Clinical Management of Focal Hand Dystonia: Priming the Nervous System to Learn Paired with Sensory and Motor Retraining

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Purpose of Lecture on FHD
- Define focal hand dystonia (see videos)
- Discuss incidence/prevalence of hand dystonia
- Summarize current science of the etiology of FHD
- Summarize the components of the evaluation to
  - “Rule in” the diagnosis of FHD
  - Identify impairments and functional loss
  - Define goals of intervention/management (not cure)

Purpose of Lecture/Laboratory
- Summarize different intervention strategies
- Stop abnormal movements
- Prime the nervous system for retraining
- Retrain the brain based on neuroplasticity
  - Describe different intervention strategies
  - Give specific examples for retraining
  - Demonstrate some training
  - Discuss innovative ideas from participants

Purpose of Lecture
- Summarize the effectiveness of intervention strategies for focal dystonia
- Outline research directions for the future
- Enable audience discussion and sharing of experiences regarding treatment of FHD
**Dystonia: Definition**

- **Idiopathic, pathologic, synergistic involuntary movement affecting a body part, body segment or specific task**
  - Sustained / intermittent end range, twisting postures (with and without a tremor)
  - Co-contraction of agonists and antagonists (flexors/extensors; internal/external rotators)
  - Involuntary movement quiet at rest
  - Involuntary movement worse with stress and specific task performance

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**Dystonia**

- General dystonia
  - Third most common movement disorder (300,000)
  - Commonly genetic; may or may not progress
  - Can be a type of cerebral palsy
- Focal dystonia
  - Can be genetic
  - Most commonly multifactorial etiology
  - Can progress

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**Associated Findings with Focal Dystonia**

- Often improved with a sensory “trick”
- Usually associated
  - sensory hypersensitivity
  - ↓ sensory discrimination
- May begin following
  - Trauma
  - Chronic severe pain
  - Repetitive use
  - Inflammation (chronic)
  - Subclinical recurrent neck pain
  - Sensory de-enervation

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**Types of Focal Dystonia**

- Dystonia of a specific body part
  - Neck
  - Hand/arm
  - Foot leg
  - Trunk
  - Eye lids
  - Lips (embrochure)
- Dystonia when performing a specific functional or occupational task
  - Musician’s dystonia
  - Writer’s cramp
  - Golfer’s yip
  - Runner’s dystonia
  - Keyboarder’s dystonia

(Albanese, Front in Neurology 2017; 8 1-11)
**Focal Dystonias**

- Most commonly seen in physical rehabilitation:
  - Cervical dystonia (spasmodic torticollis)
  - Cranial dystonia (including blepharospasm)
  - Oro-mandibular dystonia
  - Trunkal dystonia
  - Blephorospasm
- **Focal hand dystonia**
  - 2nd most commonly seen in rehabilitation
  - Most common occupational dystonia

**Clinical Significance: Hand Dystonia**

- Estimated prevalence
  - 17,000 cases of Writer’s Cramp in US (Nutt, 1988)
  - 7-69/million diagnosed with hand dystonia
  - Musicians dystonia-1%-2% of professional musicians
- Estimated incidence (under estimate)
  - 600 new cases of Writer’s Cramp/year (Nutt, 1988)
  - Increasing cases of *Keyboarders cramp* (2006)
  - Nine of 10 musicians have RSI, and of those seeking medical attention, 5-24% are diagnosed with FHd (Altenmueller et al 2010)

**Etiological Understanding of Hand Dystonia: Early 1900’s**

- Disorder categorized as psychological
- Occurred during a time of stress
- Many individuals depressed
- Could not explain task specificity
- No underlying neurophysiological dysfunction
- Counseling + medical treatment not effective
- Most had to give up task performance, especially musicians

**Focal Dystonia: Excessive Plasticity in Perfectionists?**

- **Famous pianist** - 10+ years disabled; return to performance following botulinum toxin injections and Rolfing
- **Famous classical guitarist** - sensorimotor retraining- 100% recovery of performance
- **Famous cartoonist**:
  - Hand dystonia (changed to drawing pad) to continue cartooning but developed spasmodic dysphonia (?)heavy schedule of public speaking
Etiology: Idiopathic

<table>
<thead>
<tr>
<th>Intrinsic Factors</th>
<th>Extrinsic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetics</td>
<td>Environment</td>
</tr>
<tr>
<td>Anatomic/osteokinematic deficits</td>
<td>Ergonomics</td>
</tr>
<tr>
<td>Psychological/personality factors</td>
<td>Biomechanics</td>
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<tr>
<td>Neurophysiological deficits</td>
<td>Repetitive use</td>
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<tr>
<td><em>Excessive plasticity</em></td>
<td>Trauma</td>
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<tr>
<td><em>Imbalance of inhibition/excitation-basal ganglia</em></td>
<td>Stress</td>
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<tr>
<td><em>Abnormal cortical and subcortical sensory/motor processing</em></td>
<td></td>
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<tr>
<td><em>Aberrant learning</em></td>
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Etiology Genetic

<table>
<thead>
<tr>
<th>Extrinsic Factors</th>
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<tbody>
<tr>
<td>• DYT1 gene identified in Ashkenazi Jewish families (now 15 different genes)</td>
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<tr>
<td>• All family members with gene do not develop dystonia</td>
</tr>
<tr>
<td>• The most common dystonia developing was focal dystonia of the hand or neck</td>
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<tr>
<td>• Gene of low penetrance</td>
</tr>
<tr>
<td>• Phenotype only appears in presence of risk factors</td>
</tr>
<tr>
<td>• Genetic carriers have abnormal cortico motor firing (2011)</td>
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</table>

