of Zurich Spinal Cord Injury Center, Research Balgrist University Hospital, Zurich, Switzerland, 4Palo Alto Veterans Healthcare System, Palo Alto, CA, USA, 6VA St. Louis Healthcare System, St Louis, MO, USA, 7Division of Plastic and Reconstructive Surgery, Department of Surgery, University of Toronto, Toronto, ON, Canada, 8ICORD, University of British Columbia, Vancouver, BC, Canada.

Purpose: Functional gains can occur for years post spinal cord injury (SCI), but candidacy for nerve transfers can be time sensitive due to axon and muscle degeneration after injury. To identify eligibility criteria and allow for optimal timing of restorative surgical treatment for cervical SCI, more precise information is needed on spontaneous motor recovery and independence in activities of daily living within the first year after injury. This study evaluated the improvement in upper limb motor strength and functional independence with no surgical intervention at differing levels of cervical SCI.

Methods: Using the comprehensive European Multi-center Study about Spinal Cord Injury data set, analysis was undertaken of individuals with traumatic SCI, motor level C5-C8. Recovery of motor function between 6 and 12 months after injury was ascertained. Data on feeding, bladder management and transfers (bed to wheelchair) were also compared at 6 months and 12 months. Subgroup analyses of symmetric and asymmetric SCI, and between complete and incomplete SCI were performed. The impact of age and gender on functional independence was ascertained.

Results: From 6 to 12 months post-SCI, few patients recovered additional strong (MRC 4-5) function below the motor level. The majority of recovery occurred at the level immediately below the motor level. Specifically, analysis of 402 limbs showed that 3% of individuals with strong proximal cervical level function (C5 +/- C6 intact) and no elbow extension (C7 function) at 6 months gained strong (MRC 4-5) and 8% gained antigravity (MRC 3) elbow extension by 12 months. With respect to recovery of C8 function (finger flexion), of those with intact proximal level function at 6 months (n = 519 limbs), 3% gained strong finger flexion at 12 months. Participants with incomplete SCI injury (AIS C or D) had significantly greater recovery than those with complete SCI (AIS A or B). At 6 months post injury, data on feeding, bladder management and transfers were available for participants with symmetric (n = 204) and asymmetric (n = 95) SCI. There was no significant increase in independence between 6 and 12 months for any activity of daily living. Feeding with assistive devices was reported for nearly all with strong wrist extension (C6). Independence in feeding and bladder management was noted with strong finger flexion (C8). Elbow extension (C7) did not uniformly result in the ability to transfer independently, whereas finger flexion (C8) did.

Conclusion: There are no significant gains in motor strength or functional independence between 6 and 12 months post SCI. Thus, if individuals are interested in nerve transfers to gain function, evaluation for eligibility at 6 months post SCI is appropriate. The expected functional range from this study will guide expectations for independent self-care.

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Intercostal Neurectomy And Regenerative Or Dermatosensory Peripheral Nerve Interface For Chronic Mastectomy Pain

Sarah Hart, MD1, Shailesh Agarwal, MD2, Jennifer Hamill, MPH1, Niki Matusko, BS1, David Brown, MD1

1University of Michigan, Ann Arbor, MI, USA, 2Brigham and Women’s Hospital, Boston, MA, USA.

Purpose: Chronic post-mastectomy pain due to intercostal cutaneous nerve injury can affect up to 40% of patients, causing diminished quality of life and increased risk of opioid dependence. It is a poorly recognized etiology, yet diagnosis and treatment can be straightforward. Neurectomy with “physiological capping” of the nerve end with muscle (regenerative) or dermis (dermatosensory) peripheral nerve interface (RPNI or DSPNI, respectively) has shown to significantly reduce neuromatous pain in limb amputees. We proposed that intercostal sensory neurectomy, combined with RPNI or DSPNI, would significantly reduce chronic post-mastectomy pain.

Methods: Retrospective review was performed for seven patients (2016 - 2019) with a history of breast surgery and chronic pain, who underwent intercostal neurectomy with RPNI or DSPNI. Patient demographics, comorbidities, pain scores, length of follow up, surgical techniques and complications were reviewed.
**Results:** Neurogenic pain was diagnosed by history (unrelenting pain greater than three months postoperatively, limited to the chest or back) and physical exam (tenderness in specific intercostal spaces over the anterior, lateral and/or posterior divisions of the nerves and positive Tinel signs) in all seven patients. Five patients underwent preoperative confirmatory nerve blocks with local anesthetic.

