

FOOT ORTHOSIS PEARLS: EFFECTIVE USE OF REVERSE MORTON'S EXTENSIONS

Dudley Joy Morton (1884-1960) was a physician, anatomist and anthropologist who, in 1935, published the book, *The Human Foot, It's Evolution, Physiology and Functional Disorders*, which is one of the most important early works on mechanical pathologies of the human foot. In his book, he theorized that a shortened first metatarsal, or “hypermobility of the first metatarsal segment”, correlated strongly with excessive pronation of the foot and its associated pathologies. Dr. Morton even patented a “compensating insole” in 1927 that supported the medial arch and incorporated an extension plantar to the first metatarsal head which was subsequently known as a “Morton’s extension”. Morton believed that by supporting the first metatarsal head that was “hypermobile”, many foot pathologies could be effectively treated.

Even though the Morton’s extension is still used by podiatrists as an orthosis modification, another common, but perhaps misunderstood, orthosis modification is the “reverse Morton’s extension”. Instead of the plantar 1st metatarsal head extension of the Morton’s extension, the reverse Morton’s extension consists of a forefoot extension of flexible, non-compressible material plantar to the 2nd through 5th metatarsal heads, extending from the distal orthosis shell to the digital sulcus (Fig. 1). The reverse Morton’s extension is typically attached to the orthosis shell by a flexible topcover material such as vinyl, leather, EVA or neoprene. I first saw the reverse Morton’s extension being used during my freshman year at the California College of Podiatric Medicine in 1980. Therefore, it is likely that the reverse Morton’s extension modification has been used in custom foot orthoses for much longer than 45 years ago when I first saw it being used.

After four decades of designing and creating custom foot orthoses for my patients, the reverse Morton’s extension is still one of the most commonly-used and therapeutically effective forefoot extension designs in the many orthosis modifications used in my podiatric practice specializing in the biomechanical treatment of foot and lower extremity pathologies. Unfortunately, not all podiatrists are familiar with the many clinical uses of the reverse Morton’s extension and tend to under-utilize this valuable modification not only in their custom foot orthosis prescriptions, but also in their shoe insole and over-the-counter (OTC) foot orthosis modifications. Thus, the purpose of this newsletter is to discuss the important uses of the reverse Morton’s extension in the treatment of biomechanical pathologies of the foot and lower extremity.

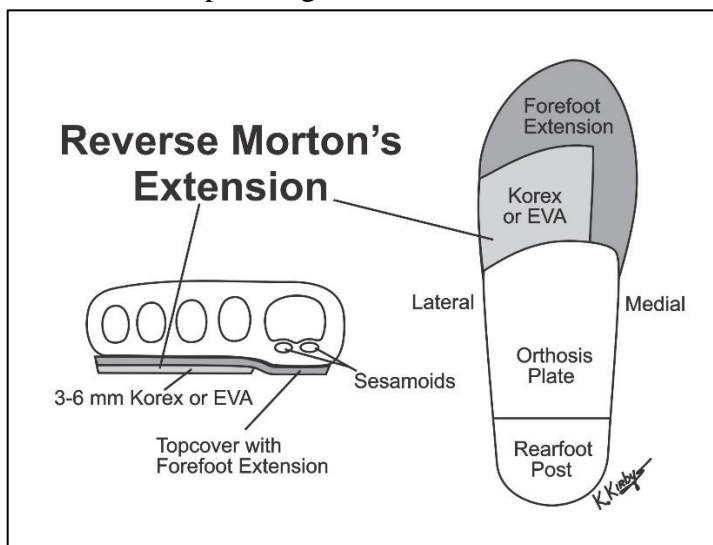


Figure 1. The reverse Morton’s extension orthosis modification consists of a forefoot extension of variable thickness of a flexible, non-compressible material, such as korex or EVA, plantar to the 2nd – 5th metatarsal heads which will reduce the ground reaction force plantar to the 1st metatarsal head and also increase the pronation moments acting across the STJ during weightbearing activities.

One of the more common reasons that a reverse Morton’s extension would be used in the custom foot orthosis is to off-load the plantar aspect of the first metatarsal head. By reducing the compression force from ground reaction force (GRF) acting on the first metatarsal head and sesamoids, conditions such as sesamoiditis, sesamoid stress fractures and degenerative joint disease of the 1st metatarsal-sesamoid joints can be effectively treated with a reverse Morton’s extension of 3-6 mm thick korex or EVA, when combined with a well-designed, anti-pronation custom foot orthosis. Of course, the more damaged and painful the sesamoids are, the less chance that a reverse Morton’s extension will cure plantar 1st metatarsal head pain. However, in many cases, plantar 1st metatarsal head pain, or pain in the sesamoid region, will be considerably reduced in the active patient by incorporating a reverse Morton’s extension in a well-designed anti-pronation custom foot orthosis.

