IAPMR Guidelines
USE OFANKLE FOOT ORTHOSIS IN PMR

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Ankle Foot Orthosis (AFOs) are intended to improve biomechanics of Ankle and Foot. The benefit of orthosis is not limited to the direct mechanical effect on the joint it acts, but can act remotely also.
AFO's are very common prescription in patients with neurological or muscular diseases to promote walking ability. AFOs may provide better functional outcomes by facilitating normalization of walking kinematics and thus improving walking ability; by providing the external support and stability; and by limiting the available range of motion. Different designs of AFO's have been described, based on the purchase the orthosis has on the foot and leg. Each design affects a different treatment outcome.

Conventionally AFO or below knee brace, made of metal and leather, have a calf band and two uprights which are anchored in a boot. These braces effect very good control on the ankle in sagittal plane and frontal plane. These are usually heavy and require maintenance.
The thermoplastic moulded ankle-foot orthosis was first described in 1958 by Yates who used it in the treatment of a flaccid foot drop. Subsequently, it was used in children with cerebral palsy. These braces are made of lightweight plastic (usually polypropylene) and fits inside a conventional shoe.

An UCBL (University of California Biomechanics Laboratory) shoe insert, is an in-shoe plastic slipper that controls functional varus and valgus deformities and, to some degree, supple mal alignment of the hind foot and mid foot.
Supra Malleolar orthosis, SMO, are custom moulded foot supports that facilitates correct weight bearing and offers stability in transverse plane. These have also been described as Dynamic AFO's and usually incorporated within a rigid or articulated AFO.

A rigid AFO is used to manage stance-phase deformities that are too strong to be controlled. These hold the ankle joint by having higher trim lines at the ankle and restrict any movement at the ankle. Rigid AFO's which restrict and changes kinematics of gait also decreases the energy cost. Brehm et al. verified this among CP diaplegic children wearing an AFO. Their study found that changes of stance and swing phase knee kinematics was responsible for the reduction in energy cost of ambulation.

A leaf-spring AFO is a one-piece, short leg brace that is usually made with low trim lines and the ankle in 5^{o} to 10^{o} of dorsiflexion. This is also called posterior shoe insert, and usually delivered off the shelf. The design and the trim of the orthosis allow closed chain dorsiflexion at ankle, and prevent planter flexion during swing. Since the purchase of the AFO is very less around the ankle, it offers little or any medial lateral support. It cannot hold the roll of the sub talar to pronation and cannot restrict ankle valgus or varus.
The articulated AFO allows normalisation of ankle kinetics and kinematics, thus causing a decrease in energy cost of ambulation. The effect of normalisation of walking kinematics using AFO was verified by Balaban et al and Bukon et al among children with hemiplegic CP. Bregman et al, recorded lower energy cost of ambulation in stroke patients who used articulated AFO's.

Neurophysiological AFO's or Tone inhibiting AFO's help inhibit the tonic reflexes that can cause deformities (Duncan, 1960). The AFO holds the foot and ankle in a position that can inhibit the hyperactive phasic stretch reflex, hyperactive tonic reflexes and clonus, even in upright positon, overcoming the deforming potential. Rigid and articulated versions of tone inhibiting / reducing AFO's are used.

Floor reaction orthosis, fall in the nomenclature of AFO's. Developed by Saltiel (1969), for post-polio paralysis, was aimed at reducing the weight and segments of the conventional KAFO. This one piece design, covers the shin of the tibia, and prevents the anterior movement of the tibia. FRO, positions the ankle in planter flexion and creates initial contact at the toe. This design particularly assists the knee extension capabilities of the patients, with fair minus strength in their quadriceps femoris muscles, and therefore helps prevent the knee joint from buckling.
The patients who wore these three types of orthoses had trouble sometimes with stumbling or had difficulties in descending slopes or stairs. This could also be done only as unilateral fitting. Design alterations were needed to get bilateral fittings. Lehneis et al (1983) published case studies using FRO's that were positioning the ankle and subtalar in neutral. These were fitted in patients who had paraperisis following spinal cord injury (Lehneis et al 1986) and Lin et al (1983) fitted FRO's to children with cerebral palsy and observed that knee extension improved . Lucareli PRG et al, (2007) fitted and evaluated floor reaction ankle-foot orthoses (FRAFO) and found it effective to improve the extension of the knees and ankle in the stance phase of children with spastic cerebral palsy.
Anterior AFO, or Pretibial AFO, or rear entry AFO are all variants of FRAFO's which are used for preventing the anterior translation of tibia, thus preventing dorsiflexion at ankle and thereby preventing crouch posture.

The prescription for an AFO begins by identifying the specific diagnosis of the pathology and the biomechanical need. Age is essential for the choice of material, and the level of function before and the goal after intervention also improve the choice of design and material to be used. Given the limitations of AFOs in peer reviewed research:

<u>Consider a Standard (Solid) AFO when:</u>
• External support, stability, and limit on ankle range of motion are needed
• Ankle motions are excessive and a more stable ankle is needed
• Increased stride length and decreased cadence are desired
• Specific skill execution is limited when barefoot

<u>Consider an Articulated AFO when</u>:

• Walking results in excessive energy expenditure
• Dorsiflexion at initial contact is limited or absent
• Shoes provide limited plantar flexion power
• A dynamic equines deformity is present in children with hemiplegia
• Sit-to-stand takes too long
• Walking speed and stride length are too short in children with hemiplegia
• A heel-toe pattern is lacking
• There is excessive knee hyperextension in children with hemiplegia
• More dorsiflexion is needed on stairs

Consider a Dynamic AFO when:

- Increased stride length, decreased cadence, and decreased ankle motion are desired
- Motor skills (crawling/kneeling, standing, andwalking/jumping) are delayed or absent

Consider a Posterior Leaf Spring Brace when:

- Knee extension needs to be increased

Consider a FRAFO when:

- Crouch posture
- Tip toe gait

Consider a Tone inhibiting AFO when:

- Dynamic collapse of the foot shape
- Tip toe gait

Though studies have justified the prescription of an AFO, than allowing standing or walking barefoot, in patients with neuromuscular diseases only very low level of evidence is available regarding their efficacy. A decrease of energy cost is associated with the successful normalization of specific biomechanical parameters of gait, which were a priority identified as a target for orthotic intervention. However, not all parameters that are associated with a decrease of energy cost of walking can change significantly and that not all significant changes of biomechanical parameters are positively associated with a decrease of the energy cost. Independent walkers benefit greater from AFOs than children using assistive devices.