Aberrant Learning Hypothesis: FHD

Assumptions

- FHD does not necessarily develop in patients with
  - Gene for dystonia
  - Degenerative neurological conditions (PD, MS, ALS)
  - Personality disorder
  - Stress
  - Trauma
  - Excessive repetitions
  - Anatomical/postural/biomechanical deficits

Hypotheses

- FHD Phenotype is multi factorial consequence of
- Genetics
- Psycho-social, lifestyle, behavioral factors, personality
- Occupational stress/overuse
- Environmental factors
- Anatomical, biomechanical limitations
- Prior trauma plus
- Neurological factors

Aberrant Mapping

Normal (A,B,C)
Small dense receptive fields on each segment, each finger; organized cortically from medial–lateral, proximal–distal

Abnormal (D,E,F,G)
Large receptive fields Overlapping adjacent fingers, across palmar and dorsal surfaces, even whole hand but on cortex, fingers areas overlapping and essentially clumped

Byl et al 1996, 1997
Altered Spatial Representation: Response to Simple Stimuli

- Disordered topography in sensory, sensorimotor, motor, supplemental and pre motor cortex
- Decreased digital spread
  - Contralateral primary somatosensory cortex (S1)
    - affected
    - unaffected hands

Animal Research (Barbe et al)

- FHd may develop following excessive repetition
  - Initial signs of local inflammation
  - Inflammation spreads and becomes bilateral
  - Continued repetition may be associated with pain
    - Pain is replaced with
      - Change in precise grasping to gross scooping
      - Degraded representations sensory and motor

Etiology: Aberrant Homeostatic Plasticity

- Excessive neural plasticity with practice
  - Brain does not provide information that CNS has reached a plateau in efficiency and timing potential
  - Brain continues to adapt until it exceeds ability to process two stimuli individually
  - Multiple fingers contract simultaneously; cannot inhibit simultaneous movements
  - Agonists and antagonists contract together

Abnormal Grey Matter Volume

- Putamen (Basal Ganglia)
  - During performance of coordinated motor task
    - Patients with FHd have increased grey matter volume in the putamen
    - Normal subjects demonstrate decreased grey matter volume in the putamen with precision movements
  - First consistent reported findings of abnormal processing in basal ganglia for patients with hand dystonia
Abnormal Personality Characteristics

- Musicians with FHd have personality differences compared to musicians with RSI
  - Excessive perfection
  - Perseverative
  - Compulsive
  - Anxious and stressed; performance anxiety
  - Phobic
  - Started career late
(Jabusch and Altenmueller, 2005, 2009)

The CNS is Out of Balance

<table>
<thead>
<tr>
<th>Information</th>
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<tbody>
<tr>
<td>Strong Signals</td>
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<tr>
<td>- Variety of good signal</td>
</tr>
<tr>
<td>- Young, healthy individuals</td>
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<tr>
<td>- Easy to process</td>
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<tr>
<td>Normal adaptation</td>
</tr>
<tr>
<td>- Still easy for computer to adapt</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Weak Signals</th>
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<tbody>
<tr>
<td>- Reduced, good but weak signal</td>
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<tr>
<td>- Part of the natural aging</td>
</tr>
<tr>
<td>- Neural pulses slower</td>
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<tr>
<td>- Muscles react slower</td>
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<tr>
<td>- Lens focuses slower</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Bad Signals</th>
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<tbody>
<tr>
<td>- Excessive excitation/poor inhibition; excessive plasticity</td>
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<tr>
<td>- Loss of confidence</td>
</tr>
<tr>
<td>- Inflammatory pain</td>
</tr>
<tr>
<td>- Muscles (back and neck)</td>
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<tr>
<td>- Iritis, glaucoma, labyrinthitis</td>
</tr>
<tr>
<td>- Acute loss (labyrinthectomy)</td>
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<tr>
<td>- Joint/neck/TMJ</td>
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<tr>
<td>- Computer challenged</td>
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Purpose of Assessment/Evaluation

- Confirm clinical diagnosis
- Determine need for further medical w/u
- Identify the primary problems to treat
  - Impairments
  - Functional limitations
  - Work dysfunction
  - Lifestyle contributors
  - Personality issues

Listening to the Patient
Musicians Dystonia: Beginning Story

• https://www.youtube.com/watch?v=suwdLaYBaAs

Assessment/Evaluation of FHD: Identify Problems to Design Intervention

• Thorough History
  – Family
  – Medical
  – Trauma history (hand/neck)
  – Occupational
  – Social-life style; stress
  – Personality; depression
  – Mental status
  – Sleep
  – Nutrition

• Observe and videotape patient in different positions
  • Positions (supine, prone, sitting, standing)
  • General activities: walking, jogging, balance
  • Functional activities: typing, dealing cards, lifting
  • Using sensory tricks to make neck better
  • Demonstrating what makes dystonia worse

Assessment/Evaluation

• Neurological Exam
  Traditional
  – Reflexes
  – Head/arms-rapid/slow alternating / coordinated mvt
  – Neural tension UE
  – Posture and balance
  – Pathologic reflexes
  – Pain (location, type, severity,better/worse)
  – Strength measurements

