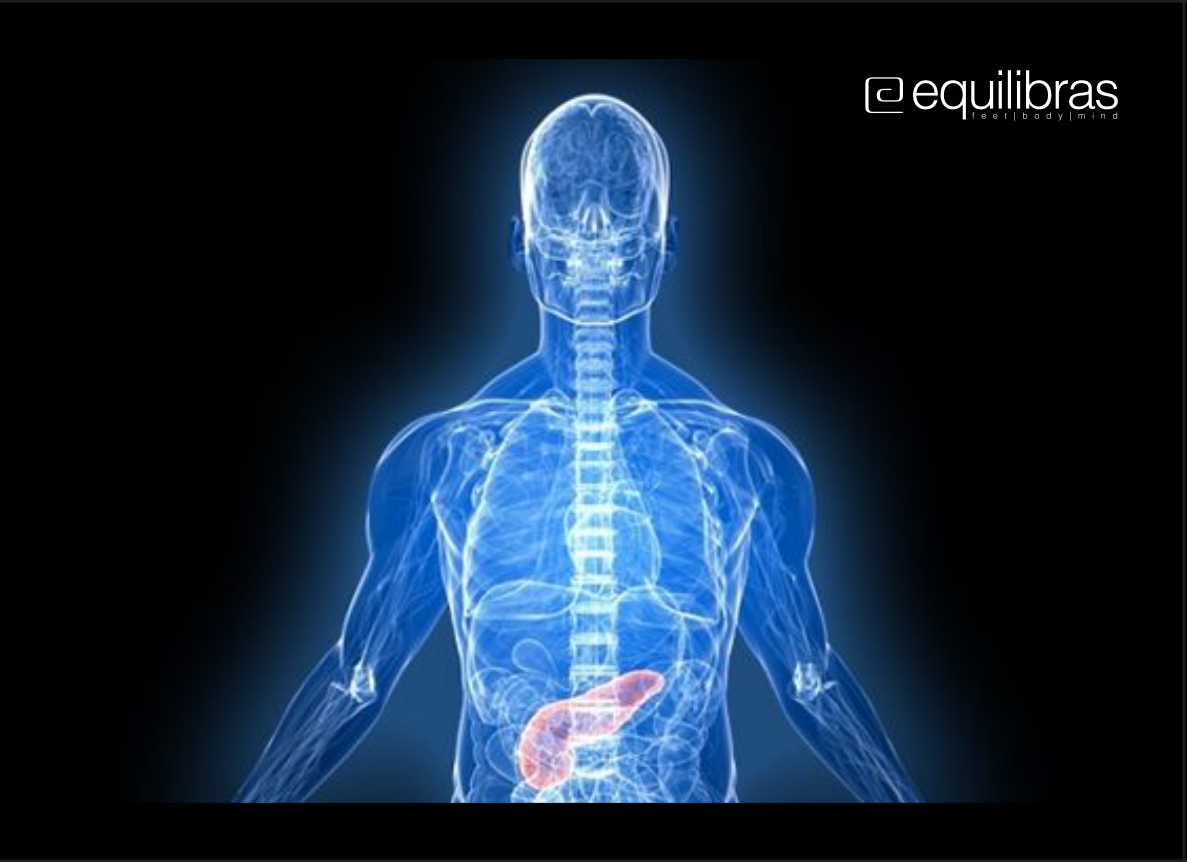

Diabetes is a common condition that can contribute to illness, disability and early death. Diabetes is on the rise worldwide and in many countries it is the fastest growing chronic disease. The Australian Government for instance estimates that over 20% of its population is suffering from the disease and many are not even aware of it. Worldwide it is estimated that 246 million people have the disease. Diabetes and its associated complications, which include heart, kidney and eyes diseases, affect the quality of life of a large number of people (74, 83-89).

When looking at footwear for a person suffering from diabetes, there are several factors to be considered:

- The shoe must minimise the risk of ulceration, which due to poor circulation and innervation is very common. Small blisters can develop into ulcerations, which often lead to lower limb amputation **(75,76,79-83,87,89)**.
- The shoe must be comfortable and have adequate shock absorption to minimise fatigue as seen in anti-fatigue matting **(see INCREASED PRODUCTIVITY IN INDUSTRY)**. It must also provide micro-movement in order to prevent blood pooling in the lower limbs, which will lead to an increased load on the cardiovascular system, in particular the heart. Since heart issues are already a feature of diabetes, this needs to be seriously avoided **(42-47,49,50,78,83,84).**
- Cardiovascular strain should further be alleviated by an appropriate soft orthotic contour in order to diminish ineffective biomechanics and MSD. The tricky part here is to use an effective orthotic contour that does not cause tissue irritation or scarfing **(53,61,75-78,82).**
- An effective generic orthotic contour not only diminishes stress on the wearer but also tends to be more cost effective than a custom made device.
- The innovative flat-sole design of the **e-bed™** provides some unique and effective qualities well suited for people with sensitive feet, poor circulation and a need of proper support (as with diabetes).
- The flat-sole design prevents irritation and the formation of blisters from the footbed as the foot strikes a flat surface.
- As this surface is softish it feels comfortable yet still supportive. The latter comes from the gentile but definite stimulation of the invisibly inbuilt orthotic contour.

