



Implementation Project to Improve an Upper Limb Spinal Cord Injury Clinic

HYATT REGENCY DENVER & COLORADO CONVENTION CENTER · SEPTEMBER 3-6, 2017



Presenters:

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- Jeff Jaramillo, DPT
- Maura Murphy, OTR/L

○ No Financial Disclosures

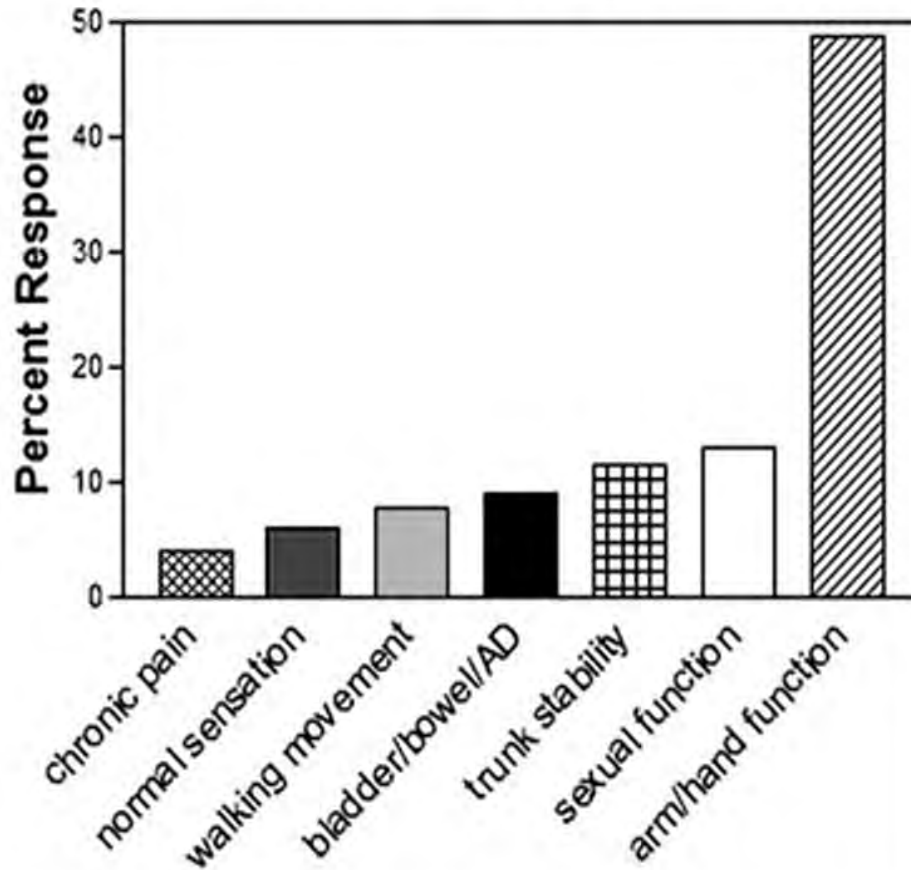
Course Objectives:

1. Describe the process for implementing a successful SCI Upper Limb Clinic
2. Increase awareness of treatment options for SCI patients who have potential to benefit from surgical and nonsurgical therapeutic interventions for upper limb issues
3. Identify three key outcome measures

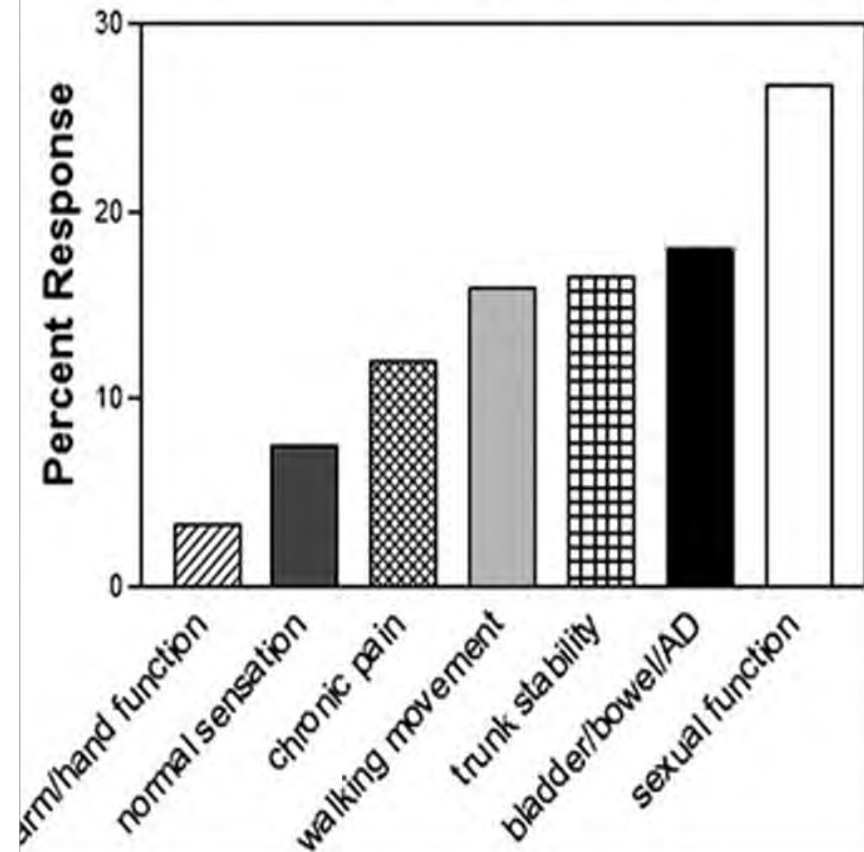
Purpose:

Determine if a routine assessment of patients with spinal cord injury (SCI) in the upper limb clinic will result in improved upper limb care

Highest Priority to Quadriplegics



Highest Priority to Paraplegics



Anderson K. Targeting Recovery: Priorities of the Spinal Cord-Injured Population. *J Neurotrauma* 2004;21(10), 1371-1383.

Jeff Jaramillo, DPT

- Role of Research and Clinical Practice

Research findings Informing Upper Extremity Clinical Car



Clinical Care Informing Research Directions



Preserving and/or Improving Existing Upper Limb function

- Measurement
- Therapeutic Outcomes
- Reevaluation of therapy paradigms

Case Study

Right shoulder					
	Pain (0-10)	Strength Flexion (kg)	AROM Flexion (deg)	AROM Internal rotation (deg)	Wheelchair Stroke Efficiency (m/s)
4/6/10	3	7.8	178	60	1.81
5/12/10	3	6.7	162	52	1.31
5/31/11	4	4.6	165	45	
3/12/12	4	4.35	160	43	
5/22/12	3	4.55	155	37	
7/30/12	4	3.7	150	40	

Quantification of outcomes

- Using muscle dynamometry to better quantify strength changes over time.