• Additional Neuro Tests
  – Dystonia severity (limited hand/arm component)
    – Fahn Marsden Scale (s)
    – United Dystonia Scale
    – Global Dystonia Scale
  – Broad sensory exam
  – Perceptual motor skills
  – Motor Learning
  – Measure ROM
  – Perform target task in different postures

Sensibility Assessment

• Difficult to measure sensibility especially after brain insult or nerve injury and repair (Jerosch-Herold C. Systematic Review, J Hard Surg Dr 2005 30 252-264)
• Spatial representation and cortical sensory problems may be predictive of motor learning problems (Witney and Wolpert, 2003, J Neurophysiol :89:1837-1842)
• Impairment based sensory assessments may not predict function (Lundborg, Rosen; 2004:29:418-422)
• Evaluate sensory status of UE and motor learning in patients with recurrent subclinical cervical neck pain
**Sensory Evaluation**

- Accuracy (2 pt discrimination, Semmes Weinstein Monofilament Test)
- Hyperesthesia to tactile input (VAS)
- Graphesthesia (interpreting stimuli delivered to the skin)
- Stereognosis (palpating and discriminating information about an object)
- Sensory motor skills (PositScience)
- Manual Tactile Test (MTT)

**BCB Stereognosis**

**Assessment: Sensory Examination**
Manual Tactile Test (Hsu, 2017, JHT)

**Components**
- Barognosis (weight)
- Roughness (touch)
- Stereognosis

**Materials**
- Cylinder (100 cm x 54 cm)
- Square (25.4 cm by 25.4 cm)
- Different shapes
  - Oval (20 x 35.5 cm)
  - Circle: 25.4 cm diameter
  - Square 25.4 cm x 25.4 cm

Administration/Scoring: MTT

- Based on *seconds* required to detect differences in:
  - Weight of objects of the same size (barognosis)
  - Roughness of objects of same size (Roughness)
  - Stereognosis: distinguish objects of different shapes

Manual Tactile Test (MTT)

- Functional MTT
  - Reliable (Hsu et al 2014; Arch Phys Med Rehab)
  - Specific (Hsu et al arch phys med rehab 2013; 94:341-458)
  - Sensitive to measuring change (Hsu et al 2017; JHT 30: 65-73)
  - MMT: Percentage change with time (sensitivity) similar to SWM and 2 pt discrimination


Weakness of MTT

- Based on time to perform task but no limit on time for testing or how to score is the patient cannot complete the task accurately
- Has been tested primarily on patients with peripheral neuropathy and not central sensory and motor dysfunction

Hsu et al J Hand Therapy 2017 (30) 65-71
Another New Sensory Motor Testing (Posit Science)

- Posit Science
  - 15 minutes
  - Recommended for screening for PD but may be helpful for hand dystonia
  - Computer based
  - Online testing
- Time it
- Tap it
- See it
- Spot it
- Hear it
- Say it

New Sensory Motor Screening Battery

- Time estimation (3 trials, tap each second for 3 sec, 60 sec, 120 sec)
- Sequential motor tapping: tap as fast as can between two arrows for 30 sec
- Eye movement task: letters will move between a central fixation and periphery forcing saccadic movements
- Color discrimination: subject clicks the oddball color in grid
- Auditory magnitude of loudness: standard tone presented the a test tone (use slider to say if tone < or > than test tone)
- Voice pitch measured by patient copying the sound "ahh"

Other Outcome Measurements: Patients with Hand Dystonia

- UE Function
  - DASH
  - Writing sample (speed, size)
  - Copying
- Balance/mobility
  - iTUG + dual tasking (carrying water, count)
  - Postural righting
  - Arm swing/gait
- Self-rated function / QOL (Café 40: Functional Independence)
- Upper Extremity Function
- Beck Depression
- Refer for Personality Inventory

Personality Inventory: Type A (16 factors)

- Waiting in long lines kills you inside
- You’ve been described as a perfectionist, overachiever, workaholic.
- You bite your nails or grind your teeth
- You have a serious phobia of wasting time
- You’re very conscientious
- You’ve always been a bit of a catastrophist
- You frequently talk over / interrupt people
- You have a hard time falling asleep at night
- People can’t keep up with you — walking/conversation
Type A Personality

- You put more energy into your career than your relationships
- At work, everything is urgent
- Relaxing can be hard work for you
- You’d be lost without your to-do list

- You have low tolerance for incompetence
- You’re sensitive to stress
- You make things happen

“Ruling in the Diagnosis”

<table>
<thead>
<tr>
<th>Findings</th>
<th>Yes</th>
<th>No</th>
<th>(comments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal Neurological Exam except sensory sensitivity and selective involuntary movements at target task</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>2. Poor ergonomics in hand (excessive use of extrinsic muscles, hypermobility of IP joints, difficulty stabilizing thumb, ulnar wrist deviation)</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>3. Type A Personality (perfectionist, impatient, compulsive)</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>4. Uses sensory tricks to control movement</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>5. Under stress/ and/or history of high levels of repetitive practice</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>6. Sensory discrimination problems (graphesthesia, stereognosis)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>7. Familial Ashkanzi Jew</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>8. Previous hand trauma/chronic pain</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>9. Chronic pain; central sensitization</td>
<td>X</td>
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</table>

