

Custom Carbon Ankle Foot Orthosis (CCAFO).

Medical Necessity and Justification.

January 2023.

Relevant Diagnoses (not all-inclusive).

Some relevant diagnoses for spastic foot and ankle are Cerebral Palsy, Traumatic and Closed Head Injuries, some Muscular Dystrophies, and Multiple Sclerosis. Relevant diagnoses for flaccidity are Spina Bifida, Peripheral Nerve Injuries, and Incomplete Spinal Cord injuries.

Medical Necessity.

Plantarflexion Weakness: Users with plantarflexion (soleus) weakness demonstrate increased knee flexion ($>0^\circ$) and dorsiflexion ($>10^\circ$) from Mid-stance to Terminal Stance. There is also a lack of heel-off. This excessive flexion at the knee and ankle causes the Center of Gravity (COG) to fall below the normal parabolum of the vertical sinusoidal curve. To counteract this excessive drop the user must compensate with one of two strategies; lift the COG back to the correct height on each step with the contralateral quadriceps or perform a lateral trunk lean away from the stance limb so the limb can begin advancement of the swing phase. Some users employ a combination of the two. Regardless, both cause fatigue and pathologic use and overuse of limb and truck muscles and joints.

Triplanar pathomechanics of the foot and ankle further exacerbate the pathologic gait pattern. Normal foot and ankle complex function during stance phase cause it to act as a shock absorber, terrain adaptor and rigid lever at varying times during the gait cycle. It must complete these changing requirements very rapidly (during normal gait, this all would occur in 0.8 seconds). Triplanar pathomechanics further affect the improper movement and position of the COG. Triplanar pathomechanics occur due to joint ligament laxity and/or muscle spasticity or flaccidity. In the spastic muscle the issue is too little motion of the foot and ankle complex joints and bones, and in flaccidity the issue is the opposite. In either the spastic or flaccid muscle joints axes alignments and bony alignments are compromised and are the primary factor contributing to foot and ankle triplanar pathomechanics.

¹Medical Justification.

Base AFO: The base AFO addresses the sagittal plane pathomechanics (excessive knee flexion and ankle dorsiflexion) secondary to plantar flexor weakness. It does so by slowing and restricting advancement of the tibial shaft over the foot from Mid-stance to Terminal Stance thereby keeping the COG at the correct height. The anterior tibial shell on the AFO is needed to distribute forces on the anterior tibia over a large area to restrict the tibia from advancing over the foot in excessive of 10° at Terminal Stance due to plantar flexor weakness. It also is the mechanism by which heel-off is restored. In both instances the position of the COG is affected positively.

Molded Inner Boot: The Molded Inner Boot addition is necessary to control the triplanar pathomechanics foot and ankle (subtalar joint) for proper positioning in the transverse and frontal plane in advance of donning the AFO section. The circumferential contact of the molded inner boot is necessary to maintain neutral alignment throughout the stance phase.

High Strength Lightweight Material: A high strength lightweight material added to this AFO is necessary to allow for control of sagittal plane motion in a dynamic fashion. Historically plantarflexion deficient users were fit with solid ankle AFOs or ground reaction AFOs with no movement in the sagittal plane. While this old style did address Terminal Stance pathomechanics, it induced Initial Contact to Loading Response pathomechanics (dysphasic and excess knee flexion and anterior hip rotation) secondary to lack of plantarflexion range of motion. Using Pre-Impregnated Carbon Composite material in this AFO allows for normal plantarflexion to occur from Initial Contact to Loading Response while still restricting excessive knee and ankle range of motion at Terminal Stance.

Soft Interface: The addition of a soft interface is required to dissipate corrective forces of the orthosis over bony prominences.

Additional Features if Ordered.

Varus/Valgus Correction: The addition of Valgus/Varus Correction is necessary to address frontal plane pathomechanics present in any foot and ankle with triplanar pathomechanics.

Anterior Tibial Shell: The Anterior Tibial Shell addition is needed to distribute forces on the anterior tibia over a large area to restrict the tibia from advancing over the foot in excessive of 10° at Terminal Stance due to plantarflexor weakness. It also is the mechanism by which heel-off is restored. In both instances the position of the COG is affected positively.

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