- Using wheelchair devices to measure push performance.



Strength Changes Over Time

Strength (kg) for paraplegia by decade since injury

	1-10 yrs (n = 19)	11-20 yrs (n =18)	21-30 yrs (n=16)
Shoulder flexion	20.1 (9.7)	11.7 (7.0)	8.6 (2.0)
Shoulder Abduction	18.7 (9.0)	10.6 (5.7)	8.1 (3.2)
Internal rotation	34.3 (17.8)	19.4 (13.2)	16.3 (7.3)
External rotation	20.5 (10.4)	13.7 (7.2)	11.5 (2.4)
Elbow Flex	16.2 (6.2)	17.9 (5.4)	17.9 (5.9)
Elbow Ext	10.4 (3.8)	11.9 (2.9)	16.9 (1.2)

Strength Changes Over Time

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Shoulder ABD	18.7 (9.0)	10.6 (5.7)	8.1 (3.2)
Shoulder IR	34.3 (17.8)	19.4 (13.2)	16.3 (7.3)
Shoulder ER	20.5 (10.4)	13.7 (7.2)	11.5 (2.4)
Elbow Flex	16.2 (6.2)	17.9 (5.4)	17.9 (5.9)
Elbow Ext	10.4 (3.8)	11.9 (2.9)	16.9 (1.2)

40% lower shoulder strength averaged across muscles from first decade to the second decade

Strength Changes Over Time

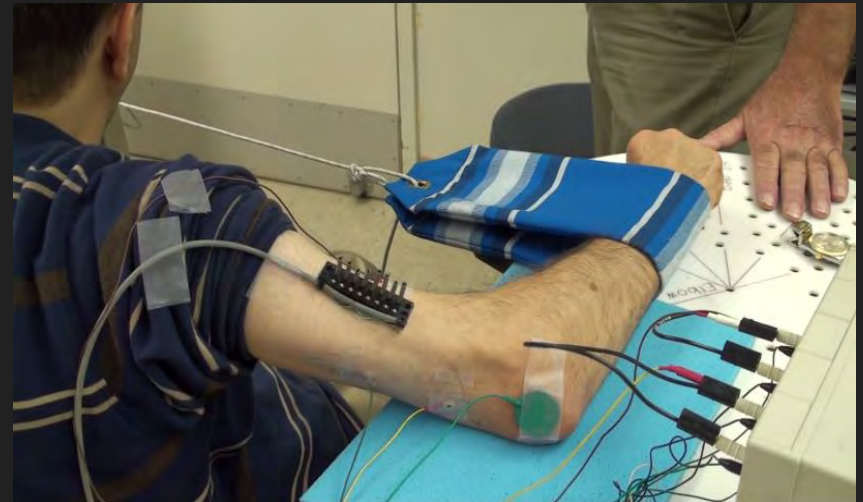
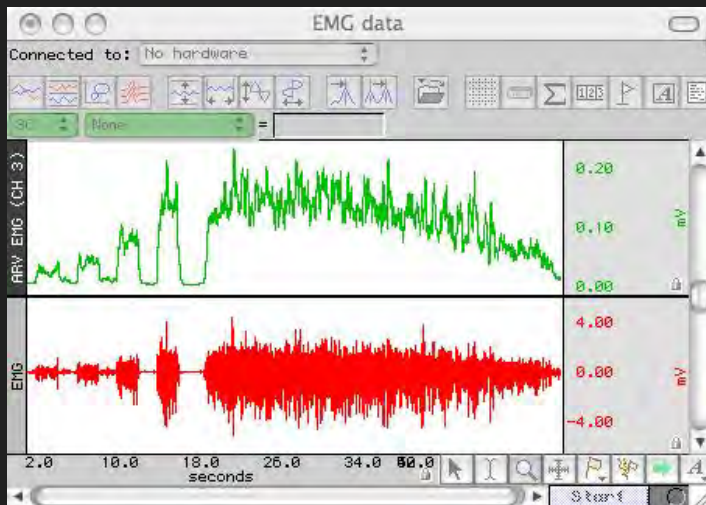
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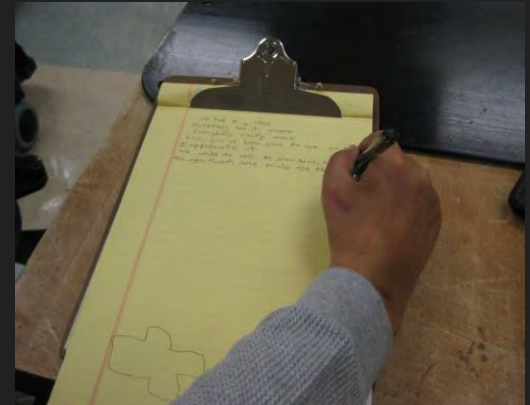
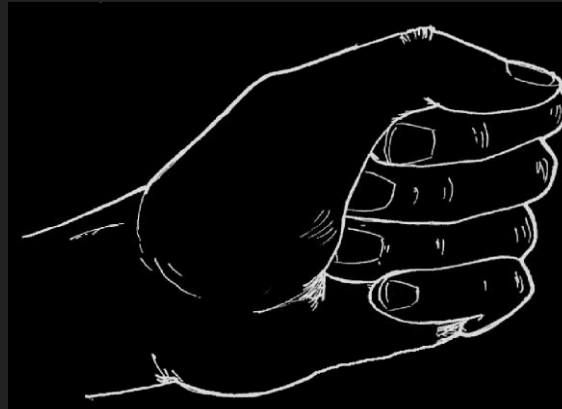
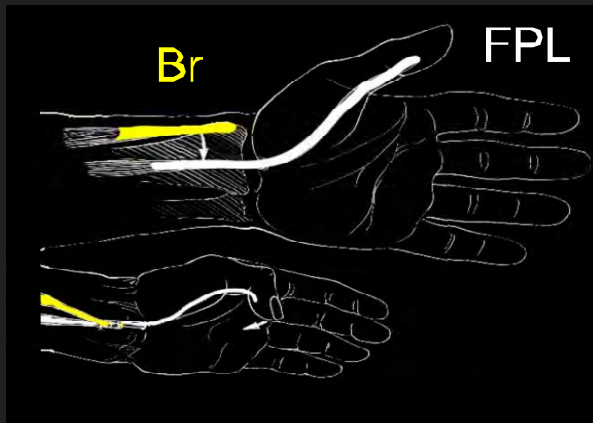
22% lower shoulder strength averaged across muscles from second decade to the third decade

Focused Upper Extremity Evaluation

Using EMG techniques to better understand muscle function and predict functional outcomes prior to surgical and/or exercise routines.