- The dual-action shock absorption allows for dispersive force dissipation through the upper layer in line with natural arch shock absorption. A further vertical absorption through the firmer bottom layer still allows for good control.
- The facilitation of the windlass and reverse windlass locking mechanisms **(90-108)** as well as the engagement of the natural mid foot locking mechanism **(15,16)** add further stability to the foot even in an open shoe **(e.g. e-flip™)**.
- A complete orthotic contour also encourages a high quality sensory afferentiation leading to high-resolution brain mapping. This allows for good fine-motor control and maintenance of natural foot structure (arches etc) **(4-12)**.
- Being a generic device it is very cost-effective and versatile plus easy to fit.

Likewise these qualities have also been shown to be useful in diminishing the incidence of spontaneous ankle bleeds in Haemophilia sufferers **(110).**

Of course improving alignment, control and proper shock absorption with a smooth non irritating contact to the sole of the foot is a package that can assist in many health related disorders such as many types of arthridities (Osteo, Rheumatoid, Stills etc), MSDs (musculo skeletal disorders) such as overuse injuries, as well as NFP (neurophysiological fatigue problems) **(2,13,14,17-23, 28-37, 40, 41,109).**

As equilibras™ provide a foot bed (e-bed™) as well as an open shoe (e-flip™) sufferers can now enjoy all those advantages anywhere, anytime.

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CHILDREN

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The 26 bones and 35 joints of the human foot go through a major transformation in early childhood. It takes from 5 to 6 years until the triple arch configuration resembling that of an adult foot is achieved. Generally babies start off with flat feet. From the time they start to walk (8-18 months) the calcaneal (heel) inclination angle starts to increase, eventually tensing the plantar aponeurosis, giving rise to the foot arches (3, 26).

This process is important to establish a proper windlass mechanism and thus stability through the various phases of gait or stance. The triple arch structure can act as a tri-pod providing stability on uneven ground, as well as a spring like shock absorber protecting the foot against the 3-5 g-forces produced during normal locomotion **(1)**.

As we have mentioned under **STATUS QUO**, it has not been that long since humans started living mostly in shoes and predominantly on flat, hard surfaces. This will understimulate the receptors of the foot preventing more and more often the child's foot from developing properly. ***In these cases early intervention is vital, for if a child continues to walk on this foot type, the condition rapidly becomes irretrievable.***

Due to these circumstances it makes sense to allow kids to walk as often as possible on soft natural (and safe) surfaces, which will also condition their feet properly. Since that is often not possible in our modern urban societies, it is paramount to choose footwear wisely.
The following are some of the important qualities to consider:

- The shoe should be wide and spacious as not to restrict foot growth.
- The sole must be soft and flexible as to allow for proper development of the foot architecture **(90-108).**
- A low, soft contoured foot bed is advisable to provide appropriate sensory stimulation, aiding in the correct natural foot development **(4-12)**
- Obviously external materials should be child friendly and non-toxic as well as comfortable.

Let's now look at the performance of the **e-bed™/e-flip™** in regards to these requirements:

- The **e-flip™** in particular offers plenty of freedom for the foot, so it can develop without compromising the required qualities of the footbed.

- Both the **e-bed™** as well as the **e-flip™** are soft and flexible allowing for proper foot development.
- The invisible inbuilt contour is perfect for the development of the child's foot, as it is gentle yet highly stimulating and stabilising at the same time. It mimics walking on natural flat surfaces with various densities thus giving ample sensory stimulation for a proper foot development as well as maintenance thereof **(4-12).**
- The polyurethane has a long-lasting memory and is completely non-toxic.

Let's not forget that proper foot development does not just affect the health of the feet, but has an impact on the entire musculo skeletal system, the cardiovascular system and the nervous system **(34-51,56-65).** It is therefore very important and pertinent that parents and guardians carefully choose the footwear for children from the beginning as soon as they start to walk.

A proper *NEURORTHOTIC™* footbed (e-bed™ / e-flip™) is NOT A LUXURY but should be A UNIVERSAL REQUIREMENT if we are to seriously combat the ever worsening foot crisis we find ourselves in.

Sister (6 years old) after 2 months wear of ordinary flip-flops - Note foot pronation and flip-flop collapse

Brother (10 years old) after 5 months wear of e-flipsTM - Note good foot alignment and great condition of flip-flop.

