Intelligent Optimization of Brace Treatment for Scoliosis

Adolescent Idiopathic Scoliosis (AIS) is a deformity of the spine affecting 1.5-3% of the population. It often causes higher pain levels, lower self-image, and lower social function. AIS is usually detected between age ten and skeletal maturity, with 70% of cases being female. Full-time brace treatment (up to 23 hours per day) is often prescribed as a means of slowing or halting the progression of the spinal curve. If brace treatment fails surgery will be required, correcting the curve but often leading to back pain in later life.

Literature has shown brace treatment is most effective when patients follow the brace-wear protocol defined by the treatment team. However, patients are easily made to feel self-conscious at this age, and the brace can draw unwanted attention. When patients become frustrated treatment compliance can suffer, jeopardizing the success of the treatment. Therefore, the effectiveness of the brace treatment must be improved to increase patient's confidence and willingness to receive the brace treatment.

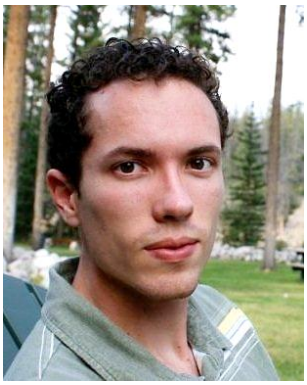
To increase our understanding of brace treatment and how it can be improved, several outstanding research questions must be answered. For one, the ideal amount of pressure – applied to the patient's torso by the brace – needs to be identified. This will enhance orthotist's ability to build effective braces. The relationship between brace wear characteristics and treatment outcome needs to be identified as well. This will enhance specialist's ability to design and adjust treatment protocols. Finally, a way to maintain the prescribed brace pressure during treatment must be invented, as research indicates conventional braces are unable to maintain the intended level of corrective force during daily activities. This research project intends to accomplish each of these tasks.

In this research a system will be designed to regulate brace pressure to a desired level, and also measure/record various brace-wear characteristics. Preliminary results from our laboratory indicated that maintaining the desired brace pressure long-term will improve the treatment outcomes. The system will be tele-rehabilitative: sending and receiving data from remote researchers. This feature increases convenience and quality of health care services (one third of patients live 200km away from Edmonton).

The system will be used to determine the ideal level of brace pressure. It will dynamically vary the three-point pressure configuration during brace fitting, and ultrasound will be used to observe the effect of each configuration on the spinal curve. This process will allow discovery of an optimal pressure configuration.

The system will then be embedded into a brace and used to regulate pressure and record brace-wear characteristics during long-term treatment. Machine-learning methods will be applied to the data collected during treatment, to derive a relationship between brace-wear characteristics and treatment outcome. The improved understanding offered by this relationship will allow specialists to better design and adjust treatment protocols.

This work will directly improve the quality of life of children with scoliosis. Optimizing brace treatment will improve treatment outcomes, and possibly reduce the discomfort experienced by the patient and/or the required brace wear-time.



Eric Chalmers received a B.Sc. degree in electrical engineering in 2011, from the University of Alberta. Between the university's co-op degree program and other employment, Eric was afforded a mix of industry work and research experience. With the support of his wife, their two children and his supervisors, he is currently pursuing a Ph.D. degree in biomedical/electrical engineering from the University of Alberta.

Eric's research interests include nonsurgical treatment of scoliosis and – more generally – the application of electronics engineering and machine learning to biomedical problems.