Total = 8/9, High probability of FHd

Benefit of Diagnostic Criteria

<table>
<thead>
<tr>
<th></th>
<th>Has FHD</th>
<th>Does Not have FHD</th>
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<tbody>
<tr>
<td>LR+ = 86</td>
<td>5.4</td>
<td>1.16</td>
</tr>
<tr>
<td>LR- = 14</td>
<td>1.66</td>
<td>0.84</td>
</tr>
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</table>

Score 8

<table>
<thead>
<tr>
<th>Has FHD</th>
<th>Does Not have FHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Sensitivity 25/29=86%</td>
<td></td>
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</table>

Score <8

<table>
<thead>
<tr>
<th>Has FHD</th>
<th>Does Not have FHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>Specificity 26/31=84%</td>
<td></td>
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</tbody>
</table>

False negative 5/30 (17%) have a positive test and no disease
False positive 4/29 (13.7%) have negative test, have disease

LR+ = sensitivity/1-specificity (high) LR- = 1-sensitivity/specificity (low)

ROC plots sensitivity by 1-specificity (want combination high sens and low 1-spec)

Prognosis: Retraining can be Limited by Personal Traits

- Negative expectations
- Low self esteem
- Habitual activities; reluctant to change
- Continued stress with poor management
- Persistent perfection
- Doubts effectiveness

Unwilling to stop current performance intensity
Continue repetitive practice using abnormal movements
Unable to find or accept training from a teacher, PT or OT for supervision
**Patient Requirements for Remediating Focal Dystonia**

- Use all tricks/strategies to stop abnormal movements
- Be able to think positively about recovery
- If CNS is hyper-excitable (on autonomic drive or fight-flight), quiet nervous system with rocking, swinging, going to a relaxing place

- Willing and able to use imagery (mental, mirror and graded motor imagery to restore normal hand control
- Can imagine it is your hand when watching a video of someone with performing your target tasks

**Contingencies for Successful Intervention**

- Patient and professionals agree on goals and objectives
- Patient/family understand a cure is “unlikely”
- Management requires a comprehensive approach: life style changes as well as retraining
- Successful management is highly dependent on patient and family compliance

**Rationale for Intervention**

- If FHd represents a case of excessive plasticity combined with aberrant learning (e.g. excessive stereotypical repetition, bad habits, inherent biomechanical instability, poor inhibition, excessive sensory excitation, genetics, environmental or personality risk factors) … then

- **Intervention** must be based on retraining the brain, the peripheral nervous system, the musculo-skeletal system and cognition to improve voluntary motor control

- It is not possible to focus just on retraining the brain
- The abnormal movements must be stopped
- The brain must be primed for relearning
- Practice of normal movements must be greater than abnormal movements
- The preparation for retraining is as important as the retraining itself
- Many patients cannot prepare the brain for relearning thus brain retraining fails
### Goals for Intervention

- Establish a team to coordinate patient treatment
- Educate the patient and the family of FhD
- Stop the abnormal movements
- Prime the nervous system for retraining
- Retrain the brain

### Objectives: Find a Team

- Movement disorders neurologist
  - Believes patients can improve and available
  - Able to do botulinum toxin injections as necessary
- Local PT or OT to supervise retraining
- A coach who can help with
  - stress and anxiety management _ guided imagery
  - self healing _ hypnosis _ depression _return to work
- Individuals recovered /effectively managing
  Schuel et al 2005

### The Team: Need for Referrals for Speciality Evaluation

- Orthopedic surgery
  - Severe degeneration
    (with/without peripheral nerve impingement)
  - Anatomic defects
  - Traumatic injury (e.g. dislocation, tendon tear, fracture, muscle tear, nerve rupture)
- Radiology for special functional imaging studies (as become available for diagnosis)
- Neurosurgery
  - DBS if dystonia- severe
  - New technology- brain interface training

### Professional Coaching Options

- Psychological counseling to address personality strengths/weakness and psychiatric challenges (Newby et al; Movt Dis 31 2016)
- Vocational counseling to determine if can meet vocational goals/potential or change is needed
- Ergonomic assessment at work site
- Employer discussions regarding change in hours and demands to decrease stress on the job
- Recreational activities to enjoy life
  Schuel et al 2005
Objectives: Educate Patient and Family

- Etiology of FHD
- Goal is management, not necessarily cure but positive expectations for improved function
- Benefits of a local team and possible referrals
  - Consultation with experts
  - Recovered, well managed patients with FHD
- Prime the nervous system for learning
- Retrain the brain
- Discuss effectiveness of different interventions

Objectives to Prime the Nervous System

- Stop the abnormal movements
  - Use all sensory tricks
  - Perform tasks in unusual positions

Objectives to Prime the CNS for Learning

- Medical treatment
  - Medications
  - rTMS, rDCT
  - Fatigue therapy
  - Remote limb ischemic conditioning
- Physical techniques
  - Cooling dystonic muscles
  - Manual techniques (STM, Jt mobilization)
  - Technology

- Environmental techniques
  - Modify home/work ergonomics
  - Improve biomechanics
  - Improve life style, sleep, nutrition, stress and pain management
  - Develop health and wellness exercise program
  - Maintain positive self esteem/expect improvement

Priming the Brain for Retraining

Primed the Brain to learn
Objectives to Prime the Nervous System: Medical Interventions

