

# 9<sup>TH</sup> ORTHOPEDICS & RHEUMATOLOGY ANNUAL MEETING & EXPO

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### Targeted muscle and sensory reinnervation for amputees

Providing adequate control of a powered artificial arm is difficult, especially with high levels of amputation where the need is greatest. We have developed a new technique to create a bi-directional neural interface for artificial limbs called 'targeted muscle reinnervation' (TMR). With TMR, it is possible to take the residual nerves in an amputated limb and transfer them to spare muscle and skin in or near the limb. The nerves grow into this muscle and then the surface EMG over this muscle can be used as an additional control signal. For example, if the median nerve reinnervates a small region of surface muscle, then when the amputee thinks 'close hand' this muscle will contract and the myoelectric signal can be used to close the powered hand. Since physiologically appropriate neural pathways are used, the control is intuitive, thus easier and faster for the amputee. Similarly, sensory nerves can be transferred to the residual nerves so that skin of the chest or arm is reinnervated-targeted sensory reinnervation (TSR). Then when the amputee is touched on this reinnervated skin, it feels like he or she is being touched in the missing arm or hand. TSR can provide a pathway for true sensory feedback of light touch, graded pressure, sharp/dull and thermal feedback. Research is presented showing how the skin of residual limbs has been reinnervated by hand afferents and our early attempts to provide closed loop feedback. TMR also is proving to be a very successful treatment for painful neuromas and it is likely an effective treatment to prevent neuromas. Essentially when a cut nerve or cut off neuroma are transferred to a small section of denervated muscle (by cutting a local motor point for example), the regenerating nerve now has a volume of muscle to grow into and many functional connections are formed. Thus the nerve is treated in a physiologically appropriate manner, more like a primary nerve repair. Compelling animal model data and a thorough review of neuroma pain in TMR patients will be presented.

### Biography

Todd A Kuiken has received his MD and PhD in Biomedical Engineering from Northwestern (1990) and his Residency in PM&R at the Rehabilitation Institute of Chicago (1995). He is a Professor in the Department of PM&R, Biomedical Engineering and Surgery of Northwestern University. He is currently the Director of the Center for Bionic Medicine (CBM). His key projects have included the development of targeted muscle reinnervation, pattern recognition control for powered prosthetic arms, the development of novel robotic arm and leg prostheses and unique wheelchair designs.

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