W-Exo: Pediatric Cerebral Palsy Exoskeleton

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Background

- In 2011, over 60,000 Canadians were living with Cerebral Palsy (CP)
- 14,202 children were diagnosed with CP in Canada in 2010/2011

Statistics retrieved from Stats Canada

- Children with CP tend to “w-sit”
- W-sitting compromises joint mobility, muscle length, development of postural muscles

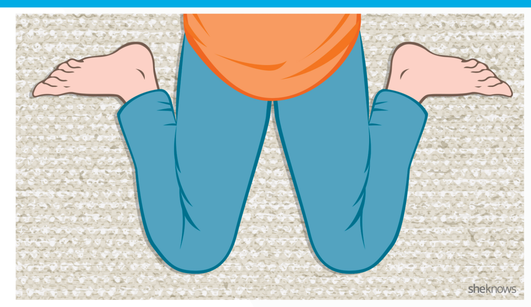


Image retrieved from www.cdchk.org

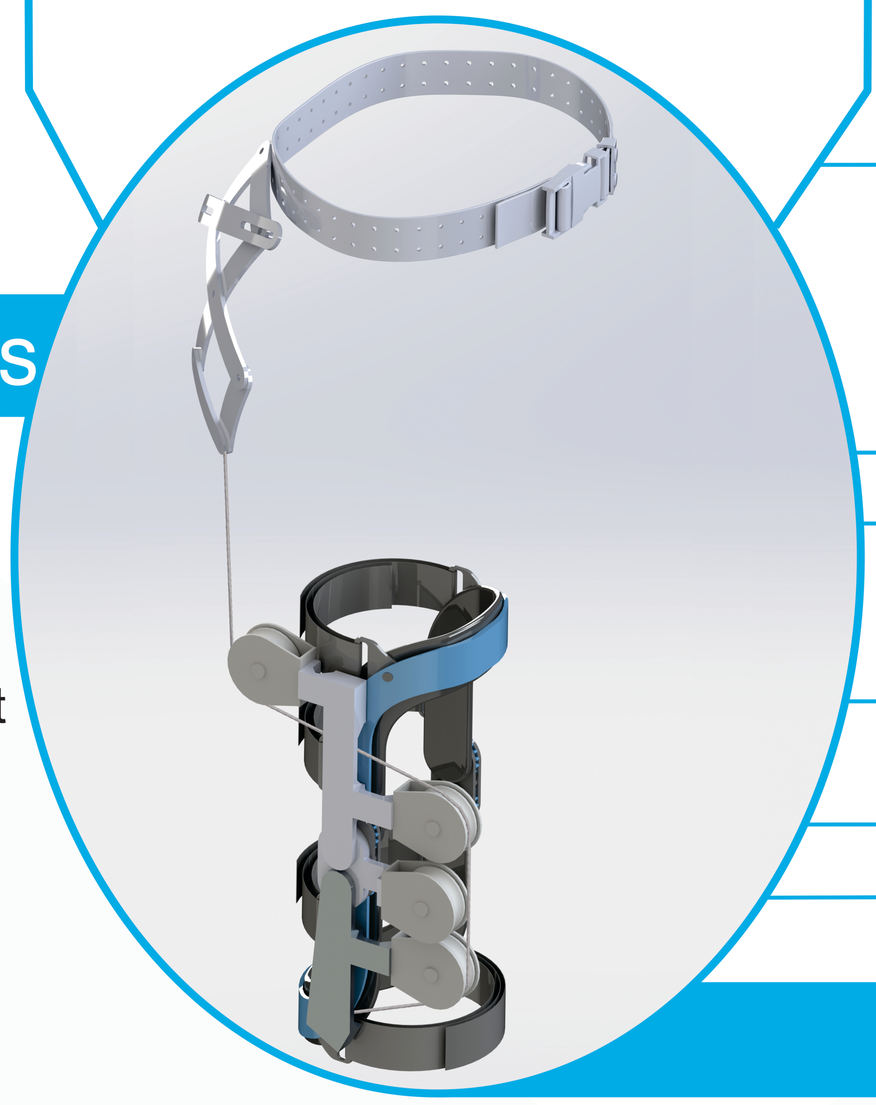
Objectives

Aims to provide children with CP a device to reduce the frequency of w-sitting, resulting in:

- Decreased muscle tightness
- Increased core muscle strength
- Achievement of a normal gait cycle

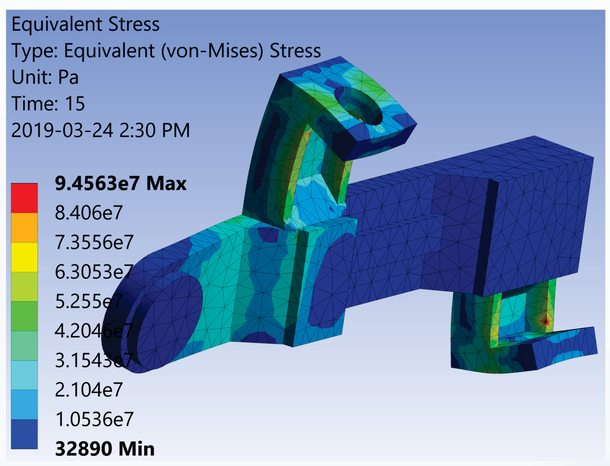
Problem Statement

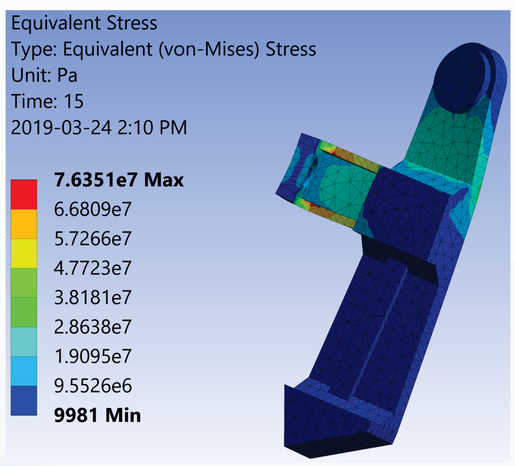
How can the occurrence of w-sitting amongst pediatric individuals with CP be reduced or eliminated?

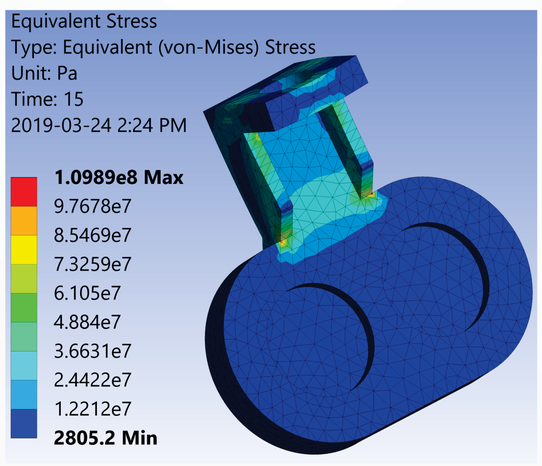


Engineering Analysis

- Determination of stress concentration areas using Finite Element Analysis
- 1 kN applied to the pulley mounts and hinges of knee joint
- Determined equivalent (von-Mises) stresses and compared to the yield stress of 6061 Aluminum (110 MPa)







Prototype Testing

Constraints/Criteria	Result
☑ Holds paramount the safety, health and welfare of the public (Engineers Canada Code of Ethics)	Achieved
Motion Restriction ☑ Internal Hip Rotation ☑ Flexion of Knees ☑ Flexion of Hips	 10° 130° 90°
☑ Wearable Hours	8 Hours
☑ Ankle-Foot Orthosis Compatability	Achieved
☑ Application/ Removal Time	52 sec
☑ Weight	<5 kg
☑ Adjustability	Achieved

Future Works

- Identify additional postural problems that can utilize a similar solution
- Obtain REB approval to test the device on the pediatric population
- Conduct pre- and post-usage testing to validate the effectiveness of the design

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