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# Spinal Bracing for the Future

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## Background

Several chronic and degenerative illnesses utilize spinal braces to support and correct spinal curvature and gait. Spinal braces are designed to use counter point pressure, putting force in the opposite direction to the unwanted spinal curve in an attempt to counteract the progression of the deviation. Typically this is undertaken during adolescence while the spine is still growing. During teenage years wearing a brace can add additional burden to what is often a challenging period in a young person's life. The key issues contributing to the tolerance of wear include comfort, aesthetics and fit. This research looks at the feasibility of using an additive manufactured (AM) and computer aided design (CAD) approach for the design and fabrication of spinal braces. The aim of the study is to use a digital design workflow that combines existing bracing principles with user specific input in order to create individualized braces.

## Methods

The digital design workflow utilizes a modelling procedure that was developed with McNeel Rhinoceros and Grasshopper to model the spinal brace and customize several specific features. Three spinal braces have been manufactured using fused deposition modelling (FDM), stereolithography (SLA) and material jetting via Objet Connex. The suitability of this approach was compared to conventional braces and evaluated by experienced brace wearers and practitioners.

## Results

Use of co-design activities with experienced brace wearers fed forward design criteria critical to them in respects to aesthetics, tolerability and comfort. This partnership was developed alongside balancing clinical needs and informed the digital design workflow and AM spinal braces.

## Conclusions

AM and CAD processes can customize and develop spinal braces comparable to standard braces. Further work is required to test the materials used in the manufacture so that optimization of relevant strength can be assessed. It also concluded that FDM was considered the least suitable AM process for spinal bracing. The greater scope for user specific manufacturing, design and optimization suggests that AM spinal braces may have success in overcoming the tolerability and aesthetic issues seen in current methodologies.