Wear comparison: left ordinary after 2 months, right e-flipsTM after 5 months

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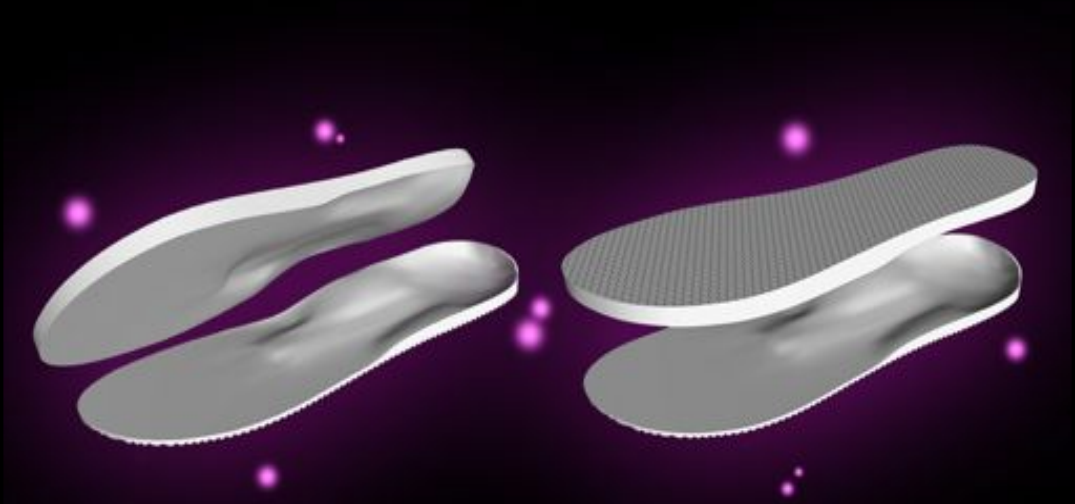
NECESSARY MARKET



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The common attitude to date by the general public as well as many health professionals seems to be that footbeds/orthotics are simply used to alleviate and help control existing problems. As we have seen this approach has some serious shortcomings and considering our current scientific understanding (4 -12, 17,18, 29-40, 46-51, 61) this is not only inadequate but also illogical.

Firstly we have to realise that potentially the vast majority of people are walking around unaware of their existing foot malfunctions. Unless they experience discomfort or symptoms that are linked to the feet how can they know?! Of course as any health care practitioner will tell you, problems frequently exist long before symptoms develop.

Secondly it has been a longstanding debate within professional circles as to when and indeed whether kids should start to wear orthotics/specific footbeds as they are still in the developing phase. In light of the extensive research available regarding brain mapping and brain plasticity **(4 -12)** and the information presented in **'CHILDREN'**, the answer seems a "no-brainer". If we accept the premises that our lifestyle on predominantly flat surfaces with simple, flat footbeds understimulate our brain **(poor sensory afferentiation leading to poor brain mapping creating inadequate foot control through our nervous system)** leading eventually to a compromise of the foot structure, then logic dictates that kids as soon as they start weight bearing **(26)** should be exposed extensively barefoot to uneven, natural surfaces.

However since much of their lives tend to take place on flat, hard surfaces they **SHOULD ALL** use footbeds, which offer the right stimulation for a healthy sensory afferentiation. ***This habit should then be maintained throughout ones life, as the brain mapping is a continuous, dynamic process allowing us constantly to adapt to our environment.*** Let's not forget the other three core qualities we have discussed, as right from a young age their nervous system will be reacting with NSR to any unfavourable exposure of the feet.

Due to the incredible results we are getting with **e-flips™** and **e-beds™** we have positioned our products in medical as well as more specialised fields. However as we now know everyone should wear our **equilibras™** - everyone should wear footwear with the ***Neurorthotic™*** properties included in **equilibras™** especially the 5 core qualities.

This footbed therefore addresses the following 4 core qualities:

1. **Alignment**
2. **Stability**
3. **Shock Absorption**
4. **Adequate Sensory Afferentiation**
5. **Nervous System Compatibility**

1. Preventing excessive pronation/supination that cause negative kinetic chain reactions.
2. Engaging natural foot lock mechanisms thus also reducing stress on support tissues.
3. Dual-action for protection against MSD, NFP and Fatigue.
4. Brain Mapping, allowing for good quality fine motor control and maintenance of normal foot structure.
5. Thus avoiding neurophysiological stress compensations.

FURTHER QUALITIES of PU are:

- More **durable** then rubber or EVA compounds **(=much longer memory).**
- It has **anti-fungal and bactericidal** properties.
- It is also **water resistant**
- Insulating against **temperature** extremes.

As one can see this simple looking *Neurorthotic™* flat-sole footbed (equilibras™ e-bed™/e-flip™) is innovative and deceivingly complex. It packs a serious punch and it's incredible versatility and unbelievable performance puts it on top of the field. It must be anyone's first choice when selecting footwear.

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equilibras™ are the first flat-sole to be registered by the
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as a **neurological and orthotic medical device.**

Trade Mark Registrations relate to:
equilibras™ (brand name),
e-flip™ (flip-flop),
e-bed™ (footbed)
Neurorthotic™ (neurologic and orthotic qualities).

The **equilibras™** concept is protected by **PCT** and **patents.**

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