During the operation, nerves were easily located on the muscle fascia, via a vertical incision in the mid-axillary line or 3cm lateral to the posterior midline. Neurectomy was performed at the level of the fascia, followed by wrapping of the proximal stump with a muscle or dermal graft. Average patient age was 51.9 years with an average BMI of 27.2. Patients presented an average of 56.9 months post-breast surgery. Five patients presented with anterior chest pain and two with posterior pain. The average number of RPNIs/DSPNIs performed per patient was 3.14 (SD 1.86). The average length of the operation was 129 minutes (SD 41.8). There was a significant reduction in VAS pain scores following surgery, from 9 (range 4-10) preoperatively to 1 (range 0-6) postoperatively (p = 0.02, Wilcoxon signed-rank test). One patient had a postoperative surgical site infection treated with oral antibiotics. Average follow-up was 6.14 months.

**Conclusions:** Peripheral nerve injury causing chronic neuropathic pain is an under-recognized but easily diagnosed and treated cause of post-mastectomy pain. In an initial retrospective case series with seven patients, neurectomy combined with RPNI or DSPNI resulted in clinically and statistically significant pain relief with minimal complications.

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**Surgical Angiogenesis To Nerve Allografts Improves Early Functional Recovery In A Rat Sciatic Nerve Defect Model**

Tiam M. Saffari, MD, Femke Mathot, MD, Allen T. Bishop, Prof, MD, Alexander Y. Shin, Prof, MD

**Mayo Clinic, Rochester, MN, USA.**

**Purpose:** It is widely accepted that functional results are poor when nerve grafts are transplanted in severely scarred tissue beds and that independent blood supply of nerve grafts could improve outcomes. Optimized processed allografts (OPA) have no vascular supply. Addition of vascularization to the OPA promotes immediate revascularization and minimizes the period of ischemia, diminishing fibrosis and central necrosis potentially enhancing functional recovery. The purpose of this study was to determine how addition of vascularization to nerve allografts would affect functional recovery.

**Methods:** Sixty Lewis rats were divided into three groups of 20 animals each. Nerves harvested from Sprague Dawley rats were decellularized according to protocol (Hundepool et al, 2017), irradiated and stored until use as OPA. Unilateral 10mm sciatic nerve defects were repaired with (i) OPA, (ii) OPA wrapped with a superficial inferior epigastric fascial (SIEF) flap to provide vascularization to the nerve bed, and (iii) autografts. Twelve and 16 weeks after surgery, nerve regeneration was assessed using functional, electrophysiologic, histomorphologic, and immunofluorescence analyses (N=10/time point). Ultrasound was used during the survival period to noninvasively evaluate muscle atrophy.

**Results:** Rats in which a well-vascularized SIEF flap was provided to the nerve allograft showed significantly better isometric tetanic force (ITF) recovery at 12 weeks, compared to allograft alone. ITF recovery normalized between groups at 16 weeks. Ultrasound showed a trend toward less atrophy in SIEF rats, compared to allograft only, however, this was not significant. Electrophysiology showed superiority of autografts at both time points. Histomorphometric analysis revealed no differences between groups with regard to axon area, axon count and myelin area, however, the N-ratio was significantly inferior in allografts at 12 weeks compared the autograft and SIEF group. Using immunofluorescence, the expression of CD34, indicating vascularity, showed significantly improved levels in SIEF samples compared to allografts at 12 weeks, and highest expression at 16 weeks compared to all groups. Protein gene product 9.5 (PGP9.5), a pan-neuronal marker, did not reveal any differences between groups at 12 or 16 weeks.

**Conclusion:** This study suggests that addition of a well-vascularized fascial flap to the nerve allograft bed increases vascularity in the nerve allograft, subsequently improving early functional recovery, comparable to autografts.

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**Ccl2-ccr2 Signaling Is Critical To Macrophage Recruitment, Angiogenesis,**