General

• Education re dystonia
• R/O other causes: PD, ALS, head injury, CVA
• Refer to rehab team
• Refer for novel strategies
  – rTMS; tDCS; DBS
  – Fatigue therapy
  – RILC
  – Hypnosis

Specific

• Prescribe medications
  – Muscle relaxants
  – Levadopa
  – Anticonvulsants
  – Inject botulinum toxin
  – Phenol injections
  – Cannaboids

Prescribing medications

Priming the NS: Medical Interventions

• Botulinum Toxin A injections
  – Supported by 1A level of evidence
  – Around 300 IU injected in dystonic muscles
  – Repeated @ each 3 months
  – 25% adverse events
    (swallowing, excessive weakness, pain)

• Addressing poor inhibition and excessive excitation
  – rTMS
  – rDCS
  – Fatigue therapy
  – DBS (severe cases)

Priming the nervous system

Priming the NS: Reduction of Excitation and Improvement of Inhibition

• rTMS (repetitive transmagnetic stimulation)
  – Cathodal magnetic stimulation to inhibit
  – Anodal magnetic stimulation to excite
  – Follow with retraining

• tDCS (transcutaneous direct current stimulation)
  – Cathodal stimulation to inhibit
  – Anodal stimulation to excite
  – Follow with retraining

Priming the nervous system

Fatigue overactive muscles
  – exact time needed varies by person
  – Works best with early diagnosis of FHD
  – Begin retraining

Cooling the unaffected or affected hand

Remote Limb Ischemic Conditions (RLIC)
  – Blood pressure cuff on one arm or leg
  – 200 hg mm on 5 min, off for 5 minutes (5 cycles)
  – Then begin retraining

Priming the nervous system
Priming the CNS by Decreasing Neural Hypersensitivity (Quiet the Nervous System)

- Wrap tightly in a blanket
  - Rock in a rocking chair
  - Nap while wrapped up
- Swing on a swing
- Get a battery operated porch swing to swing at different speeds
- Have friend gently stroke your head, neck or foot
- Listen to relaxing music
- Play calming sounds (breaking waves, birds)
- Laugh and have fun
- Participate/imagine doing pleasurable activities
- Go to a special relaxing place (e.g. mountains)

Primed the nervous system

Priming NS: Maximize Health/Wellness

- Stress management
- Sleep
- Nutrition
- Hydration
- Stop smoking; eliminate unnecessary medications, drugs and ETOH
- Balance work and recreation

Primed the nervous system

Priming NS: Stress Management

- Breathe deeply and blow away stress
- Try to progressively relax tense muscles
- Take a class to learn about causes of stress and physiological effects (e.g. Sapolsky)
- Use guided imagery to focus on
  - sleeping better - reducing anxiety, fear/panic
  - speeding healing - changing bad habits
  - reducing pain - reducing pain meds

Primed the nervous system

Priming NS to Learn: Stress Management

- Take a class or do online training in stress management (Mindfulness training)
- Examples of 6 week online training courses on mindfulness (Florence Meleo-Meyer and Saki Santorelli)
  - Oasis Institute for Mindfulness-Based Education and Training
  - Center for Mindfulness in Medicine, Health Care, Society

Primed the nervous system
**Nutrition to Reduce Inflammation**

- **Probiotics** (Lipski, 2012; Dickerson, 2014; Giardina, 2014; Xiao, 2014; Vaghef-Mehrabany, 2014)
- **Antioxidants** (nuts, variable colored fruits and vegetables) (San Miguel, 2013; Urios, 2007; Kim, 2014; Demirkol, 2012; Park, 2010; Grieger, 2014)

Priming the nervous system to learn

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**Nutrition to Reduce Inflammation**

- **Vitamin D** (sunshine, liver, grass fed dairy) (Angeline, 2014; Park, 2014; Sanfhi, 2013; Baggerly, 2015; Park, 2015; Vit D Council)
- **Gelatin/Collagen** (healing of gut lining) (Han, 2015; Atiba, 2011; Ao, 2012)
- **Curcumin (Turmeric)** (Shakibaei, 2011; Somchit, 2014; Ganjali, 2014)

Priming the nervous system to learn

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**Nutrition to Reduce Inflammation**

- **Eat whole nutrient rich food when hungry**
- **Eat in a calm manner**
- **Stop eating when full**
- **Do intermittent fasting** (extend the interval between meals or eat early, go to bed early and get up late)

Priming the nervous system to learn

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**Remove**

- Refined flour, refined sugar, refined vegetable oils, processed foods,
- Unnecessary medications (under a physicians guidance)

*Only go to meat and produce sections of the grocery store*

**Replace**

- Eat whole organic produce, meats, fish and healthy fats.
- Drink 8 glasses H2O

**Restore**

- Healthy inflammatory response
- Better health

**Hydration**

- Adequate hydration required to deliver O2 to the body tissue and promote healing
- Exact amount of liquids needed varies by individual, environment and activity
  - 8-10 glasses of fluids (H2O with electrolytes best)
  - Each glass/cup of caffeine or ETOH, need additional glass of H2O
  - Dry environment, need more H2O and moisture creams on skin, nasal passages

Priming the nervous system
**Priming the Nervous System: Sleep**

- Most individuals need 7-8 hours of sleep with a good period of deep sleep
  - Consolidate learning
  - Allow recovery from stressful life events
- Behaviors to improve quality of sleep
  - Dine early
  - Relax before going to bed
  - Warm shower helps relax muscles before sleep
  - Review positive and challenging aspects of day
  - Review for activities for next day

