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Life Sciences



Nominated for the CTI Swiss Medtech Award 2015

## Laser-cutting of bones replaces sawing



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**When it comes to cutting bones, modern medicine still uses methods employed in the 19<sup>th</sup> century. AOT AG, a spin-off of the University of Basel and the university hospital, has developed a system in which a robot uses a laser beam to cut through the skull and other types of bone precisely and without contact.**

When the daughter of laser physicist and entrepreneur Alfredo E. Bruno needed orthodontic treatment, oral and maxillo surgeons Hans-Florian Zeilhofer and Philipp Jürgens at the University Hospital Basel sawed through her upper and lower jaws and screwed them back together in another position. This rather crude operation was a success, but Bruno asked himself why the surgeons had not used a laser to cut the bone. This was the beginning of fruitful discussions with the surgeons, who had for some time been interested in laser technology. "Hans-Florian and Philipp knew a lot about the potential applications," remembers Bruno. "And I knew how a laser needs to be constituted so that it cuts tissue without charring. And I had already developed a mini-laser for use in robots."

### Great interest among investors

The three men agreed that a well-programmed robot combined with navigation and laser technology could work much more precisely than even the best surgeon. So they contacted Philippe C. Cattin, Professor of Image-Guid-

ed Therapy (IGT) at the University of Basel, to go about developing a system. Once the key patent had been submitted and Bruno had written the business plan, together they founded Advanced Osteotomy Tools AOT AG in 2010, with Bruno as CEO. In 2011 the company attracted considerable interest among investors at a CTI Invest event.

The robot CARLO (short for Computer Assisted, Robot-guided Laser Osteotome) now processes several hundred megabytes of data per second and can make its own decisions based on sensor data. "CARLO goes much



Precise and non-contact: CARLO cuts through bone with a laser beam.

**“CARLO goes much further than the well-known Da Vinci operations robot, which actually only does what the surgeons tell it.”**

Philippe C. Cattin, Professor at the University of Basel and head of development at AOT

further than the well-known Da Vinci operations robot, which actually only does what the surgeons tell it,” says Cattin.

Will the robot CARLO soon replace the surgeon? “Not at all,” says Cattin. “The surgeon is still needed to do all the preparatory work, such as exposing the bone. Then CARLO comes along and cuts extremely precisely for 10 to 15 minutes, before making way for the surgeon again.”

**Shorter operating times relieve pressure on the patient**

The first ever operation using the new technology developed in the CTI project will be carried out in 2016. The surgeon will operate on a child whose skull bones fused too early, thereby restricting the growth of the brain. The surgeon will instruct CARLO on what needs to be removed and given new shape. The robot will then cut a grid pattern in the skull with the laser, weakening the bone in specific places and making it more malleable. While the robot is working, the surgeon will re-structure the bone around



Alfredo E. Bruno, CEO AOT and Philippe C. Cattin, Professor at the University of Basel and head of development at AOT

the eyes, as these are always wrongly positioned in patients with this problem. This will save up to an hour on the operating table and under anaesthetic, relieve pressure on the body’s organism and the young patient will lose less blood.

The pioneers who developed CARLO have found ways of getting round tricky issues such as restricting the depth of the cut and keeping temperature down. To begin with, the 100% Swiss technology will be used for two indications, on the skull and lower jaw. As demand is already so great, also from other surgical disciplines, it is planned to use the technology for further indications on the rest of the skeleton once the appropriate clinical tests have been conducted.

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