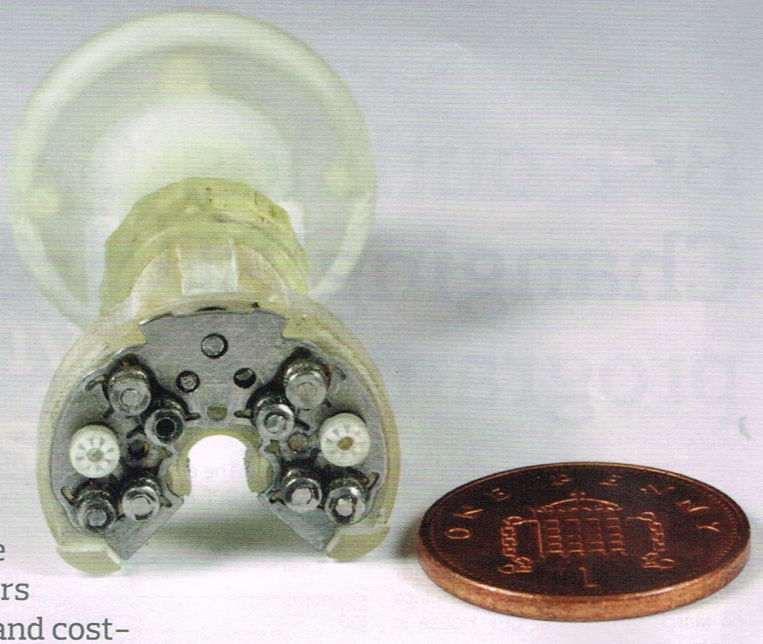
The future of suture?



From the beginning of surgical history, nothing has been able to come close to the accuracy and delicacy of a surgeon's fingers to stitch wounds, but thanks to the speed and cost-effectiveness of 3D printing technology, the first device to rival even the dexterity of human hands could be around the corner.

Words | Rose Brooke

Amazing stories can find you at unusual times and the Sutrue additive-manufactured endoscopic device found EPPM on a train journey to London one November afternoon. If a gentleman set down a Formlabs Form 1 3D printer on the table near your seat, would you pass up the chance to ask what he was doing with it? Even if you only have a passing interest in additive manufacturing, I am fairly sure many people would strike up a conversation just like I did, and luckily for our additive manufacturing feature, Sutrue Founder and Director Alex Berry was not only an enthusiastic conversationalist, but he had a genuinely ground-breaking story to share.

The Sutrue device is a mechanical stitching tool that has been designed and intricately prototyped and tested multiple times thanks to 3D printing technology.

As medical and surgical science has developed, the process of hand stitching the patient's body back together again has not advanced, as little can compare to the dexterity of a seasoned surgeon's fingers.

One such surgeon is Mr Richard Trimlett, Medical Advisor on the project and Surgical Tutor in Cardiothoracic Surgery and Consultant Adult Cardiac Surgeon at the Royal Brompton Hospital in London.

"Alex set himself a complicated task to take a relatively small needle and develop a device that would pass it safely through tissues and recapture it - and the reason why such a device doesn't exist already is because it's a difficult thing to do," he said. "There have been many iterations of this, but it's kept its momentum because we've been able to come here, test it, build it, and we've discussed what needs to be changed and it's printed with relatively short turnaround."

Safer surgery

From Mr Trimlett's perspective, the Sutrue could be approached by the medical community from two angles. At the more basic end, in the case of a long wound such as those seen in abdominal and orthopaedic surgery, these long closures are usually delegated to more junior surgeons. With a Sutrue, a less experienced surgeon could close up a wound much more quickly than suturing by hand, making the operation safer and reducing the likelihood of the surgeon injuring themselves. Needle-stick injuries affect two million healthcare workers globally a year the Sutrue website claims, with 15 per cent of these injuries taking place during suturing.

At the other end of the spectrum, as operations increasingly move towards keyhole surgery and away from open surgery, there are still too few ways of passing a needle and thread through tissues, but the Sutrue enables the surgeon to suture endoscopically, closing the wound delicately with very small needles without the risk of infection and increased recovery times associated with open surgery.