Multi-Center Trial to Improve Grasp in Tetraplegia



Multicenter survey of the effects of rehabilitation practices on pinch force strength after tendon transfer to restore pinch in tetraplegia

Hentz VR. et al 2016.

Multi-Center Trial to Improve Grasp in Tetraplegia

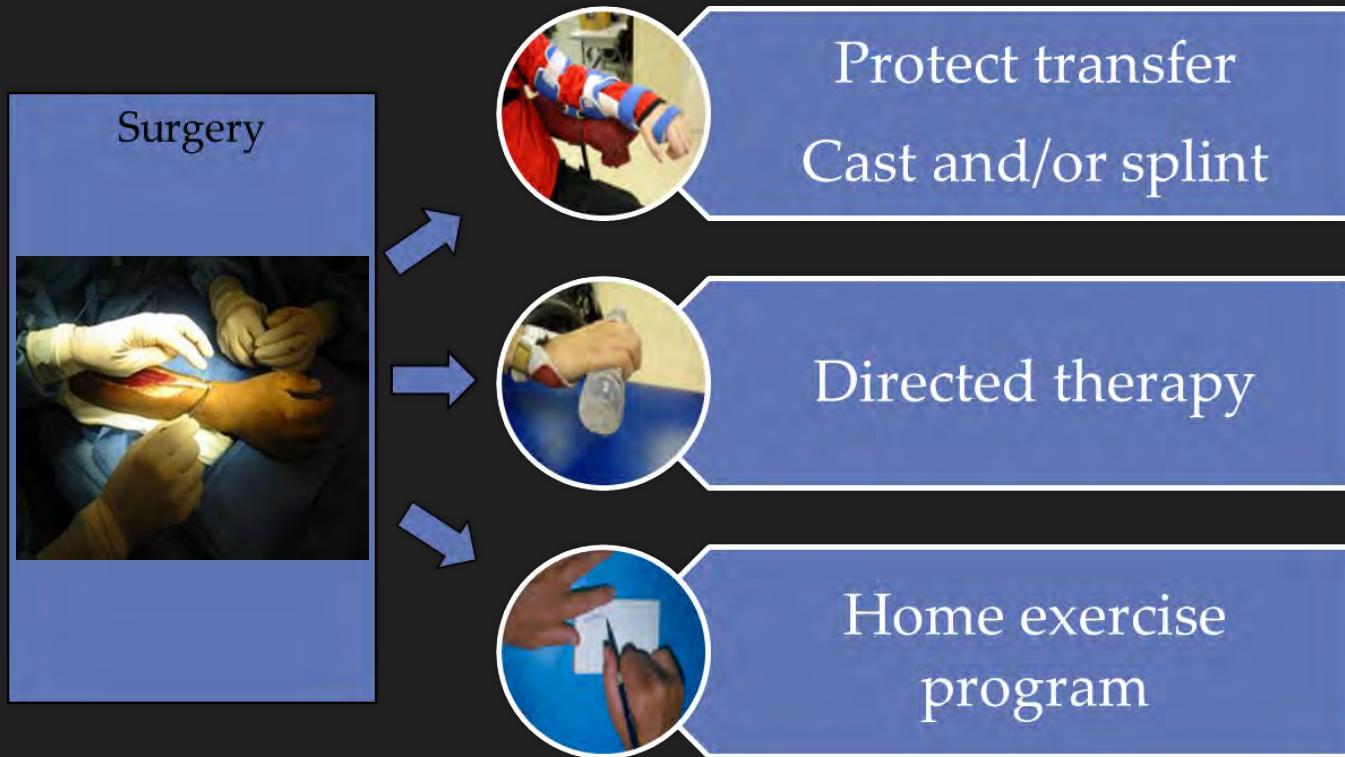
- Geographical Challenges



- Directed Care Challenges



Re-Evaluate Protocols



Surgery



Protect transfer
Cast and/or splint



Directed therapy



Home exercise
program

Importance of Re-assessment



Additional therapy to meet surgical goals



Strengthening proximal joint for stabilization

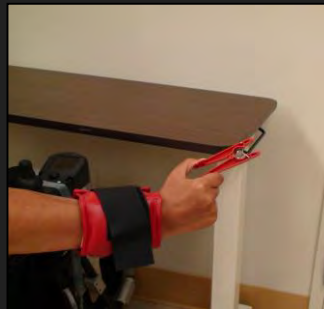


Need for revisions to adjust posture

Evaluate Therapeutic Interventions

Improvements with intervention 10 years post surgery

- **10% increased pinch force**
- **10 % increased brachioradialis activation**



Adjunctive Therapy Options

Technology as a Therapy Tool



Technology as a
Preventive Tool

Long-term re-assessment

Preserving and/or Improving Existing Upper Limb function....

....to meet patient goals !!!!



Conclusions

- An upper extremity clinic benefits by multidisciplinary collaboration
- An upper extremity clinic serves as a great way for continuing and encouraging long-term follow-up of individuals

Maura Murphy, OTR/L

- Role of Therapy

The Role of Therapy:

- Increase awareness, referral, and utilization of SCI UE clinic as a resource and tool.
 - Broaden our lens when assessing patients (acute and chronic settings) and dig deeper into reported or noted functional changes or potential areas for improvement even if “that’s how it’s always been.”
 - Provide a roadmap to identify potential areas of intervention
- Establish and implement accessible protocols to improve upper extremity function
- Monitor progress including adherence to program and outcomes

Method

- Incorporate focused upper extremity assessment into inpatient and outpatient annual evaluations
 - Current function and functional limitations
 - Changes over time—degenerative, post-injury or illness, post tendon transfer
 - Pain
 - Potential for surgical/nonsurgical intervention

Method

- Initiate exercise protocol and establish HEP for:
 - Restoration of function: ROM, strength, dexterity, pain management
 - Prevention of age and/or overuse related changes
 - Preparation for surgery including more proximal/postural musculature
 - Post-op neuromuscular reeducation/strengthening for both new and old surgical patients

Method

- Assess for and fit with orthotic devices
- Refer to SCI UE clinic:
 - localized or new onset pain
 - loss or change in function, ROM or strength
 - Candidate for tendon/nerve transfer
 - Lack of improvement post-operatively
 - Anything that raises concerns/warrants further assessment.

