Rapid Development of Muscle Stimulator Probe Prototype for Anorectal Malformation (ARM) Reconstruction Using Three Dimensional (3D) Printing: An economical approach to Surgical Innovation

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Introduction

Electrical stimulation of muscle groups is essential for precise repair of anorectal malformations (ARM) in children. Unfortunately many areas of the globe lack access to electrical stimulators for ARM repair due to their prohibitive costs. Our previous research showed the success of utilizing low-cost muscle stimulator devices for ARM surgeries, but peripheral nerve stimulators (PNS) are not sold with the appropriate probe for their use in ARM surgery. We identified a need for a low-cost surgical stimulator probe that was compatibile with existing peripheral nerve stimulator devices. (Short, S et al. *Eur J Pediatr Surg* (2013) 23:25-28. PMID: 23100060)

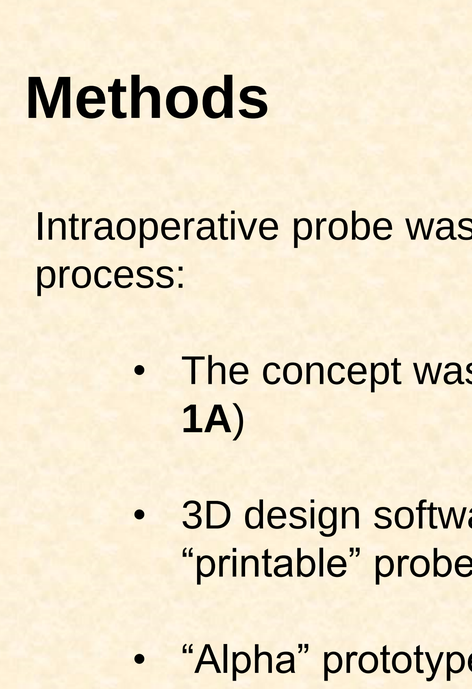
As a vehicle for developing and distributing these devices, we formed a non-profit corporation: *Global Pediatric STEP, Inc*. and sought to create a cost conscious approach to developing an affordable muscle stimulator probe.

Aim: To develop a low cost approach for developing a stimulator probe to use in ARM surgeries.

Methods

Intraoperative probe was developed using an iterative process:

- The concept was developed and sketched (**Figure 1A**)
- 3D design software was used to create an initial "printable" probe (**Figure 1B**)
- "Alpha" prototype 3D printed probe and PNS device assembled for testing (**Figure 2**) of electromechanical characteristics and sterilization durability.
- "Beta" prototype for small scale production of probe ready for animal testing (**Figure 3**).



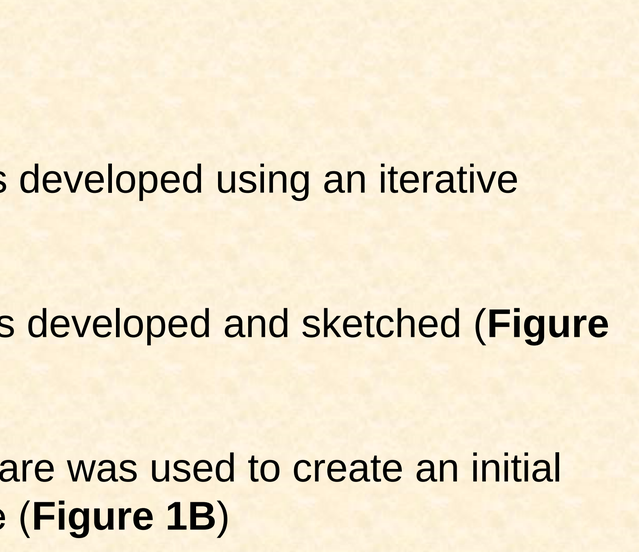


Figure 1. A, Initial probe concept drawings. B, 3D probe design.

Figure 2. "Alpha" prototype using 3D laser stinter printing with nerve stimulator device.

