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"HUMAN PERFORMANCE OF LOWER KINEMATIC CHAIN"

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- **The enclosed presentations are the views of the author and not necessarily the views of Nike.**

I am delighted to be here today to share with you some of my views on the health, importance of strength and well being of the human foot and it's relationship to performance and injury.

As a Physical Therapist I have had the opportunity to work with so many of the stars of athletics, over 500 Olympians including 53 Olympic medal winners, numerous world champions and record holders, indeed some of Britain's most prolific athletes, Colin Jackson, Linford Christie, Liz Mc Colgan, Kelly Holmes and Paula Radcliffe.

My interest in functional biomechanics and human performance goes back to 1975. I was fortunate when I started competitive athletics to have a coach who had great practical knowledge.
He advocated to his athletes to run barefoot on grass to strengthen our feet.
On a regular basis we trained barefoot, running up and down sand dunes. We did exercises to strengthen our feet, which involved skipping and bounding.
I won several national titles in middle distances and won seven Irish triathlon titles and competed in World triathlon and Hawaii Ironman events.
In 15 years of competitive sport I only suffered one injury. I know firsthand that running barefoot and strengthening my feet protected me from overuse injury.

Many coaches have advocated barefoot training and strengthening of the feet
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In my profession as a physical therapist I realized how many athletes were debilitated with lower kinetic chain injury.
Moses Kiptanui ruptured his Achilles tendon and that ended his international career. So too did the US 1,500m champion Suzy Hamilton.
Kelly Holmes ruptured her Achilles in 1998 and is one of the few athletes to have won Olympic gold medals post surgery.

It is my view that most people's feet are redundantly weak.
The deconditioned musculature of the foot is the greatest imbalance resulting in injury that I see in my practice.

Mankind by relying on footwear to control and protect the foot has allowed the foot to become weak and deconditioned.

The focus by the athletic footwear industry in the past 25 years in treating the foot as a weak link that needs to be packaged, cushioned and controlled in motion by anti-pronation devices has its limitations.
It solves one problem but it presents us with another.

Let me use the analogy of a cervical collar. - (Demo)

If a cervical collar is worn for a long period of time the muscles become redundant and weaken, we term this disuse atrophy. The person ends up with a bigger problem because the weight of the head does not change yet the muscles are weaker and the muscles that are functioning have a greater job in holding up the weight of the head.

This analogy relates directly to the feet.

If a biological structure is supported it will weaken.
Wolf's Law states that, "The body adapts to the stresses placed upon it".
Leonardo da Vinci described the foot as "a masterpiece of engineering and a work of art".

Certainly feet are an amazing structure. Healthy feet allow us to live a very active lifestyle. Unhealthy feet can be very debilitating.

I have worked with over 100 world-class African athletes, Kenyans, Ethiopians, South African and Moroccan athletes.
Most of these athletes never wore shoes until their late teens.
They have few foot defects.
The ranges of their foot motions are remarkably great, allowing for full foot activity.

In developed countries shoes are worn from a very young age. I believe that we have become dependant on footwear to protect the foot resulting in disuse of the intrinsic muscles leading to a Functionally deficient structure.

It is well known that restrictive footwear; particularly ill-fitting shoes cause most of the ailments of the human foot.
Foot defects such as Hallux Valgus, Hallux Rigidus, Hypo-mobile subtalar joints, poor flexion/extension capabilities of the toes etc. Many of these conditions have resulted due to the feet being restricted in footwear.
Footwear reduces sensory feedback. The bulkier and more supportive the shoe the greater the sensory deprivation.

With all the athletes I work with the first thing I check is balance. - (Someone from audience).

Feet do not work in isolation. The central nervous system originating in the brain controls proprioception.
Around our ankle joints are nerve endings or balance organs called Ruffini End Organs, part of the peripheral nervous system. These proprioceptive nerve organs responsible for keeping balance in check need to be constantly stimulated and trained. If you don't use them you lose them.

Our feet are all part of the human kinetic chain.
The kinetic chain describes the human locomotive system as a series of joints in the lower extremity, i.e. foot, ankle, knee, hip, SI. Injury or a weak link in the kinetic chain has an adverse affect on the other joints and their supporting structures i.e. ligaments, tendons, and muscles.

I have witnessed so many people with deconditioned feet being prescribed orthotiocs to support the feet.
Orthotics only hold up a weak structure. Like the cervical collar holding up the neck the orthotic device will do a good job in supporting a weak foot.
Use orthotics for a period of time without doing specific exercises for the feet and the ruffini end organs become redundant, muscles become weaker and one becomes dependant on the extrinsic orthotic device because without them the weak foot cannot adequately support the weight of the body in locomotion.

Feet are the contact point with the ground. They should be the strongest link.The muscles around the ankles should be strong enough to give structural support.

Depending on shoes with antipronation devices and orthotics is not the solution.There has been a lot of focus over the years on pronation in locomotion.
The athletic footwear industry designed shoes on a straight last and added anti-pronation devices to control excessive pronation.
Pronation is a normal function of locomotion. The gait cycle in walking and running can be divided into stance and swing phase.
The stance phase consists of heel strike, mid-stance and propulsion.
At heel strike the foot begins to pronate in order to adapt to the terrain and to absorb shock.
Pronation continues until the early part of the mid-stance when the foot begins to re-supinate in order to provide a rigid lever from which to propel.
Pronation should be controlled by the eccentric contraction of the Tibialis Anterior and Tibialis Posterior muscles and the synergistic contraction of the deep intrinsic muscles.

Both the amount of pronation and the rate of pronation should be controlled by muscular activity.

