ASPN/ASRM Combined Scientific Paper Presentations
Sunday, January 15, 2017, 9:45am – 10:15am

23. Primary Targeted Reinnervation for the Amputee - Can Painful Neuroma and Phantom Limb Pain be Prevented?

Department of Plastic Surgery, The Ohio State University Wexner Medical Center, Columbus, OH

John Byers Bowen, MD, MS; Department of Plastic Surgery, The Ohio State University Wexner Medical Center, Columbus, OH; Corinne Wee, BS; The Ohio State University, Columbus, OH; Ian L. Valerio, MD, MS, MBA; Department of Plastic Surgery, The Ohio State University, Wexner Medical Center, Columbus, OH

Introduction

About 25% of major limb amputees develop chronic localized painful neuroma (PN) and phantom limb pain (PLP). Previous studies prove TR successfully treats and, in some cases, resolves PN and PLP in patients whom have undergone previous amputation (i.e. secondary TR). This study examines the incidence of PN, PLP, and associated outcomes when TR is performed at the time of initial amputation (i.e. primary TR).

Methods

A retrospective review of all patients that underwent primary TR at our institution was completed. Each patient had his or her major amputated mixed motor-sensory and sensory peripheral nerves identified at his index amputation surgery. A nerve stimulator was utilized to identify proximal motor nerves entering specific muscle units. These target motor nerves were divided near their associated uscle and the prior amputated nerves were coapted to the target motor nerve.

Subjects were followed at one, three, six, and twelve-month intervals to evaluate symptoms of PN, PLP, phantom limb sensation, patient satisfaction, and functionality.

Results

Fourteen patients have been treated with primary TR. Operative details and follow-up reports of PN and PLP are shown (Table 1). Thus far, one patient reported PN at one month, which resolved by three months. At one month, 64% of patients reported PLP which, in all patients, resolved by three months. By three months, a majority of patients demonstrated targeted specific muscle reanimation with intuitive control of this muscle fasciculation.

Discussion

Improvement of PN and PLP was first noted in upper limb amputee patients undergoing secondary TR in order to improve bio-prostheses intuitive control. Our pilot study suggests that TR can decrease the incidence of PN and PLP when performed at the time of amputation. Our patients demonstrate early muscle fasciculation that suggests better muscle motor end plate function and less disuse/atrophy due to earlier nerve to muscle interface. We have noted trends towards quicker disuse of narcotics potentially due to decreased central nervous feedback. This study expands the use of TR, provides a basis for future studies regarding the specific use of TR to prevent PN and PLP, and also provides patients with the future option for bio-prosthetics.

Table 1: Painful Neuroma/Phantom limb pain report

Indication	Level of Amputation	Age	Post Operative Duration	Neuroma Pain Report Follow-Up Interval (mo)				Phantom Limb Pain Report Follow-Up Interval (mo)				Time to use of Prosthetic (mo)
				1	3	6	12	1	3	6	12	
Oncologic												
1	AKA	9	14	No	No	No	No	Yes	No	No	No	2
2	Trans-radial	48	12	No	No	No	No	Yes	No	No	No	
3	BKA	42	7	No	No	No	N/A	Yes	No	No	N/A	2
4	Forequarter	58	5	No	No	N/A	N/A	Yes	No	N/A	N/A	
5	BKA	32	2	No	N/A	N/A	N/A	No	N/A	N/A	N/A	
Skeletal Trauma												
1	BKA	39	15	No	Lost to F/U			No	Lost to F/U			
2	AKA	37	10	No	No	No	N/A	No	No	No	N/A	1
3	BKA	31	8	Yes	No	No	N/A	Yes	No	No	N/A	3
4	Trans-humeral	57	4	No	No	N/A	N/A	Yes	No	N/A	N/A	
Chronic Osteomyelitis												
1	BKA	64	14	No	No	No	No	Yes	No	No	No	2
2	BKA	51	7	No	No	N/A	N/A	Yes	No	N/A	N/A	2
3	BKA	43	7	Lost to F/U		No	N/A	Lost to F/U		No	N/A	
4	BKA	44	7	No	No	No	N/A	Yes	No	N/A	N/A	2
5	BKA	47	4	No	No	N/A	N/A	Yes	No	N/A	N/A	

