Magnetic force for unmet clinical needs: obstructive sleep apnoea, surgical anastomoses, and skeletal deformities

In future, magnetic technology could help to address clinical needs related to a variety of medical conditions. Dr Michael Harrison, working at The University of California in San Francisco, has dedicated much of his career to the invention of new treatments and devices, with a particular focus on those that use magnetic force to correct anatomical problems. Some of his most recent work focused on the development of magnetic devices that address issues related to obstructive sleep apnoea, surgical anastomoses, and skeletal deformities.

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technology that uses magnetic force has the potential to help in a variety of medical settings. Dr Michael Harrison and his colleagues have developed and tested titanium enclosed permanent magnets that are surgically implanted using minimally invasive techniques to address unmet clinical needs.

One device called MagNap helps to maintain an open airway at night for patients with obstructive sleep apnoea. A second device MagImplant/MagTrack, part of the Magnetic Mini-Mover Procedure, helps to repair an anatomic malformation called pectus excavatum (or sunken chest) in children aged between eight and 13. Another device named Magnamosis surgically creates a stronger, leak-free, post-surgery connection (anastomosis) in the gastrointestinal or biliary tract. His team is also working on utilising the Magnamosis device for the surgical treatment of type 2 diabetes. Finally, his device innovation has the potential to help in a variety of medical conditions. But Dr Harrison’s devices use the force generated by the magnetic fields to gradually alter the development and biology of anatomical structures.

Dr Harrison is an internationally renowned scientist, primarily known for his work in paediatric and foetal surgery. While researching aspects related to foetal surgery, the professor and his team invented tools and devices that could tackle unmet clinical needs even after retiring from clinical practice. His most recent work focused on developing devices that use the magnetic force to surgically treat sleep apnoea (MagNap) and another to replace staples for intestinal anastomotic connections (Magnamosis).

A MAGNETIC IMPLANT TO TREAT OBSTRUCTIVE SLEEP APNOEA: MAGNAP

The magnetic technology invented to address pectus excavatum inspired Dr Harrison to devise another similar device to treat obstructive sleep apnoea (OSA). Millions of people worldwide suffer from this disorder. Symptoms of OSA include excessive daytime sleepiness, loud snoring, breathing cessation during sleep, difficulty concentrating during the day, mood changes, and abrupt awakenings during the night. OSA can also cause cognitive and behavioural problems, and has been associated with cardiovascular disease and metabolic syndrome. The primary measurement for OSA is the Apnea Hypopnea Index (AHI) which shows the severity of the patient’s problem. Conventional treatments for OSA include positive airway pressure therapy (CPAP) or palate surgical procedures, which can in some instances create disruptions in normal functions such as speech or swallowing. In many cases, the CPAP machine can offer significant relief. However, many patients cannot tolerate

In his most recent work, Dr Harrison’s devices use the magnetic force to treat obstructive sleep apnoea. A second magnet is worn in a brace on the patient’s chest. By adjusting the strength of the second magnet, the two devices are pulled together, slowly repairing the defect.

Dr Harrison is currently working under an NIH-NHLBI grant to develop a new implant which will better treat patients with more abnormal pectus issues. To date, 25 patients have been implanted and a significant level of success has been achieved.

A MAGNETIC IMPLANT TO CORRECT PECTUS EXCAVATUM: MAGNETIC MINI-MOVER

The first device Dr Harrison developed addresses pectus excavatum deformities, or sunken chest. This is the most common congenital chest wall defect, which is characterised by a depression at the back of the sternum. About one in 400 children are born with this disorder and over 10,000 require the surgery worldwide. Dr Harrison was not satisfied with standard surgical interventions for pectus excavatum including the Nuss and Ravitch procedures which attempt to correct the skeletal defect in one big procedure. He instead took the approach that a little pressure applied over a longer time could remodel the abnormal cartilage.

The procedure devised by Dr Harrison and his team, called magnetic mini-mover procedure (3MP), works by applying a sustained outward force on the depressed sternum in order to correct its anatomical position. One titanium-encased magnet is surgically implanted on the front of the sternum via a 2cm incision, performed as an outpatient under general anaesthesia. A second magnet is worn in a brace on the patient’s chest. By adjusting the strength of the second magnet, the two devices are pulled together, slowly repairing the defect.

In future, magnetic technology could help to address clinical needs related to a variety of medical conditions. Dr Michael Harrison, working at The University of California in San Francisco, has dedicated much of his career to the invention of new treatments and devices, with a particular focus on those that use magnetic force to correct anatomical problems. Some of his most recent work focused on the development of magnetic devices that address issues related to obstructive sleep apnoea, surgical anastomoses, and skeletal deformities.

Magnetic force has the exciting potential to simplify a number of complex and tricky surgical procedures.
When and how did you first start developing magnetic devices that could help treat medical conditions?

The first unsolved problem was how to apply outward force on a sunken chest without having a screw or wire piercing the skin. Magnetic attraction between an implanted magnet and a second magnet in an external brace was the answer.

What do you believe are your most promising findings so far, in terms of applications of the magnetic devices invented by you?

Aside from offering potential solutions for a variety of rather uncommon paediatric surgical problems like oesophageal atresia, there are two potential solutions to very big common problems: Magnap for obstructive sleep apnoea and Duodenal-ileal bypass (DIPASS) and the Magnamosis device for type 2 diabetes.

What are the potential advantages of using magnetic devices compared to standard medical procedures?

In all the conditions we have studied, the use of magnetic force appears to be better, faster, and considerably cheaper. Have you already started developing a device that can help correct spinal deformities? If yes, what stage of development is it at?

The Roboimplant device has been developed, undergone initial testing, and is being further developed and commercialised by a start-up company. What are your plans for future research and investigation?

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When did you first start inventing and developing new tools that could tackle unmet clinical needs even after retirement from clinical practice?

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