Dilatant Insole to Reduce Damage Inflicted by Peripheral Neuropathy

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Peripheral neuropathy afflicts 20 million United States citizens and leads to sensory loss in the extremities as well as infection, injury, and amputation. Daily ambulation alone can cause damaging blunt force trauma. Shear-thickening non-Newtonian fluids (dilatants) can absorb and disperse pressure. Pedobarography studies foot pressure, analyzing gait and pressure distribution in walking. This project's goal was to create a shoe insole using a dilatant to disperse pressure over the shoe's sole, reducing the damage inflicted by repetitive trauma. Insoles were manually created out of plastic, sealed with heat and filled 60% of their measured maximum volume with a dilatant colloid of 1.867:1 cornstarch:water. Testing between a brand orthotic insole and a built-in shoe insole was conducted at a local research institute by walking with a pedar (pedobarographical) insole on top of each of the insoles tested. Data was translated into pedar's program and displayed as images representing where and how pressure was applied over each region of the foot. The image for the dilatant insole indicated a more successful dispersion of pressure over the foot, particularly in the front. Measurements of the peak kPa of each step were analyzed with two-tailed t-tests between each insole. Every comparison with the dilatant insoles was statistically significant with a p value <0.001. There was no statistically significant difference between the built-in insoles and orthopedic insoles. The prototype dilatant insole was successful in mitigating blunt force trauma during daily ambulation. Future studies will involve more refined prototypes with raised edges to protect the foot from trauma that manifests by stubbing toes or walking into objects as well as addressing other areas of the foot.

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