**Priming the Nervous System: Improving Sleep Quality**

- Do not go to bed until you are sleepy
- Use bedroom only for sleep
- Get out of bed if you are unable to sleep after 15 min (perform relaxing activities)
- Get up each day at the same time
- Breathe through the nose and not the mouth
- Do not take naps late in the day
- Participate in regular physical activities
- Reduce evening caffeine, nicotine and alcohol
- Reduce fluid intake in the evenings

**Protect the Nervous System from Overuse**

- Decrease excessive repetitions from poor posture / weakness, poor ROM, and compensatory movements to decrease
  - Acute and chronic pain
  - Chronic soft tissue inflammation (muscle, nerve, fascia)
  - Fascial adhesions/scarring
  - Poor kinematics
- Ergonomically improve joint and soft tissue mechanics
  - Protect area and minimize unnecessary forces
  - Retrain quality, safe biomechanical movements
  - Mobilize tissues (muscle, fascia, nerve, joints)

**Priming the NS: Physical Activities**

- Exercise, ergonomics and pain management
  - Participate in regular daily physical activities
  - Decrease neural sensitivity
  - Manage neural tension
  - Improve trunk stabilization, posture, balance, strength, flexibility and rhythmic/coordinated movements
  - Modify ergonomics at work/hobbies
**Priming NS: General Exercise**

- Aerobic exercise 5x/week 30 minutes
- Strengthening, balance and posture exercises 2x/week for 30 minutes
- Chose physical activities
  - Use stairs instead of elevator
  - Walk or bike instead of taking the car
  - Take breaks from sitting with brief walks or ROM activities

*Center for Disease Control*

Priming the nervous system to learn

**Priming NS: Physical Activities - Exercise**

- Diaphragmatic breathing; avoid using neck muscles
- Neck ROM: passive, active assistive, active
- Posture exercises to improve trunk alignment
  - Strengthen lower abdominals and trunk rotation
  - Strengthen scapular stabilizers
  - Achieve posterior glide of head
  - Improve postural righting responses
  - Strengthen lower extremeties: gluteus medius

Priming the nervous system to learn

**Diaphragmatic Breathing**

Breathe using the diaphragm, the muscle below the ribs. Do not use the muscles of the neck. Let the pelvis rotate into extension with breath in and flexion (or flattening with the breath out).

**Improving Symmetry of Neck and Trunk**

Priming the nervous system to learn
**Establish Good Posture for Computer and Driving**

Lumbar roll may be helpful, especially in the car

Priming the nervous system to learn

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**Strengthen Trunk and LE Muscles for Good Posture**

- Strengthen
  - cervical muscles
  - lower abdominals
  - scapular stabilizers
  - spine extensors
  - hip abductors/extensors
- Neck posterior glide plus maintain normal ROM

Priming the nervous system to learn

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**Using the OOV: Improve Posture and Balance**

Daniel Vladeta, DO, Ada Wells, DPT, Brent Anderson, DPT, PhD

Priming the nervous system to learn
**Improve Posture**

- Can also use foam roller
- Priming the nervous system to learn

**Improve Balance**

- Secret to better balance and decreased falls
- [Website](http://www.thebalancemanual.com/?device=c&gclid=CjwKEAjwtbPGBRDhoLaqn6HknWsSJABR-o5sCJ5yd3p7y4AjaRkaKd1nZA43aWH0LwwjanptGRUt4BoCRpvw_wcB)

**Improve Soft Tissue and Joint Kinematics**

- STM/fascial/deep tissue release
  - Friction massage
  - Negative compression
  - Trigger point therapy; dry needling
  - Gentle rocking
  - Strain/counterstrain
- Joint mobilization/manipulation
- Integrate orthotics (taping, cervical collars)
- Cranio sacral therapy

**Decrease Neural Tension in Brachial Plexus**

**Priming the nervous system to learn**
Keeping Fingers Straight for Neural Mobilization

Neural Mobilization

Neural Mobilization

Neural Mobilization
Mobilizing the Thumb

Integrate Pain Management and Health and Wellness Strategies with Movement

- Yoga; medical yoga
- Pilates
- Feldenkrais
- Relaxation, strategies
- Modalities (heat, cold, laser, vibration)
- Ti Quan Do
- Ji Gong

Technology To Prime the Nervous System: Electrical Modalities

- TENS
  - Manage pain
  - Relax muscles
- Vibration
  - Specific vibration over muscles to relax or enhance
  - General vibration (vibration mats) to relax muscles

Robotic Technology

- This is coming
- Current limitations are liability and patient fears of intrusive methods
- New developments with brain interface strategies that link the thought to the creation of movement
**Brain Retraining**

- Retrain both hemispheres
  - Excite contralateral
  - Facilitate inhibitory pathways (ipsilateral)
- Concentrate on temporal sequencing; turn on/off
- Do learning activities in different positions
  - Stress free
  - Unusual position
  - Different environments

**Learning Enhancement Strategies**

- Enhance sensation by providing multi-sensory stimuli to generalize learning (auditory, visual, touch)
- Recruit task specific neurons (eg use a different limb to perform same functional task (e.g. write/type with the foot)
- Achieve performing task normally with imagery before beginning task training

