DEVELOPMENT OF A WIRELESS MULTICHANNEL MYOELECTRIC IMPLANT FOR PROSTHESIS CONTROL

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INTRODUCTION

Complete functional adoption of upper limb prostheses is unacceptably low. Myoelectric device rejection rates are comparable to those of body-powered prostheses, even though these devices should be capable of providing better function. Amputees cite awkward use and lack of perceived utility of their myoelectric prostheses, as well as dissatisfaction with the ability to perform ADLs. Ultimately, poor control of myoelectric systems limits the adoption of advanced hand prostheses.

Prostheses manufacturers have released substantially improved prosthetic arm technology in the last decade; however, a well-documented challenge with the implementation of current myoelectric devices is the common use of only two surface EMG electrodes for collection of control signals. Limitations in the control signals extracted from surface EMG signals prevent the implementation of advanced control algorithms and intuitive movement. As a result, these advances prostheses still require serial selection and control of individual joints and grips resulting in slow, unnatural motions.

SYSTEM DESIGN

Ripple has developed an implantable system which simultaneously records 32 channels of myoelectric data from multiple residual muscles, and transmits these data to an external transceiver placed in the prosthetic socket. Our objective is to provide simultaneous multi-degree of freedom prosthesis control, ultimately providing an intuitive control experience. This approach supports a high number of independent control signals and provides access to EMG from deep muscles that cannot be accessed with surface electrodes.

The system comprises a hermetic implanted module from which nine EMG leads emerge. Eight of the leads contain four electrode sites each for 32 total recording channels. A ninth lead provides the reference electrode. The implant receives power inductively from an external transceiver and sends digitized EMG data to the external transceiver via infrared light. By using a single subcutaneous module for telemetry from which several leads emerge, power coupling efficiency remains high.

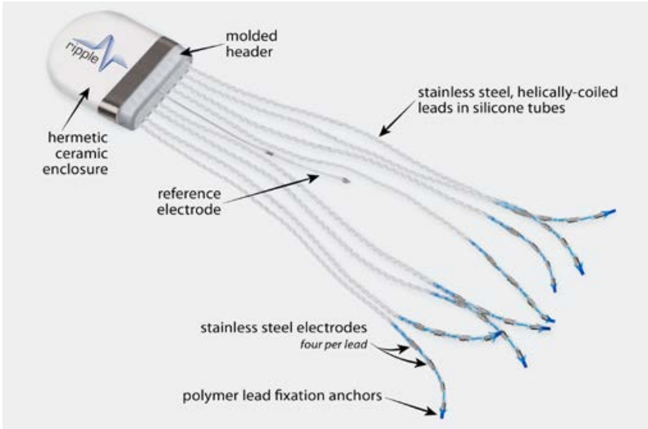

Figure 1. Wireless 32-channel Myoelectric Implant

RESULTS

We have demonstrated high data rate transmission using infrared light in chronically implanted canines. Devices were implanted in deltoideus and the long and lateral heads of triceps. Recorded EMG demonstrate very low noise and clearly indicate antagonistic activity of the gait muscles. Recordings are stable over the 6-month implant period.

We have completed and pass safety, electromagnetic compatibility, biocompatibility, sterilization, hermeticity, impact, lead flexion, and performance testing.

CONCLUSIONS

These efforts demonstrate the ability to amplify and transmit muscle signals and confirm safety and performance requirements. This approach has the potential to provide simultaneous multi-degree of freedom prosthesis control, especially if used with dexterous prostheses, surgical reinnervation techniques (TMR and RPNI), and advanced algorithms.

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