Functional hallux limitus can also be effectively treated with the judicious use of reverse Morton's extensions in foot orthoses. Functional hallux limitus is a condition where there is normal 1st metatarso-phalangeal joint (MPJ) dorsiflexion range of motion during the non-weightbearing examination, but, during standing, there is a restriction of 1st MPJ dorsiflexion motion. Functional hallux limitus commonly occurs in a foot with a lower-than-normal longitudinal arch height due to increased tension within the medial bands of the plantar fascia which are attached to the sesamoids (Kirby KA: *Foot and Lower Extremity Biomechanics II: Precision Intricast Newsletters, 1997-2002*. Precision Intricast, Inc., Payson, AZ, 2002, pp. 139-152).

In functional hallux limitus, GRF acting on the plantar aspect of the 1st metatarsal head will increase the dorsiflexion rotational forces (i.e. moments) acting on the 1st ray. If the foot becomes excessively pronated, the magnitude of tension force within the medial band of the plantar fascia attaching to the sesamoids is also greatly increased. This increase in tension force within the medial band of the plantar fascia will increase the hallux plantarflexion moment which will, in turn, tend to reduce the possibility that normal hallux dorsiflexion (i.e. 1st MPJ dorsiflexion) will occur during walking. If the plantar fascial tension force is strong enough and the medial longitudinal arch height is low enough, then functional hallux limitus will likely occur. By not allowing a normal hallux dorsiflexion during gait, hallux limitus is thought to increase the compression force within the dorsal half of the 1st MPJ, possibly increasing the risk of degenerative loss of joint cartilage and hallux rigidus occurring over time (Flavin R, Halpin T et al.: A finite-element analysis study of the metatarsophalangeal joint of hallux rigidus. JBJS, 90-B:1334-1340, 2008). Thus, by using a reverse Morton's extension to reduce the GRF on the first metatarsal and first ray in an anti-pronation foot orthosis, normal hallux dorsiflexion should be restored in patients with functional hallux limitus, thus improving their gait and decreasing the risk of hallux rigidus from occurring over time.

Another common use of the reverse Morton's extension in my podiatric practice is in the treatment of any number of supination-related pathologies in the patient. By adding a reverse Morton's extension to a foot orthosis in a patient suffering from supination-related pathologies such as peroneal tendinopathy, chronic inversion ankle sprains and/or lateral column symptoms, the "valgus-wedging" in the forefoot extension of the orthosis will increase the subtalar joint (STJ) pronation moment acting on the foot which will reduce the supination-related symptoms of the foot. Individuals with these supination-related pathologies will tend to have a laterally deviated STJ axis with either a cavus foot deformity, a metatarsus adductus deformity and/or an increased rearfoot varus deformity (Kirby KA: Subtalar joint axis location and rotational equilibrium theory of foot function. JAPMA, 91:465-488, 2001). In these cases of lateral STJ deviation, where the foot is suffering from symptoms related to over-supination of the foot, the goal of the foot orthosis is to **pronate** the foot out of its over-supinated position so that the supination-related symptom will resolve over time.

To reduce the supinated position of the foot, a custom foot orthosis should be designed with a flat rearfoot post, a lateral heel skive, a lower medial arch height, an addition of filler material under lateral arch of the orthosis (i.e. Denton modification) and a reverse Morton's extension in order to achieve good relief of the supination-related symptoms for the patient. Often in these cases, I will also add additional thicknesses, generally 3 mm at a time, of korex or EVA plantar to the 4th and 5th metatarsal region of the reverse Morton's extension to try and further pronate the foot so that excessive supination of the foot is better corrected with the custom foot orthosis and the patient's symptoms are further improved.

Even though the reverse Morton's extension may be under-utilized by some podiatrists, it is still a valuable modification which may be ordered not only into custom foot orthoses, but also added onto the patient's shoe insole or their OTC orthoses. By understanding the biomechanics of reverse Morton's extensions on foot and lower extremity function, the treating podiatrist will greatly improve their therapeutic outcomes by judicious use of this useful forefoot extension in their custom foot orthosis prescriptions.



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