**Objectives Brain Retraining**

- Decrease/stop abnormal involuntary movements
- Integrate principles of neuroplasticity
- Design an intervention of adequate dosage
- Individualize retraining strategies
- Outline a progressive behavioral program to improve sensory and sensorimotor processing to aid motor learning and improve voluntary motor control

*Jahusch et al, 2005; Leijense, 2009; Altenmueller et al, 2013; Merzenich 2013; Klein, 2009*

**Stop Abnormal Movements**

- Try to stop doing the tasks that create the dystonia (e.g. playing an instrument, keyboarding, writing)
- Reflect back in time to remember what it was like to move the hand normally
  - Look at old pictures and videos when young
  - Watch videos of people with normal hand control doing tasks that you want to do; imagine it is your hand
- Retrain the brain: Stop abnormal movements
Stop Abnormal Movements

- Use sensory tricks to stop abnormal movements
  - Put tape on the finger(s) to increase sensation
  - Temporarily use a finger splint(s)
  - Constantly explore sensory surfaces while keeping fingers in neutral
  - Wear a glove
  - Wear wrist weights to increase proprioception
  - Try sensory TENS to modify sensory input

Retrain the brain: Stop abnormal movements

Stop Abnormal Movements

- Use different imaging strategies
  - Use techniques consistent with “inner game” of performing a sport
  - Guided imagery and self healing (Marten Rossman, MD) (using audio/video training versus professional guidance)
  - Mirror imagery (noigroup.com; JHT 2012; Ramashandran)
  - Graded motor imagery (noigroup.com; JHT 2012)

Retrain the brain: Stop abnormal movements

Stop Secondary Abnormal Movements

- If have secondary problems with dysphonia
  - See a speech therapist specializing in dysphonia
  - Speak loudly, clearly and slowly
  - Have someone read a book out loud and then read the book but hear the other persons voice

Retrain the brain: Stop abnormal movements

- If eye movements are irregular, work to improve eye control (see Doidge The brain’s ways of healing)
  - If blepharospasm present
    - Work with experienced optometric professional
    - Try “on line” training: http://www.fariastechnique.com/blepharospasm

Retrain the brain: Stop abnormal movements

Follow Principles of Experience Dependent Plasticity

- Use it or lose it
- Use remap and improve it
- Have adequate but not excessive repetitions
- Make training intense (2-8 hrs/day, 2-5 days/wk)
- Attend to activities
- Vary training sequence
- Progress difficulty
- Be specific

Retrain the brain: plasticity

Klein and Jones, 2008; Byl and Merzenich, 2005; 2012 Section on Neurology, Neuroplasticity Course; Merzenich 2012, Winstein and Fisher
Principles of Neuroplasticity

- Make learning **fun, fun, fun**
- Space practice over time (8-12 weeks)
- Make training salient
- Adjust training to age
- Reinforce learning with feedback/accuracy
- Transfer learning
- Strengthen learning with interference/surprise

Retrain the brain: plasticity

New Books on Plasticity for Patients and Professionals

- Books written in easy, motivating reading based on solid research evidence (Amazon)
  - *Normal Doidge.* The Brain that Changes Itself

Convert Physical Practice to Mental Practice: Maintaining Skills

- Use mental rehearsal and practice to
  - maintain the movements needed to perform the target task
  - perform the target task without abnormal movements
  - get rid of compensatory movements
  - improve the biomechanics/ergonomics required to use the hand normally
  - maintain skill performance on target task (e.g. musician)

Retrain the brain

Integrate Progressive Brain Retraining Strategies for FHd

- Use non physical practice strategies to stop abnormal movements and restore hand control
  - Use mental practice (Page, Altenmueller)
  - Employ guided imagery/self healing for pain if needed (Marten Rossman)
  - Integrate mirror imaging (Ramachandran) and graded motor imagery (Moseley; Noi.com)

- Begin sensory and sensorimotor training
- Retrain normal motor control at target task

Retrain the brain
Non Physical Practice: Purpose of Mirror Therapy as Example

- Recover the normal sensation, location and proprioception of affected hand
- Restore “sense” of a normal hand and laterality
- Stop abnormal involuntary movements at rest
- Restore the normal sensory/motoric topographic representation of hand
- Retrain normal voluntary movement

Retrain the brain

Mirror Imagery

- Equipment
  - Purchase triangle shape, free standing mirror: Noi.com
  - Take a free standing picture frame; paste on mirror
- Both hands must look the same
  - Must remove jewelry
  - Objects must be placed on both sides of mirror
  - If assist a patient, PT/OT must place guiding hands on both of the patient’s hands

Retrain the brain:

Mirror Therapy

- 1. Look at the mirror image of the unaffected hand and imagine it is the affected hand
  - a. Hand at rest supinated (flexor surface more sensitive); when quiet
  - b. Hand at rest pronated
- 2. When quiet, ask patient to move the elbow
  - a. Tap hand (first supinated, then pronated)
  - b. Pronate and supinate the forearm
- 3. Move the wrist to tap hand (supinated and then pronated)
  - If unable to stop abnormal movements, go back to 1.
  - If necessary, place hands of therapist on hands of patient to quiet hypersensitivity
- 4. When can do 3. normally, begin to move individual fingers
- 5. When can do 5. with healthy movements, begin to manipulate objects

Retraining the brain
Retrain the Brain with Mirror Imagery

- Affected hand is behind the mirror and tries to move just like the mirror image. Do the same thing with the foot.
- The image of the unaffected hand looks like the affected hand in the mirror (translate this to the leg/foot).