"It's a device that can do surgery that keyhole surgeons can't and it can be a mass-market device for simple wound closures where they need to be done in a hurry or by someone relatively inexperienced," Mr Trimlett explained. "At the time being, we are stuck using a needle and thread, which may seem strange to people who have not had medical training that we are still using these sorts of tools, but in the speciality of cardiovascular surgery where we have an awful lot of data, a needle and thread is still giving us the best long-term results for making small joins in arteries and other delicate structures."

"With keyhole surgery," he continued, "if [we can get the Sutrue] to do what we want it to do then it has potential - which expands the remit of what you can do with keyhole surgery and make big open operations quicker and safer."

Testing, testing

The Sutrue has undergone numerous iterations over the six years Berry has been developing it and without additive manufacturing, there is no way his work could have come this far without considerable expense. Apart from "a couple of Swiss companies that can machine you some incredibly small parts", the designer admits he would have nowhere else to turn if he wanted functional prototypes of the Sutrue.

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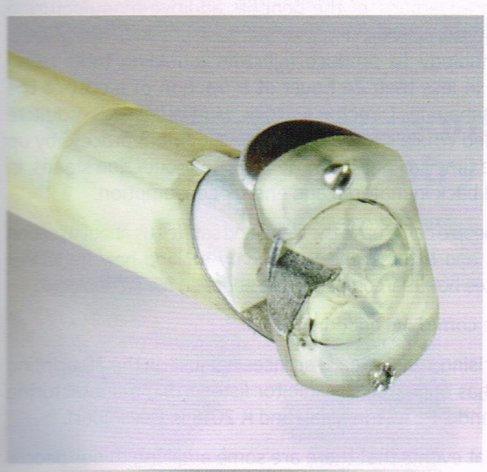
While the intricate mechanism in the head of the Sutrue is 3D printed in metal on Concept Laser machines by ES Technology in Oxfordshire, thanks to the expert insights of Dr Chris Sutcliffe at the University of Liverpool, the plastic body and casing of the device is printed on 3D Systems 3D printers by PDR in Cardiff, with Berry tinkering on the Form 1 as he goes. When the prototypes are ready, they can then be tested by Mr Trimlett on various tissue types to discover its limits within the standardised realms of robotic surgical testing.

"The limiting thing is going to be the strength of the sharp needle as opposed to the device," Mr Trimlett noted.

The latest incarnation of the main parts of the Sutrue were 3D printed in late January when Berry came up with a different approach for getting the head of the device in position, while the intricacies of the moving parts have been given the most minute of tweaks over the years, perfecting the mechanism.



The aim of the Sutrue is to give the surgeon an equal if not improved ability to sew up a wound and to do this, the Sutrue features a robotic wrist-like movement at its head.

"The theory is it will allow robotic suturing to be more simple," Mr Trimlett explained, "and it should be able to do something you can't currently do."

Exploring the boundaries of the Sutrue has only been made possible with additive manufacturing, both on a practical level and as far as exchanging ideas is concerned.

"I think some of the 3D printing tools we've been using - particularly the CADCAM software - has allowed us to develop a language between engineers and medics, because often we use words in very different ways. Being able to work in a visual language where you can both see what you're talking about has been hugely beneficial. I think it has been a by-product of this process but probably one of the most important things that I've learnt form this exercise."

Berry added that over Sutrue's six-year development process, often his time to pore over design amends with Mr Trimlett has been limited to 10-15 minute meetings, catching him between appointments and operations.

"Mr Trimlett's time is a lot more precious than your average person," Berry explained, "and the language we've developed has made it very succinct so there have been changes to the device that have come directly from Mr Trimlett's comments as opposed to me staring at a device from the practical user's perspective."

Too good to be (Su)true?

So with Mr Trimlett's involvement in perfecting Berry's design on screen before sending it to be 3D printed, does the Sutrue stand a better chance of becoming a mainstay of the operating theatre?

"As a law with equipment," the surgeon explained, "the early adopters will take it on and if they can make it work, you start to see them in theatres and appear in publications and it will be adopted across the board. If early adopters don't like it, it will sink and die like many other things that have been tried, but it's probably got a fighting chance."

"We can only do the best we can to present something we think may be useful and after that it's up to the medical community," Alex added. "It's a leap of faith in a sense, but at the same time, it's a solution. The first patent application to change a standard surgical needle was in 1914 - so people have been trying to do this for 102 years. There's got to be a reason for that."

www.sutrue.com