



## DC motor driven surgical tool helps provide less pain and faster recovery.

Powerful maxon DC motors ensure smooth actuation of robotic surgical instruments.

Astonishingly, many tools currently used in surgery were developed as early as 1930 without improvements. More often than not, the surgical tools have been sufficient enough to fulfil their tasks, although there was more trauma to the patients than necessary, increasing the recovery time. When the physician needs access to the chest cavity during heart or lung operations this becomes particularly poignant. A thoracotomy or sternotomy have been the two common procedures used thus far in order to give the doctor enough room to operate within the chest cavity.

With a thoracotomy access is gained between two ribs. With a sternotomy the surgeon cuts the sternum and spreads it apart. For each scenario, the ribs or sternum are then pulled apart with a mechanical jack named a thoracic retractor. Spreading the ribs requires a very large force. Interestingly it has been discovered that the force required to open the ribs is close to the weight of the patient and the thoracic retractor can have the adverse effects of broken bones, crushed nerves, wrenched joints, and torn ligaments. This is a factor towards negative post-surgery results and sometimes ongoing adverse effects.

Physcient has developed technology that is expected to dramatically reduce the harm caused to the body with thoracic retraction. "Two of the concerns we ran into," said Chuck Pell, co-founder (with Hugh Crenshaw) of Physcient, "were that we had to maintain the same footprint as other thoracic retractors being used in the operating room today, plus we had to be able to sterilise the tool repeatedly, to be used for literally hundreds of cycles." The company's Assuage™ Smart Retractor™ was designed to apply technology to solve a longstanding problem without changing surgeons' procedures.

According to Mr. Pell, "We both (he and Dr. Crenshaw) studied biomechanics, and it is that understanding of how creatures move that we use to translate into technology. We recently turned that knowledge to surgical tools, and are finding it very interesting. Many of the tools used in surgery today were invented prior to biomechanics becoming a mature science."

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1/3

According to the Heart, Lung, and Blood Institute more than 500,000 heart operations are carried out annually. Additionally another 100,000 lung operations highlights the requirement for improved tools. The old fashioned design of thoracic retractors and the volume of operations lead to an increase in the number of rib fractures.

There has been very little research on the forces created by rib spreaders. The Physcient engineers measured the properties and have produced an instrument that reduces trauma. Typically a bone flexes before breaking and a contributing factor is the speed that the retractor travels. Hand operated retractors can cause a sudden bend causing ribs to break. The DC motor driven Assuage™ rib spreader is fitted with high tech sensors to detect if fibres begin to collapse and this valuable information is sent back into the device so it can then react accordingly. This forms a closed loop feedback system to the DC motor which follows with high precision and is 100% reliable for use in medical equipment.

Prototype rib spreaders were designed around a DC motor manufactured by maxon motor. A critical feature of the DC motor was the zero cogging nature of its operation. This allows the device to move smoothly eliminating sharp movements that can cause trauma to the patient. Brushless DC motors operate from a battery and an inbuilt motor controller and feedback loop maintains the controlled spreading process. Physcient selected very high torque motors to supply the necessary forces. “The motors we use from maxon not only have to handle the greatest retraction forces ever measured in the medical industry, they also have to be precise in order to reduce damage to ligaments and soft tissues,” said Chuck Pell.

### Soft motion with strong DC motors.

maxon motor manufacture a range of DC motors from 6 mm diameter to 90 mm diameter. They are used in a very broad range of applications. The brushless DC motors are electronically commutated exhibiting minimal emitted electrical noise whilst running. maxon motor DC brushless motors do not have traditional motor brush systems that can wear out, giving greatly extended motor life limited only by the bearings. Utilising highly graded ball bearings with a preload the DC motor life is extended even further.

Smart Retractor™ by Physcient Assuage™ takes account of the physics of bone and tissue. Physcient engineers constructed prototypes that use curved metal fingers that cup the ribs. When the tool opens the ribs the sensors provide feedback to the DC motor for controlled and smooth retraction. During testing the retractor significantly reduced tissue damage, lowering the patient's discomfort, making it easier to breathe and giving improved recovery.

When the Assuage™ goes to production, Physcient intend to investigate more medical devices that have remained unchanged for years. They focus on patient wellbeing achieved by supplying the perfect equipment for surgeons. Physcient plan to improve the total surgical toolkit through automation. The Assuage™ Smart Retractor™ is planned for market availability in 2013.



Authors: Debora Setters: Anja Schütz | maxon motor Australia local language edit. Contact maxon motor in Sydney for assistance selecting maxon DC motors.

Application note: 855 words.

maxon motor Australia Pty Ltd  
4/22 Leighton Place  
Hornsby NSW 2077  
Australia

Phone +61 2 9476 4777  
Fax +61 2 9476 4866  
Web [www.maxonmotor.com.au](http://www.maxonmotor.com.au)

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Figure 1: Detail of a motor housing assembly of a Physcient prototype using the latest DC motor technology. The Assuage™ Smart Retractor™. © Physcient