Barriers

- Fear of creating a message of reproach when introducing the idea of more comprehensive UE assessment with other members of therapy team.
- Not necessarily imparting new knowledge but injecting new energy, focus and empowerment in the therapist role in identifying areas of potential therapeutic intervention.
- Utilize clinical skills in a broader scope with UE clinic as a resource.

Barriers

- SCI upper extremity rehab seen as “hand therapy” and therefore a specialty or area of advanced practice.
 - A large part of SCI rehab is upper extremity rehab
 - Share knowledge: have more than one therapist in clinic, rotate therapists, orient all therapists to clinic, regular in service presentations, accessible protocols, vendor product presentations for upper extremity intervention.

Intervention: Non-surgical

- Majority of patients seen in clinic receive non-surgical intervention
- Education in biomechanics, joint preservation, new techniques or equipment
- Revised HEP
- Splinting
- Pain management such as injection or modalities

Intervention: Surgical

- Identify pre-surgical goals to maximize post-op results
- Patient and caregiver education on post-op course including timeless, need for additional care and new equipment
- Proximal muscle strengthening, ROM, stretching

Intervention: Surgical

- Post-operatively, rehab protocols are generally clearly structured and follow a timeline for initiating and progressing ROM, strengthening and splint weaning.
- A protective splint is worn for a specified duration during which a patient may need new training or AD for ADLs
- Edema management, ROM all other joints
- Splint removal for exercises, scar massage 2-3x per day.
- Gradual progression of exercises to include gentle function based activities such as pinching foam blocks
- More aggressive ROM (only if needed to achieve function), strengthening, splint weaning for ADLs

Results

- Follow up to determine carryover, effectiveness, need for further intervention.

Summary

- Our role as therapists is to maximize function and independence
- For persons with SCI/D, upper extremity use is function
- Function has many components many of which can be more readily identified by a therapist who unique clinical skills to assess function and may have greater knowledge of functional history and changes over time
- SCI UE clinic is a valuable resource for therapists and therapists are essential in implementing an effective clinic.
- UE rehab should not be considered “hand therapy” and knowledge should be shared among team members
- This is a fun and exciting interdisciplinary approach to use our skills and gain new knowledge to significantly impact the lives of our patients!

Catherine Curtin, MD

- What can we do?

Upper Extremity Care in SCI

- Optimize residual resources
- Preserve function



GOALS

IT'S BEST TO AVOID STANDING DIRECTLY BETWEEN A COMPETITIVE JERK AND HIS GOALS.

www.despair.com

Optimize Function

- The primary goal for people with tetraplegia is improved functional independence (Hanson)
- Upper extremity function is crucial to achieve more independence
 - “I’ve often thought how much easier things would be, even if I were a para. Even if I had use of my hands...How useful they are, they’re great, everyone should have working hands.” (Manns)

Preserve Function



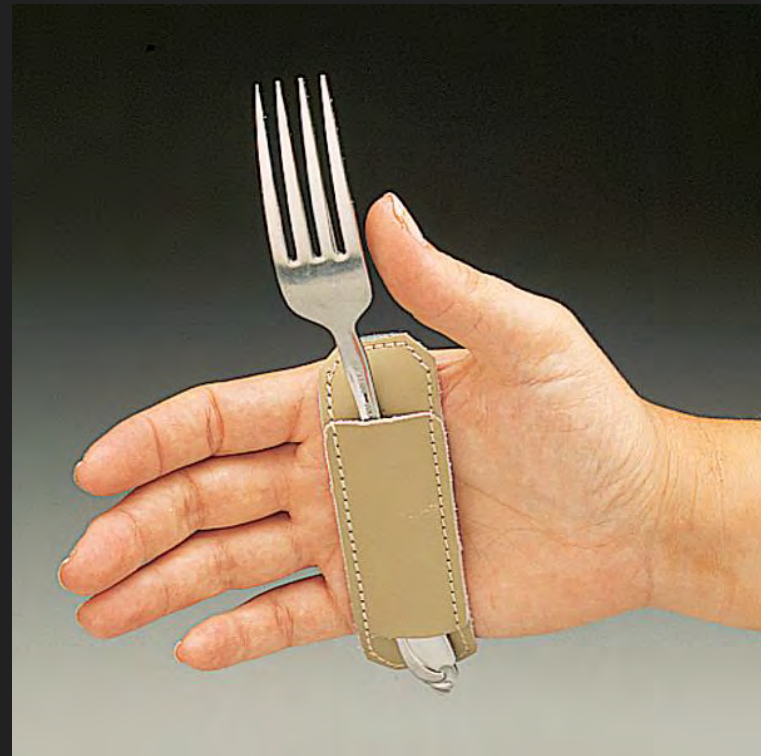
- The upper limb has new demands after spinal cord injury
 - Shoulder
 - Wrist
 - Fingers



**Upper extremity
care is a critical
component of SCI
care**

Optimize Function

- Prevention of Contractures
- Appropriate Assistive Devices
- Surgical Interventions



Upper extremity reconstruction for tetraplegia



Upper extremity reconstruction for tetraplegia

- Well Described
- Basic Surgical Techniques
- No special equipment
- Improves function



Who is a candidate?

- Must be Stable:
 - Neurologically
 - Psychologically
 - Socially
- Have spasticity controlled
- Have some residual resources to work with:
 - BR
 - Biceps

What do we do?

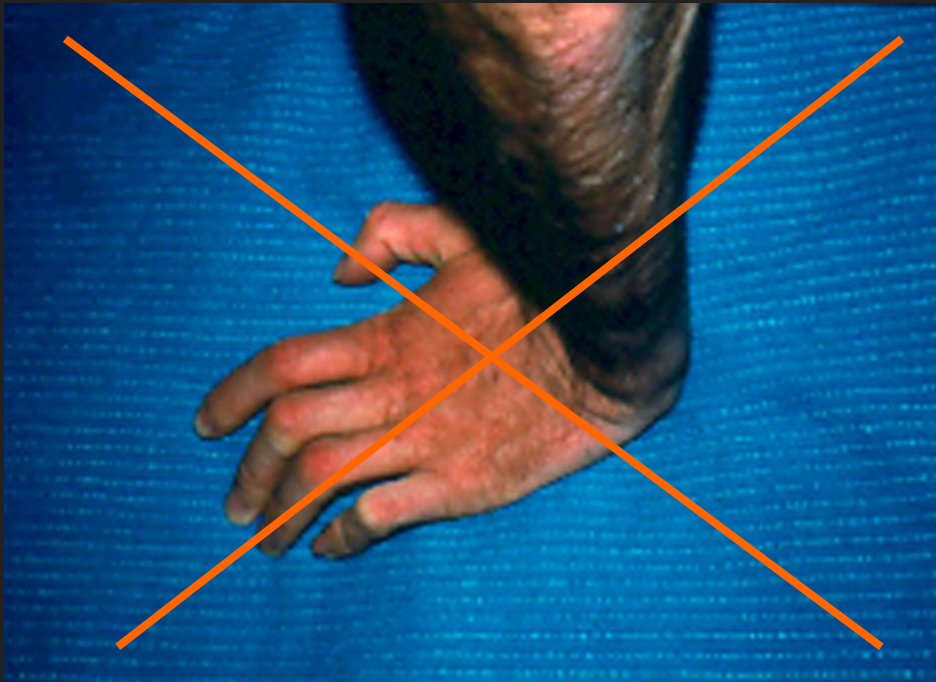
- Stabilize joints
- Re-route functional muscles to more useful functions
- Enhance tenodesis

