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DISSERTATION TITLE: *Relation between the Chiari I malformation and syringomyelia from a mechanical perspective*

Even though it is unknown to most people, about 0.1 % of the population has Chiari I. The Chiari I malformation is a neurological condition in which parts of the cerebellum is displaced into the spinal column. This causes a partial obstruction of the cerebrospinal fluid (CSF) space surrounding the brain and spinal cord. Chiari I may cause a wide range of symptoms such as severe headaches, sleep apnea, visual disturbances and muscle weakness. Secondary to a Chiari malformation many patients develop fluid filled cavities, syrinxes, within the spinal cord tissue, which causes further symptoms.

To offer these patients optimal treatment and an increased quality of life we need a better understanding of the underlying causes. The exact relation between Chiari I and syrinx formation remains unknown, but it is believed that it is related to an abnormal pressure environment and therefore mechanically driven.

The aim of this thesis were first to simulate CSF flow in healthy subjects and Chiari patients under patient specific anatomy and flow conditions. Second to simulate wave propagation and fluid movement through the spinal cord. Finally, we related results from the simulations to syrinx formation and suggest alternative measures for abnormal CSF flow.

The results showed that obstructions of the CSF space, as seen in Chiari patients, causes increased pressure gradients and decreased phase lag between velocity and pressure. A significant increase in the pressure drop may be used to distinguish a moderate from a severe obstruction. By including parts of the cranial CSF space we reproduced complex flow patterns seen in vivo in Chiari patients. Finally, an open segment of the central canal and/or a stiff spinal cord causes increased pressure gradients and enhance fluid flow in the central canal of the spinal cord.