Myoelectric Signal Transmission from Implanted Epimysial Electrodes Using Bone-Anchor as Conduit

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INTRODUCTION
Prostheses remain the mainstay of rehabilitation in upper limb loss. This presents the wearer with 2 problems: attachment and control. Bone-anchored devices can be used to overcome problems with prosthetic attachment and additionally used to transfer control signals from implantable electrodes to the prosthesis, addressing shortfalls associated with surface electrodes. [1]

In above-elbow amputees, targeted muscle reinnervation (TMR) enables more signal generation by redirecting nerves previously controlling the amputated muscles in the forearm, to surrogate muscles in the torso (e.g. pectoralis major). [2]

We describe in vivo model using implantable electrodes to record myoelectric signals (MES) in normal muscles and following TMR, utilizing a bone-anchor as a conduit to carry signals across the skin barrier.

MATERIALS AND METHODS
An in vivo n=6 ovine model was used. A bone-anchor was placed trans-tibially and bipolar electrodes sutured to proneus muscle.

RESULTS
In n=6 group, there was a positive correlation between signal to noise ratio (SNR) and time since implantation (p<0.005), with a mean SNR of 7 by week 12.

In the TMR model, functional recovery was observed after 4 weeks. This turning point was closely related to a return to normal gait - pre-op: left 4.7N/kg, right 4.8N/kg; 45 days post-op: left 4.4N/kg, right 4.8N/kg, p<0.05. Recorded MES from TMR muscle compared favourably with healthy muscle.

CONCLUSIONS
We have demonstrated that a bone-anchor is a reliable and robust conduit for transmitting MES over a period of 12 weeks. The combination of implanted electrodes & direct skeletal fixation offers clear advantages over current systems for prosthetic attachment & control. This system forms the basis of a complete solution for prosthetic rehabilitation, which can also be used in the context of TMR.

REFERENCES

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