

Inconspicuous Ankle Foot Orthosis (AFO) for Teen
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Facioscapulohumeral Muscular Dystrophy (FSHD) is a genetic muscle disorder that causes progressive muscle weakness. The patient, a sixteen-year-old girl, suffers from severe foot drop in her right foot that leads to hazardous falls and continuous pain due to FSHD. There is no cure for this disease, but the widely accepted form of treatment is an ankle-foot orthosis (AFO). Traditional AFOs, however, are extremely bulky and noticeable. The patient does not want to draw unwanted attention to her disability, so she has tasked the team with creating a sleek, athletic-looking brace.

AFOs that are currently available on the market are visually unappealing and cumbersome in nature, sometimes extending so far up the leg that they nearly reach the knee. The patient was prescribed a passive-dynamic AFO by her doctors, but does not wear it. Three previous BME Design teams have worked to create an inconspicuous AFO design that satisfies the patient's physical needs, but also appeals to her aesthetic desires. The design created in the Fall of 2024 featured a sleeve-like design with a bungee cord attachment to assist with dorsiflexion. This design, however, was lacking any significant support of the ankle in the medial and lateral directions. In Spring of 2025, the team focused on creating rigid supports to keep the ankle stable in the medial and lateral directions. These supports were 3D printed to match the patient's exact dimensions. However, this design lacked any dorsiflexion support. The team from Fall of 2025 focused on updating the supports to improve comfort around the malleoli of the ankles as well as improve the mechanical strength. Furthermore, this team implemented a dorsiflexion strap which attached to the rigid supports and looped around the bottom of the foot to prevent foot drop. Although this was an improvement from the previous designs, this AFO still needed updates as there was frequent slippage of the dorsiflexion strap toward the back of the foot, as well as of the rigid side supports falling down to the ground.

Many testing methods have thus far been applied to this project. In Fall 2024, gait analysis was performed via Runeasi. In Spring 2025, OpenCap was utilized for motion capture testing. Finally, in Fall 2025, stabilogram and gait analysis were completed via force plate testing. For the final semester of this project, the team performed motion capture and force plate testing via collaboration with the University of Michigan due to the client's location in Ann Arbor. The force plate gait analysis will be utilized to determine the significance of the dorsiflexion aid, and the force plate stabilogram analysis will provide the effectiveness of the medial and lateral supports of the AFO.

The design thoroughly meets the challenges and requirements proposed by the main problems of aesthetics, mediolateral, and dorsiflexion support. The design incorporates medial and lateral support to provide side-to-side stability. The front strap provides dorsiflexion support to mitigate the severe foot drop that the patient experiences. The double-padded interior offers maximum comfort, allows for long-term wear, and counteracts any rubbing or pressure points that may occur. The outside of the design is black in color and fits inside of a shoe, drawing minimal attention.

This design ensures that the patient is provided with a custom orthosis that has been modeled to her needs specifically. She will no longer have to feel the discomfort and insecurity that comes with wearing her prescribed passive-dynamic AFO. With the final Spring 2026 AFO, the patient reported perfect comfortability in all design aspects, no painful pressure points, and is more willing to wear the device due to its inconspicuous nature.