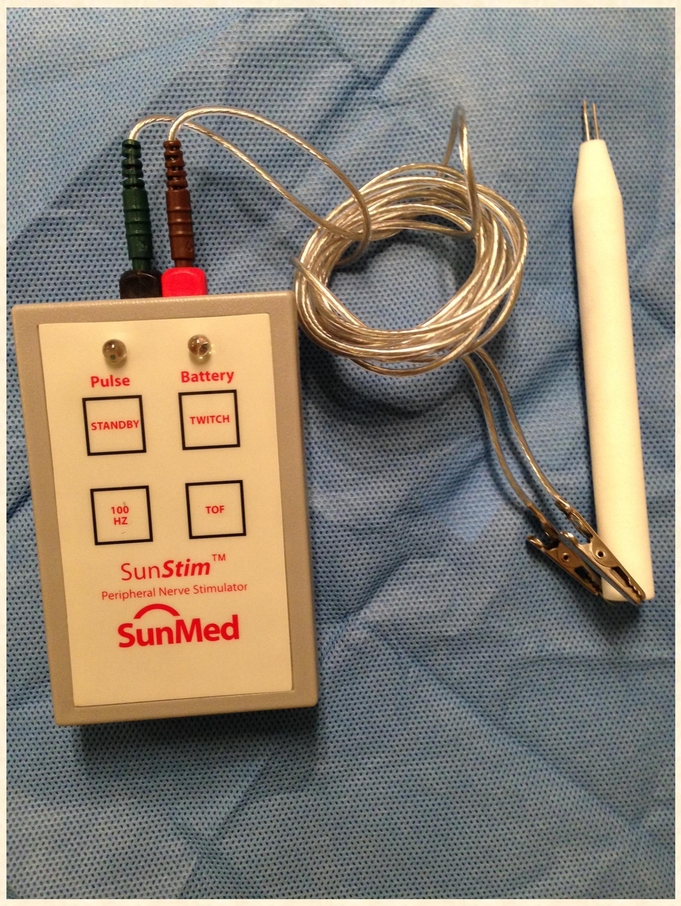
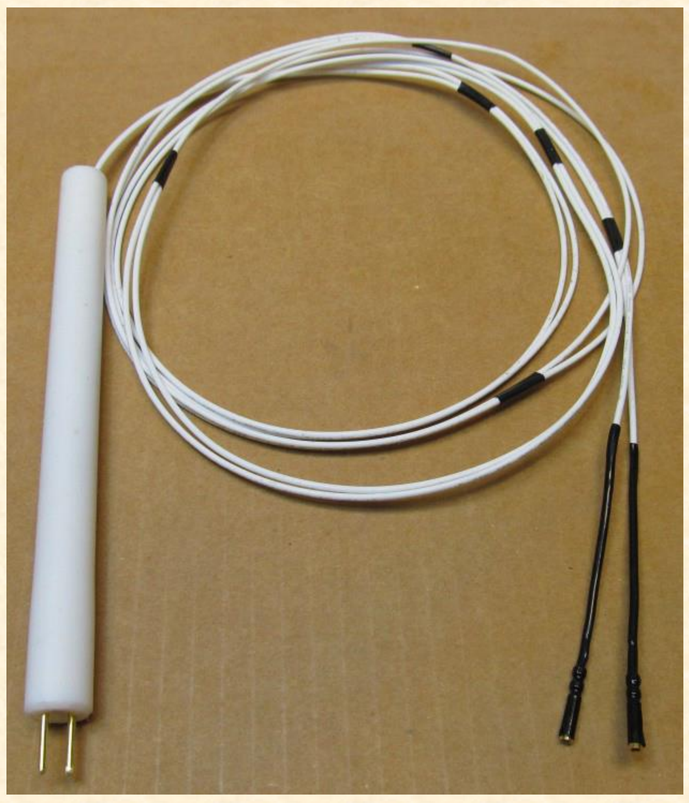


Figure 3. "Beta" prototype probe and wiring compatible with autoclave sterilization.



Results

- Creation of a non-profit entity to develop low-cost muscle stimulator probes has facilitated fundraising, and engagement of pro bono professional services that would not have been possible for a for-profit corporation. (*www.globalpediatricstep.org*)
- We found that the affordable 3D printing cost of (US$ 19) per prototype was an essential tool to maintaining low costs during the early phases of the prototype development.

Conclusion

3D printing is a game-changing technology. Herein, we demonstrated the potential for prototyping a low-cost muscle stimulator probe.

We envision that the use of these technologies will continue to lower barriers to developing affordable surgical tools.