Pinch Reconstruction

- Enhance lateral pinch
- Procedure choice dependent on residual function



Cautions/Transfer



Protect the Repair



Post-op

- Cast Variable
- Splint for 4 weeks unless exercising



Systematic Review

- We reviewed all the English and French literature on upper extremity reconstruction from 1966 to 2007
- Initial search generated 765 articles
- 37 articles met our inclusion criteria
- Two independent reviewers, evaluated the articles

Pinch Reconstruction

- 377 patients had an average postoperative pinch strength of 1.9 kg
 - 2.32 kg with active motor
 - 1.2 kg with tenodesis only
 - 40% complication rate

Elbow Extension

- Often more appreciated than reconstruction
- Improves results of grasp reconstruction





Biceps to Triceps Transfer



Post-op

- 4 weeks in a cylinder cast
- Then slowly allow flexion with splinting



Adjustments



Elbow Reconstructions Systematic Review

○ Elbow Reconstruction

- 201 limbs had an average elbow extension MRC grade of 3.3
- 25% complication rate

Conclusions

- These procedures are effective
 - 90% of patients were satisfied with the procedures
- These risk/benefit ratio is acceptable
 - Complications were generally minor
 - Function was improved

First Person Perspective:



Preserve Function

- 70% of people with SCI have upper limb pain
- Up to 75% of people with paraplegia have symptoms of carpal tunnel (Yang)
- “Walking on your hands”
- Need to repeatedly assess upper limbs

Interventions

- Education
- Therapy
- Steroid injections
- Change of wheelchair
- Splinting

Barriers to Care



© LYN TOPINKA, 2006

Limitations to Access



Competing Demands



Palo Alto VA Clinic

- Long history of SCI upper limb care
- Changes in staff
- Upper limb care was losing momentum
- We needed a change!

Susan Pejoro, MSN, RN, GNP-BC

- How we made it happen and what we accomplished...

Developed New Mission Statement:

- To improve the upper limb health of individuals with SCI/D through access to quality health care and innovative solutions
- Our goals are preserving and/or improving existing upper limb function and implementing therapeutic interventions to maximize quality of life and independence
- A combined prevention and treatment approach will address pain, overuse, and functional changes in the upper limb
- We will also investigate novel treatment paradigms to improve care of all with SCI/D

Identified Performance Improvement Goals

- Increase identification of patients with needs not previously identified
- Offer surgical and non-surgical interventions to maximize and preserve upper limb function
- Offer staff education opportunities
- Increase research participant opportunities

Kick Off - All Staff Meeting

- Provided background education on upper limb dysfunction after acute SCI
- Provided education on state of novel therapies to improve and maintain function after acute SCI
- Provided education on risk of progressive changes in upper limb(s) over time without prevention strategies or early identification

Identified Required Team Members :

- Surgeon
- Clinic Coordinator
- Occupational Therapist
- Researcher
- Ad-hoc team members as needed:
 - MD/DO/NP/Fellows/Residents
 - PT/OT
 - Psychology/Social Work
 - Case Managers
 - Recreation Therapist

Identified Augmented Supportive Services:

- OT/PT (i.e. splinting, seating posture, injury prevention, stretching, strengthening, and ROM)
- Functional Extremity Clinic
- Psychology: Bio-feedback
- Recreation Therapy: Recreation/sports goals
- Assistive Technology: Adaptive Technology

Determined Clinic Schedule:

- 2x/month
- 1st and 3rd Wednesdays
- 1300 to 1400
- 15 minute appointments
- 1 over overbooking appointment
- Maximum 5 appointment slots/clinic

Developed Referral Process:

3 Tiered Process

- Inpatient Annual Evaluations
 - Any patient with Tetraplegia diagnosis or prior pathology to be screened in clinic
- Inpatient referrals
- Outpatient referrals

Inpatient Annual Referral Process:

- SCI Admissions Coordinator:
 - Share anticipated admissions 1 month in advance to Clinic Coordinator or designate
- Clinic Coordinator:
 - Clinic Coordinator enter SCI-UE consults
 - Notify Case Managers of pending consult
- SCI Case Managers:
 - Notify patient at pre-admission screening call of pending consult

Inpatient Referral Process Cont.

- Enter SCI UE Consult
 - Clearly state question/concern to be addressed
 - Clearly state if patient has complicated psycho/social needs
 - Diagnostic tests to be completed prior to scheduled appointment
- Enter SCI UE Clinic Consult. Notify clinic coordinator for any special needs
- New SCI to be seen in clinic within 3 months of Injury

Outpatient Referral Process:

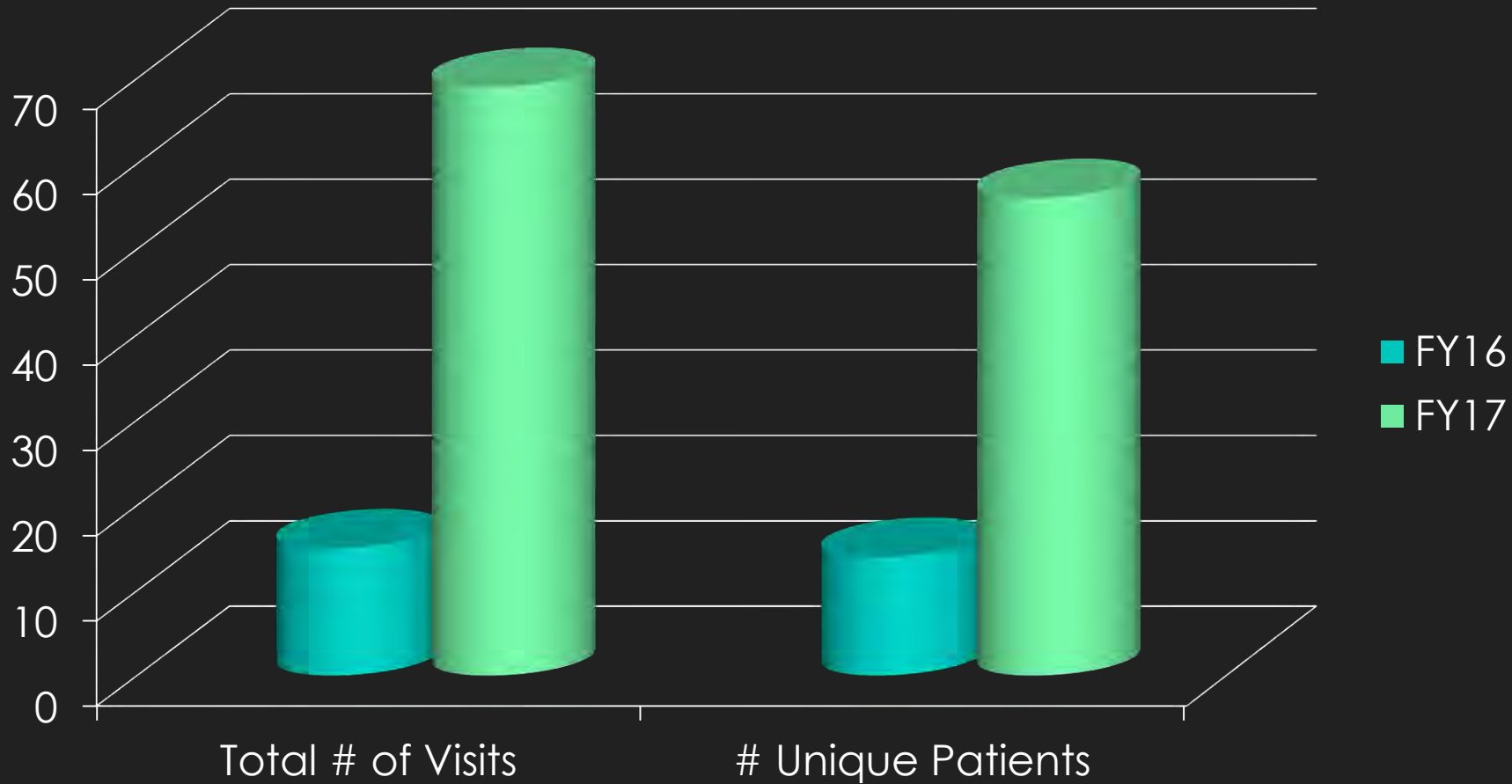
- Enter SCI UE Consult
 - Clearly state question/concern to be addressed
 - Clearly state if patient has complicated psycho/social needs
 - Diagnostic tests to be completed prior to scheduled appointment
- Enter SCI UE Clinic Consult. Notify clinic coordinator for any special needs

Developed Metrics to Access for SCI Clinic Operations:

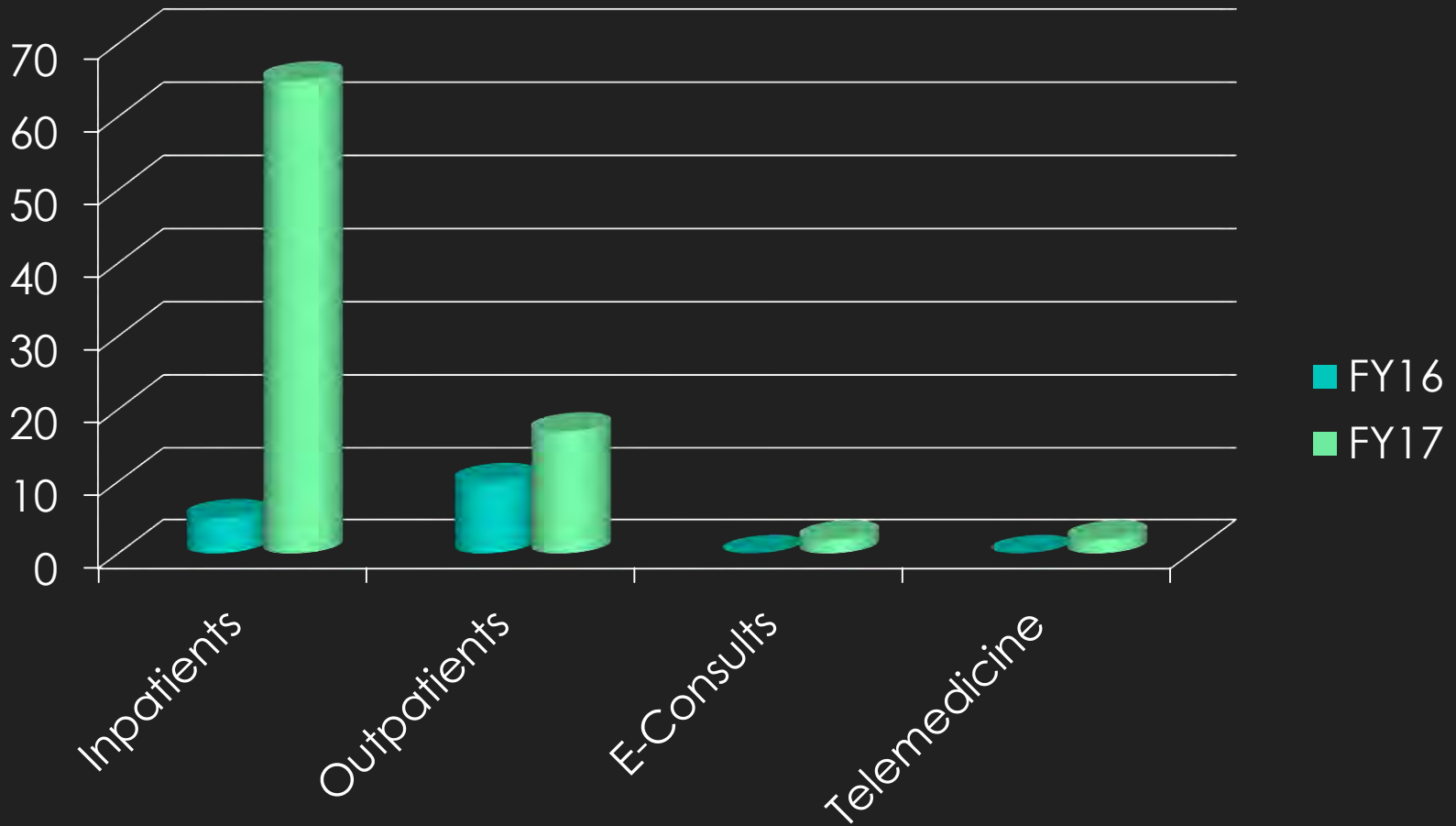
Quarterly reporting by Clinic Coordinator