24. Reconstruction Using Vasculized Free Nerve Flap for Limbs

The University of Tokyo Hospital., Tokyo, 256, Japan

Haruki Mizuta, junior; Tokyo University, Tokyo, Japan

We often experience traumatic main neural trunk injury of limbs. When the both stumps of neural trunk are separated to some extent,free nerve graft get better result than nerve anastomosis in tension. Survival of explant nerve graft depends on rhamdamised blood circulation resumption ,in other words,free composit graft. Therefore,severe scar of peripheral tissue and long free nerve graft cause poor circulation of blood. It causes central necrosis of the nerve and interfere axonal regeneration severely. So we devise vasculized free nerve flap,firstly harvest nerve graft with feeding vessel , secondly anastomos artery and vein in host site for blood resumption of free nerve flap.
method: We perform 62 vasculized free nerve flap cases among past 15 years.The breakdown is as follow. Main paralysis nerve rcnstr contains Brachial plexus,upper arm nerve,digital nerve post tibial nerve,planter nerve and so on. Nerve rcnstr with deep peroneal nerve is 26 cases,with saphenous nerve is 18 cases. Rcnstr with deep peroneal with extenser digitorum tendon is 5 cases Rcnstr with lateral femoral cutaneous(LFCN) nerve is 2 cases Rcnstr with femoral nerve branch is 2 cases Main pedicle nerve transfer contains intercostal nerve to musculocutaneous or median nerve,accesary nerve to musculocutaneous or median,deep peroneal nerve
result: About motor nerve reconstruction case, motor function is not regained enough in nerve reconstruction case passed over 6 month since Paralysis occured. However,early nerve reconstruction results in enough muscle contraction. On the other hand, sensory nerve function reconstruction is often regained enough in nerve reconstruction case passed over 6 month since Paralysis occurred. Especially in young case, sensory nerve function is recovered excellently.However in elder case ,there is a limit.
conclusion: Vasculized free nerve flap regenelates 25 cm motor axon of intercostal nerve among three month. Regenelated motor nerve make it possible that parlysis muscle and explant muscle are contacted voluntary.And it works out in host site with scar. Vasculized nerve flap make it possible not only good regenelation in host site with poor circulation but also prompt regenelated nerve expansion. Then completely new nerve reconstruction method will be published for each nerve paralysis that we can not treat before.

25. Fascicular Shifting in the Reconstruction of Global Obstetric Brachial Plexopathies – From Bench to Bedside

CD -Laboratory for Restoration of Extremity Function, Vienna, 256, Austria

Matthias E Sporer, MD; CD Laboratory for Restoration of Extremity Function, Vienna, Austria; Johannes Mayer, MD; CD Laboratory for Restoration of Extremity Function, Medical University of Vienna, Vienna, Austria; Oskar C. Aszmann, MD, PhD; Division of Plastic and Reconstructive Surgery, Medical University of Vienna, Vienna, Austria

Background: A number of models have investigated different biological and synthetic matrices as alternatives to conventional nerve grafts. However, the autologous nerve graft remains the gold-standard, even though here a pure sensory nerve is used to reconstruct mixed or pure motor nerves. Furthermore, limited donor sites often necessitate a significant mismatch of needed nerve tissue. Especially in the reconstruction of large proximal nerve defects, such as obstetric brachial plexopathies, we are facing these challenges. Here we present a new concept that overcomes these problems: the fascicular shift procedure. A fascicle group of the nerve segment distal to the injury site is harvested in appropriate length to bridge the injury site.

Animal model: In a rat model the fascicular shift was compared to nerve reconstruction with sensory, motor and mixed nerve grafts. The fascicular shift provided sufficient guidance to overcome nerve defects, had higher ($P<0.1$) motor neuron counts (1958.75±657.21) compared to sensory graft (1263.50±538.90) and was equal to motor (1490.43±794.80) and mixed grafts (1720.00±866.421). This tendency of improved motor regeneration was confirmed in all analyses. None of the analyses revealed an impairment on nerve regeneration despite of the partial defect elongation induced by the fascicular shift distal to the repair site.

Clinical work: At our department a total amount of eight large, proximal nerve defects have been reconstructed by applying fascicular shifting. The presentation of first clinical results will be limited to a long term follow-up of four obstetric brachial plexopathies. Satisfying sensory and functional recovery was found in all patients, which was evaluated amongst others by the Modified Mallet Score (in avg. 3.9 out of 5), the Gilbert Shoulder (in avg. 4 out of 5) and Elbow Scale (in avg. 2.5 out of 3) and the Raimondi Score (in avg 2.4 out of 5).

Conclusion: Experimental investigations and clinical results both show that harvesting a transplant from the nerve segment distal of the injury site provides a mixed graft without causing additional donor-site morbidity. These grafts perform statistically better than a standard sensory graft in regards to motor recovery. The fascicular shift presents a novel method to reconstruct large proximal nerve defects, and thus make it immensely attractive in brachial plexus reconstruction.