The use of orthotics and anti-pronation devices should be confined to people who excessively over-pronate or those with leg length discrepancies or those with overt biomechanical defects.

Muscles if adequately strong should decelerate the rate of pronation.

What is the solution?

The solution is to correct the underlying problem of structurally deconditioned feet and to strengthen the weak link within the kinetic chain.
The strengthening exercises that I advocate are beneficial for recreational athletes to world-class athletes.
The programme is designed to increase the following components of foot health via:

(a) Flexibility.
(b) Proprioception.
(c) Strength.
(d) Dynamic strength.
(e) Foot Detox

Flexibility

- Soleus.
- Gastrocnemius.

Proprioception-(Improve balance, unilateral stance exercises)

- Eyes closed unilateral stances hold 30 sec.
- On wobble board.
- On foam mat.
- With medicine ball.

Strength

(1) Marbles pick up with toes.
(2) Pencil pick up with toes.
(3) Step downs.
(4) Eccentric heel drops – calf raises.
(5) Theraband, dorsiflexion, inversion, eversion.
(6) Wear Nike Free throughout day.
(7) Incorporate 20 – 30 min. runs with Nike Free

Dynamic Exercise Programme

- Bunny Hops.
- Zig zag bunny hops.
- Single leg hops
- Zig zag hops.
- Box jumps.
- Step up test.

Foot Detox

- Epsom salts baths – Baking soda hot footbaths.
- Reflexology.
- Massage.

I reinforce a few simple statements to the athletes I work with:

1. Structure governs function. If structure is weak then function is compromised. Structural weaknesses or imbalances lead to structural – functional breakdown.

2. The foot is the contact point with the ground. It should be the strongest link. Shoes do not cause injury. Weak feet cause injury.

3. Stronger, healthier feet lead to better performance in terms of ankles, knees, hips, and lower back, all the way up the kinematic chain.

4. It all starts with strong feet. The foot should have control over the shoes, rather than having the shoe control the foot.

Three years ago in Nike's innovation kitchen, their research and developments team heard that Vin Lanana, the USA Olympic track and field coach and the head coach at Stanford University was an advocate of barefoot training.
Coach Lanana`s testimony was;
"I can't prove this, but I believe that athletes that train barefoot run faster and have fewer injuries. It's just common sense."
Nike went further afield and linked up with world-renowned coaches and top athletes.
The concurring feedback was the demand for "Natural Motion".

New Zealand coaching legend Arthur Lydiard`s endorsement came from over 30 years of coaching Olympic champions stated:
"You support an area, it gets weaker. Use it extensively, it gets stronger. If I'm training you as an athlete, I'd get you on the legs, work your ankles, - you'll get the muscles and sinews stronger there. You don't get shin splints and you get flexible power in ankles. You run barefoot and you don't have all those troubles."

Nike already knew that many of the African athletes endorsed a more minimalist shoe for training and competition. They now had many of the top coaches endorsing “Natural Motion” along with athletes like Paula Radcliffe and Craig Mottram endorsing footwear that allowed the foot to function naturally.
Nike shoe designers turned to their own (NSRL), Nike sports research lab. in Beaverton Oregon and concurrently engaged Professor Peter Bruggerman at the University of Cologne sports research laboratory to do independent research on barefoot running.
Trials were conducted and the results were extremely encouraging.
Running barefoot results in an even distribution of pressure pattern. Conventional running shoes showed sharper peak forces.

Think of a bed of nails. Thousands of nails, each one right next to one another. You could lie down on it.
Now think of lying down on a nail, one nail. - Ouch!!

Nike then set about rethinking shoe design.

All shoes up to this point were designed on a traditional last, which is a hard piece of plastic in the shape of a foot. It’s just a shape. It does not move or bend or twist. It’s stiff and rigid unlike the human foot.
The human foot has 26 bones that move and articulate. Nike designed the first last that moves, bends and twists. It was built to work like the human foot.
Out of this last Nike engineered a sports shoe to match the contours of the bare foot. It was christened “NIKE FREE”.

The shoe mimics the natural mechanics of the foot. Flex grooves and longitudinal siping on the sole allow great flexibility and provide an even dispersal of pressure that matches barefoot training.
A dynamic heel pocket to allow natural movement and reduce friction to the heel was added instead of a rigid heel counter.
In all Nike Free is engineered to match the contours of the bare foot.

Nike's research showed that women's feet are more flexible than men's so a double reverse groove was added to the outsole of the women's shoe to allow greater flexion and extension of the toes.

Nike Free shoe is not a running shoe in the traditional sense.
It is a shoe that works in synergy with traditional footwear and gives people the opportunity to strengthen their feet and improve their technique, balance and agility.

Nike Free is primarily a training aid.

Most of the athletes I work with wear Nike Free as an adjunct to their main training to improve the foot's natural function and increase strength in the foot and ankle.

Paula Radcliffe does easy 30 – 40 min. runs in Nike Free to strengthen her feet and ankles and I am finding that more athletes are implementing such runs in their training regime.

Interestingly the research and development of Nike Free has had two primary benefits.

1. Nike correlated a lot of interesting biomechanical data from "barefoot technology" in developing Nike Free, which they are now implementing into their mainstream sports shoes, (Show example).

"Natural motion" is a product of Nike Free but most Nike footwear now incorporates natural motion in its design.

2. In physical training terms, all the focus in the past has been on strengthening the upper body and the upper kinetic chain, i.e. hamstrings, quads etc. There is now greater awareness and focus on the lower kinetic chain and the benefits of strengthening the ankle and foot to maximize human performance and limit injury.

Thank You.