- # of clinic appointments
- # of unique patients seen
- # of referrals to OT/PT
- # of referrals to Functional Extremity Clinic
- # of referrals to Orthopedics/Rheumatology
- # of procedures done in clinic
- # of offered surgeries
- # of completed surgeries

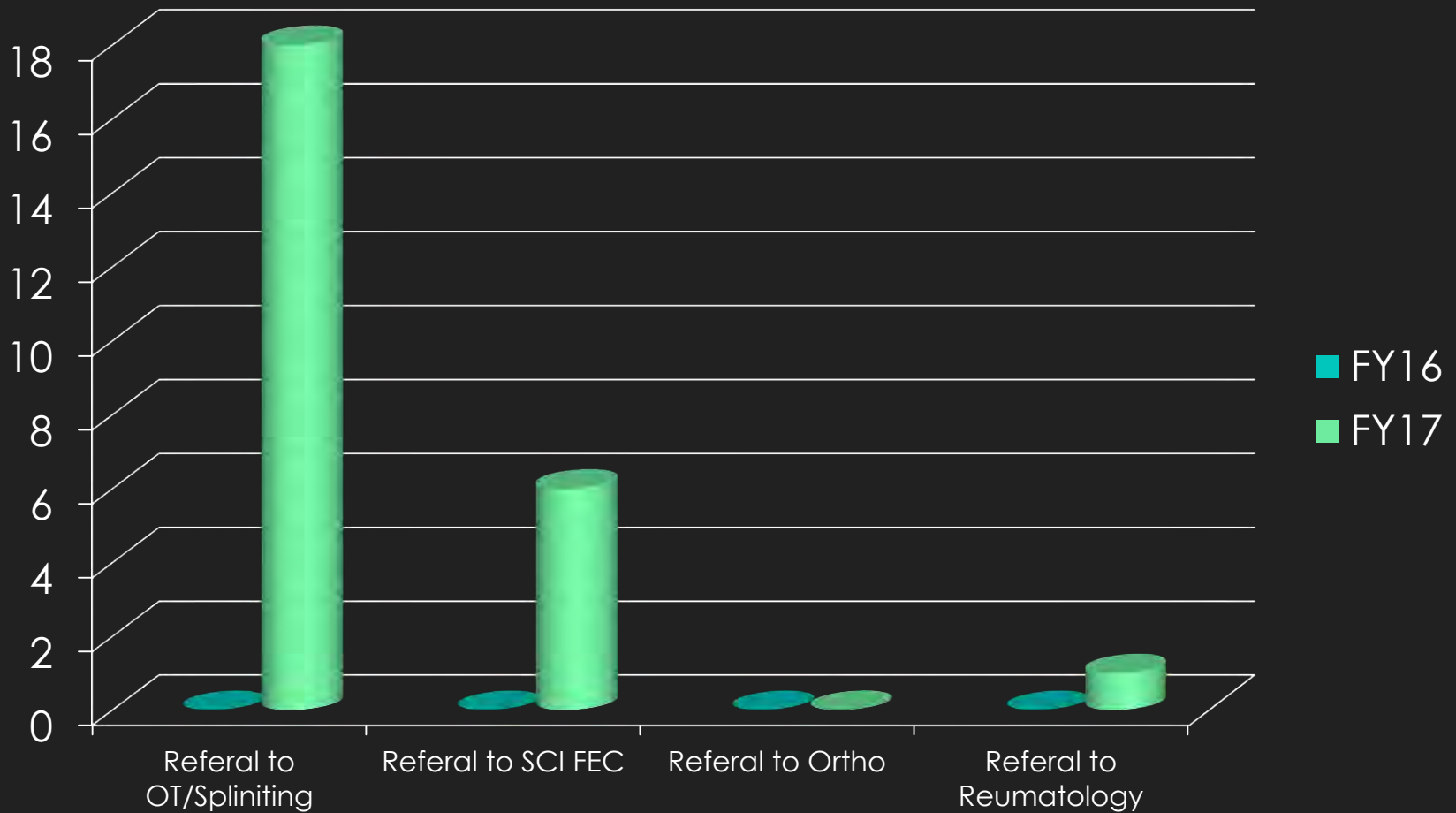
SCI UE Clinic Work Load



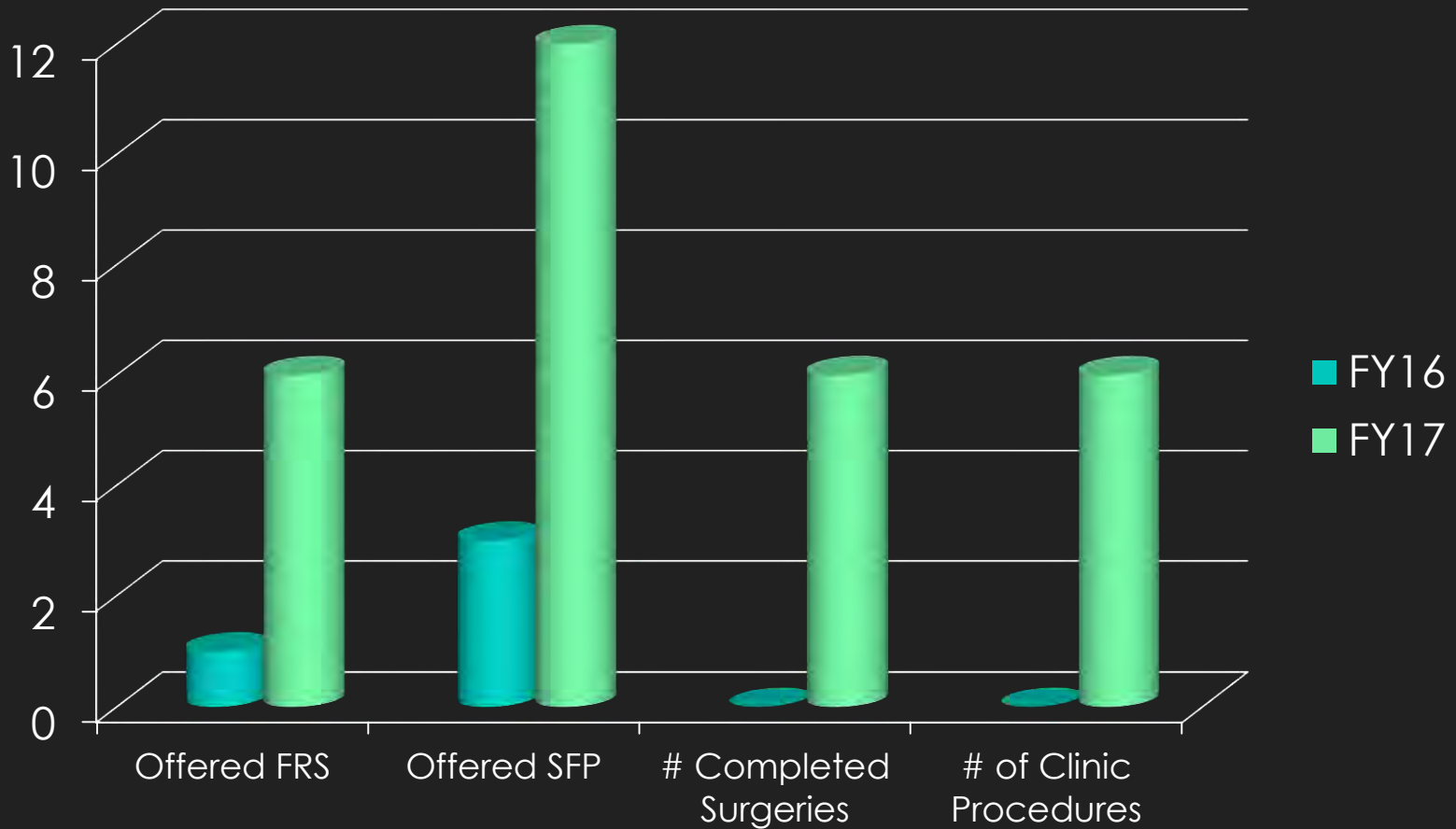
SCI UE Clinic Demographics



Generated Referrals from SCU UE Clinic



Surgical/Procedure Opportunities



Significance for SCI Practice:

- SCI upper limb specialty service ↑ 360%
- Offered surgical interventions for pathology and functional improvement ↑ 83%
- Offered consults to OT for splinting and hand therapy by ↑ 1,800%
- Offered consults to SCI Functional Extremity Clinic for joint injections or injections for spasm management ↑ 600%
- 90% of SCI Patients brought into clinic for screening had no initial upper limb complaints

Identified Areas for Improvement:

- Only capturing 50% of inpatients for SCI Annual Evaluation
- Not capturing patients being seen as an outpatient for SCI Annual Evaluation
- SCI OT/PT assigned 30 minute combined appointment time slots for annual screening – not enough time for detailed Upper Limb assessments
- Need to identify frequency routine screening after initial assessment in SCI UE Clinic
- Need to update SCI Upper Limb pre and post surgical policy and procedures

Resources:



Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(6 Suppl 2):S136-43



ORIGINAL RESEARCH

Rehabilitation After Spasticity-Correcting Upper Limb Surgery in Tetraplegia



Johanna Wangdell, OT, PhD,^a Jan Fridén, MD, PhD^{a,b,c}

ACRM

AMERICAN CONGRESS OF
REHABILITATION MEDICINE



Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(6 Suppl 2):S117-25



ORIGINAL RESEARCH

Early Active Rehabilitation After Grip Reconstructive Surgery in Tetraplegia



Johanna Wangdell, OT, PhD,^{a,b} Lina Bunketorp-Käll, RPT, PhD,^{a,c}
Sabrina Koch-Borner, RPT,^d Jan Fridén, MD, PhD^{a,b,d}

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Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(6 Suppl 2):S160-8



SPECIAL COMMUNICATION

