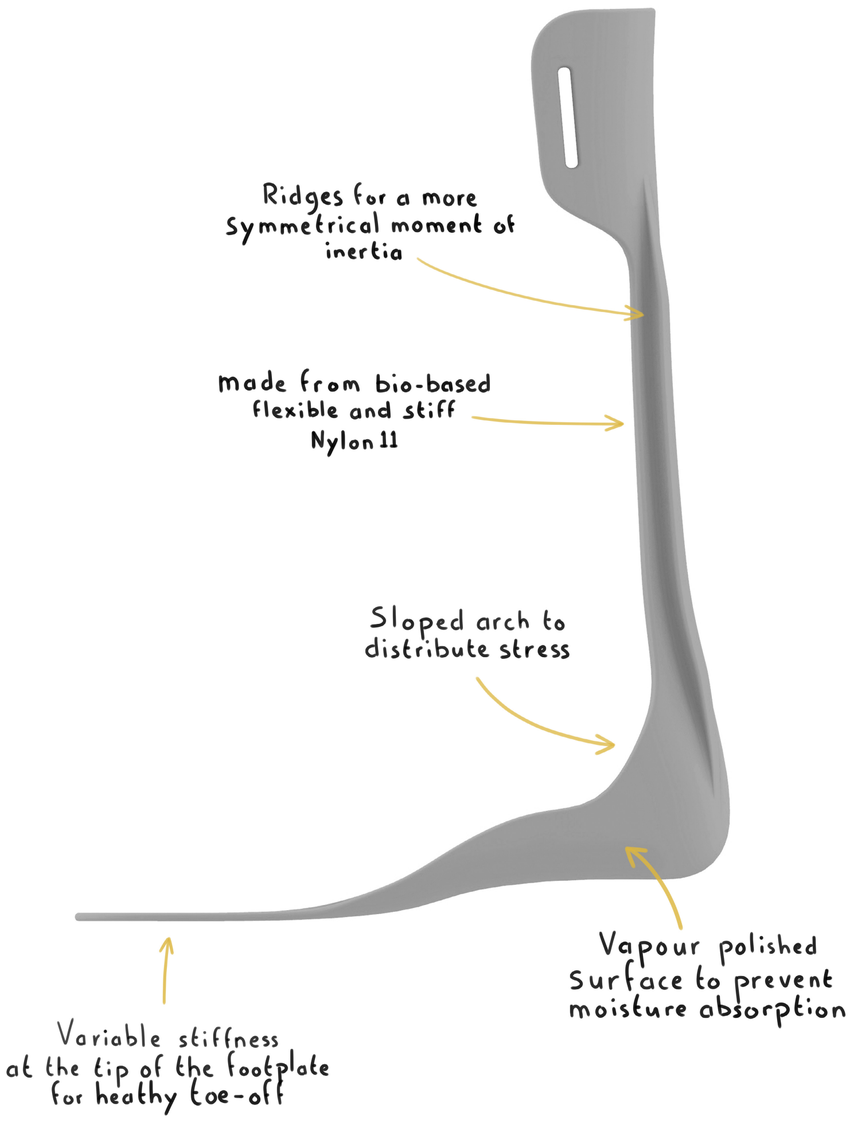
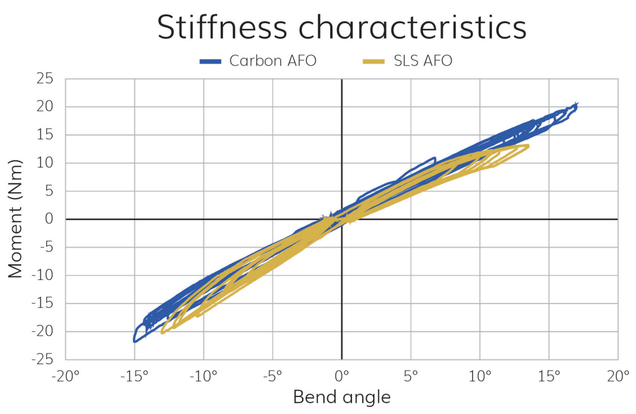
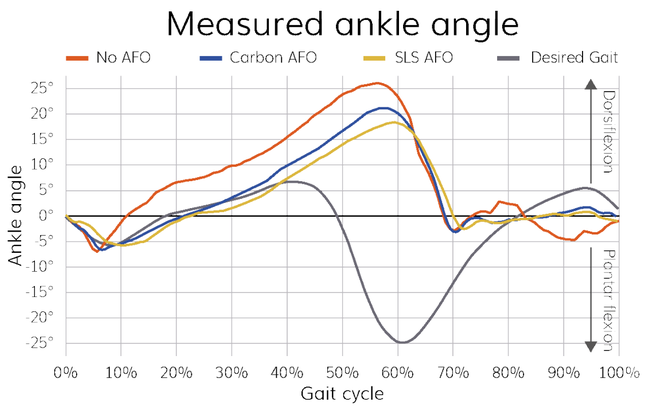
Designing a passive dynamic SLS-3D printable ankle-foot orthosis

An ankle-foot orthosis (AFO) is a medical aid that helps individuals with walking difficulties achieve a more natural gait. This project focuses on passive dynamic ankle-foot orthoses, specifically the carbon dorsal leaf spring orthosis. These orthoses leverage biomechanics and gravity to store and release energy by possessing specific stiffness characteristics. Currently, these AFOs are made through labour-intensive carbon composite layering. An alternative concept aims to replicate the desired behaviour using SLS-3D printing, which would offer a cost-effective and efficient production for a tailored fit and function.





Numerous prototypes were printed and tested to evaluate their stiffness characteristics. A parametric model was developed to generate an orthosis based on a scanned lower leg and foot. By incorporating design elements such as varying thicknesses along the orthosis, posterior ridge-like supports, and a gradually sloped arch around the heel, an AFO was successfully created demonstrating behaviour and functionality similar to that of a carbon dorsal leaf spring orthosis.



To assess the performance of the orthoses, tests were conducted with a participant incapable of plantarflexing. The SLS AFOs acted similarly in function to the Carbon AFOs, improving the gait of the participant enabling him to walk and stand without falling over. Initial results seem promising for the feasibility of SLS printing AFOs but require further validation, especially related to their longevity before the alternative production method can be implemented.

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