DESIGN OF A MECHANICALLY ANCHORING IMPLANTABLE MECHANISM FOR TENDON TRANSFER SURGERY

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INTRODUCTION
In previous work, we have shown that it is significantly beneficial to use implantable passive mechanisms to re-engineer the mechanics of force and movement transmission within the body. Specifically, we have shown that we can surgically construct in situ a differential mechanism using biological tendons and a simple strut in a hand tendon-transfer surgery. The differential mechanism enables adaptive finger movement in the fingers even though all four finger tendons are driven by one muscle. Overall, the new implant-based surgery provides significantly better finger flexion than using the current surgery that uses sutures.

A key problem with the current design of this implant is that it needs to be sutured to the tendons (see Figure). This is a problem since the suture is invasive to the tendon, and instigates a fibrotic healing response and long-term scarring. Thus, we seek to re-design the implant so that it does not have to be sutured to the implant, but will stay secure in the long-term. This paper presents preliminary designs of the implant.

METHODS
The most important requirement of the new implant design is to mechanically anchor it to a tendon without any puncturing which is the most probable cause of fibrosis. To achieve this, the structure of both the ‘Zip-tie’ and ‘Triglide slide’ are adopted to the design (Fig. 2), since both mechanisms provide substantial clamping force to the tendon despite their simple structures. The implant is designed to spiral inward toward axis B as shown in Fig. 2, where the center of the tendon will be located, to provide clamping force with its structural elasticity. The zip-tie by itself is expected to secure the tendon to the implant without having to damage the tendon with sutures. For additional security, as shown in Fig. 3, a thread will be wrapped around the zip-tie and go through the triglide slide to keep the zip-tie secured.

RESULTS AND DISCUSSION
As the changes made to the implant involve mechanically securing the tendon, we expect that the implant will work as planned. We also expect that this new attaching mechanism will eliminate the fibrosis that the initial design caused. Moreover, the surgery time is expected to be reduced, since the implant does not require suturing to the tendon.

CONCLUSIONS
In this paper, we presented the new implant design for tendon transfer for median-ulnar nerve palsy. The implant includes the structures of both the ‘Zip-tie’ and ‘Triglide slide’ for mechanically securing the tendon without puncturing it to avoid fibrosis. In the future, this implant design will be validated through a cadaver chicken, live animal and human cadaver study sequentially.

REFERENCES

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