Rehabilitation of Supinator Nerve to Posterior Interosseous Nerve Transfer in Individuals With Tetraplegia



Jodie Hahn, BS,^a Catherine Cooper, BS,^a Stephen Flood, MBBS,^b
Michael Weymouth, MBBS,^b Natasha van Zyl, MBBS^b



SPECIAL COMMUNICATION

Rehabilitation After Surgical Reconstruction to Restore Function to the Upper Limb in Tetraplegia: A Changing Landscape

M. Elise Johanson, DPT



ORIGINAL RESEARCH

Multicenter Survey of the Effects of Rehabilitation Practices on Pinch Force Strength After Tendon Transfer to Restore Pinch in Tetraplegia

M. Elise Johanson, DPT,^a Jeffrey P. Jaramillo, DPT,^a Christine A. Dairaghi, BS,^a Wendy M. Murray, PhD,^b Vincent R. Hentz, MD^{a,c}





Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(6 Suppl 2):S144-53



ORIGINAL RESEARCH

Evaluation of a Task-Based Intervention After Tendon Transfer to Restore Lateral Pinch



M. Elise Johanson, DPT,^a Christine A. Dairaghi, BS,^a Vincent R. Hentz, MD^{a,b}



Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2016;97(6 Suppl 2):S126-35



ORIGINAL RESEARCH

Rehabilitation After Posterior Deltoid to Triceps Transfer in Tetraplegia



Sabrina Koch-Borner, RPT,^a Jennifer A. Dunn, PT, PhD,^{b,c} Jan Fridén, MD, PhD,^{a,d,e}
Johanna Wanqdell, OT, PhD^d

Preservation of Upper Limb Function Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals



<http://www.pva.org/publications/clinical-practice-guidelines>

References:

1. Anderson K. Targeting Recovery: Priorities of the spinal cord injured population. *J Neurotrauma* 2004;21(10), 1371-1383.
2. Johanson ME, Jaramillo JA, Dairaghi CA, Murray WM, Hentz, VR. Multicenter survey of the effects of rehabilitation practices on pinch force strength after tendon transfer to restore pinch in tetraplegia. *Arch Phys Med Rehabilitation*. 2016; 97(6 Supp 2): S105-116.
3. Jaramillo JA, Johanson ME, Kiratli J. Survey of upper extremity muscle strength across three decades following spinal cord injury. Presentation to Academy of SCI Professionals, New Orleans, September 2015.

Special Thanks



VAPAHCS Staff



Lisa Johanson and Ann Bryden

Panel - Open for Questions

- Catherine Curtin, MD
- Susan Pejoro, MSN, RN, GNP-BC
- Jeff Jaramillo, DPT
- Maura Murphy, OTR/L