

# biomech

C O N S U L T I N G



**WHAT DO WE MEAN BY FUNCTIONAL ORTHOSIS?**

In the 1970s, Dr Merton L. Root published what has possibly been the most influential article in the development of foot biomechanics around the world, and in the English-speaking world in particular.

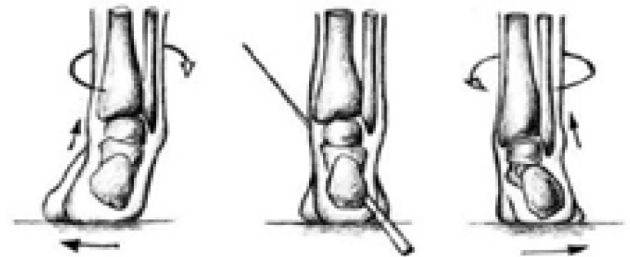


The article, explaining what has become known as the **Root biomechanics model**, provided a perspective of the biomechanical behaviour of the foot that differed greatly from the vision that existed at that time.

He introduced novel concepts such as the subtalar joint neutral position, locking the midtarsal joint, the forefoot-hind foot relationship and bisector line of the heel when it is perpendicular to the floor during the total support phase of the gait cycle (2nd rocker) as the ideal foot position during this gait moment.

Taking these principles as a reference, he developed the first classification of the foot based on its mechanical behaviour.

He established that foot pathomechanics were mediated by the existence of one or more of the following clinical situations: forefoot varus; forefoot valgus; plantar-flexed first ray; rear foot varus, rear foot valgus; and ankle equinus.

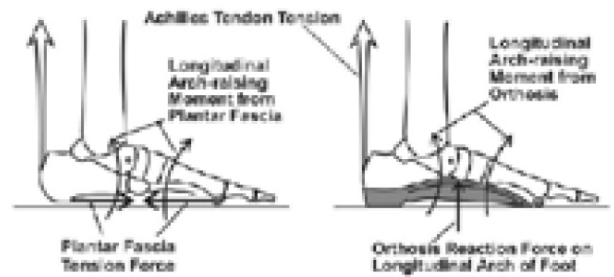


With the aim of modifying the pathomechanics presented by feet as a result of these clinical disorders, Dr Root developed a concept of orthopaedic treatment based on foot orthoses, whose aim was to maintain the subtalar joint in a neutral position with the midtarsal joint fully locked and the heel bisector line perpendicular to the floor.

To achieve these goals he described a technique for taking plaster casts that simulated the manoeuvre performed to assess the forefoot to rear foot relationship, followed by a series of modified positive casts.

Of all these modifications he discovered, the balance platform for the forefoot was the most innovative and significant as it aimed to correct forefoot-hind foot misalignment and keep the heel bisector line perpendicular to the ground (at 0° VR/VR).

From the modified positive casts, a polypropylene foot orthosis was thermoformed that Root called “functional foot orthoses” as he understood that they modified foot functioning, unlike prefabricated insoles that were often prescribed until then in orthopaedic practices and that were made of softer materials (they were also known as accommodative orthoses).



Voices were raised in the following decades questioning Root’s model because there were clinical situations that could not be explained by this biomechanical model.

These situations, which have been termed black spots of Root’s biomechanical model, highlighted that many of the principles that Root’s model was based on were not as he had described them, as later research studies have shown, partly thanks to technological advances.

This gave rise to the advent of new biomechanical models that aimed to bridge the gaps left by Root’s model.

Among these, it is worth highlighting **Dr Dananberg’s sagittal plane facilitation model and the rotational equilibrium across the subtalar joint axis model described by Dr Kirby.**

The latter model, complemented by contributions about centres of pressures by Dr Fuller and about tissue stress from Dr McPoil, has evolved into what is known today as the **Tissue Stress Model**, which forms the basis of clinical practice in foot orthopaedics in the present day.

However, although new biomechanical models have replaced the concept of the mechanical principles on which foot functioning is based, they have all maintained the concept of functional orthoses developed by Dr Root as a cornerstone of treatment.

It is true that his original description has been altered; new concepts have been incorporated, such as the inverted forefoot platforms, medial or lateral heel skives, heel modifications, or extrinsic elements have been added to the insoles, including kinetic wedges.

However, the excellent therapeutic results obtained with these orthoses are what has enabled them to stand the test of time and what has made researchers work hard to gain a better understanding of the real reasons why functional orthoses are effective in the treatment of foot pathologies.