Retrain the brain

Select a Specific Sensory-Motor Retraining Strategies for FHD

- Match sensory-motor training strategy to patient
  - Integrate technology if indicated
  - Integrate Developmental strategies (Nia)
  - Integrate dance/rhythmic strategies (Farius; betti)
  - Apply braille training (Zeuner, 2008)
- Try sensory motor retuning (Candia et al, 2003)
- Integrate Constraint induced therapy (Taub)
- Try computerized sensory-motor training with pen

Example of Dance and Focal Dystonia

- https://www.youtube.com/watch?v=DwkHK3rfKO0
### Retraining Motor Learning: Disappearing Drawings

![Image of disappearing drawings]

### Purpose of Technology

- Increase sensation
- Decrease pain if present
- Increase ability to decrease hypersensitivity and inhibit over activation of muscles
- Selectively improve ability to in
- Progressively assist in restoring normal voluntary movement
- Improve task specific performance
  
### Using Technology to Enhance Retraining

**Task specific training**
- Virtual reality
- Game oriented techniques
  - Wii
  - Kinect
  - Neuroracer
- Pressure sensitive keyboard and mats (as in toy stores)

**Assistive or protective devices**
- Orthotics
- Splints
- Passive motion devices
- Robotic devices (more for amputated limbs, hemiplegia)

### Example of Improving Cervical Dystonia with Orthotic: Mouthpiece

- [https://www.youtube.com/watch?v=VUlHvrgZME](https://www.youtube.com/watch?v=VUlHvrgZME)
  - First visit for patient who improved with TMJ splint
- [https://www.youtube.com/watch?v=Az6P0GhSR6E](https://www.youtube.com/watch?v=Az6P0GhSR6E)
  - (successful treatment of cervical dystonia with TMJ treatment and splint)
Technology To Retrain the Brain:
Electrical Modalities

- Biofeedback
  - Neurobiofeedback (cognitive, sensory, motor retraining)
  - Auditory or visual biofeedback (e.g. Myotrac)
- Functional electrical stimulation
  - Specific muscle targeting for retraining
  - Functional targeting (e.g. Bioness)

Retrain the brain

Use of Developmental Strategies to Improve Voluntary Movements

- NIA
  - Developmental progression of exercise for adults
  - Progress through developmental sequences
    - Supine limb movements, Sitting
    - Rolling, All fours
    - Head control, Standing, walking
  - Integrate smooth gross and fine motor movements to music

Retrain the brain

Example of Nia

- https://nianow.com/nia-in-action

Neuromuscular Retraining and Focal Dystonia

(Farias)
- https://www.youtube.com/watch?v=czW-xBvDtHY
Use Developmental Strategies to Improve Voluntary Arm/Hand Movements

- Kneel at end of treadmill, use arms for walking
  - Walk with the hands on the treadmill
  - Manipulate objects on the treadmill, one hand at a time
- Get on all fours and crawl
  - Facilitate weight bearing on hands and reciprocal movements keeping head in neutral
    - Forwards → Up hill or up stairs
    - Backwards → Crawl down a slant

Retrain the brain

Training FHD on Treadmill

Description of Different Sensory Motor Training Strategies: Braille Reading

- Purchase resources for braille reading
  - Books for learning read braille (I-5)
  - Purchase braille playing cards
  - Put braille on piano/keyboard keys
- Read braille daily; best when done for a a year
  - Feel braille letters on the elevator for floors
  - Play card games with braille cards (blindfolded)
  - Play scrabble blindfolded (keep score)

Retrain the brain

Description of Different Sensory Motor Training Strategies

- Sensory motor retuning and progressive splinting (Candia et al, 2003; Zeuner, 2008)
  - Splint the hand except for the dystonic finger
  - Train the dystonic finger at the target task
  - Expose more fingers and keep task training
- Constraint induced therapy (Taub)
  - Constrain the unaffected hand
  - Force task specific use of the affected hand
  - Intense training, daily, 8 hrs/day, two weeks

Retrain the brain
### Description of Different Sensory Motor Training Strategies: Writer’s Cramp

- Sensory motor training by painting
- Computerized sensory-motor training with a pen (Writer’s Cramp)
  - Use pen with computerized ability to measure downward pressure and grip force
  - Train patients to write as accurately and carefully as possible while computer records pressure down and grip
  - Practice writing with feedback to decrease pressure down and grip on pen (Blackman)

### Painting to Retrain Hand Skills: Writers Cramp

Another Example: Architect (age 40) improved writers cramp by running and then painting every morning to remove tension for doing architectural drawings

### Description of Different Sensory-Motor Strategies: Learning Based Sensorimotor Training

- Integrates the principles and science of neuroplasticity to restore the sensory motor topography and improve voluntary motor function
- Progresses intervention from general to specific to prime the brain for learning and progresses to progressive behavioral learning

### Description of Learning Based Sensorimotor Training

- The phases of progressive learning are not completely independent
- Progression through the phases is based on achievement of specific objectives
- It must be adapted to each individual
- The number of repetitions required for the task specific training is unknown, but it may be tens of thousands
Progression of Learning Based Sensorimotor Training (LBSMT)

- Phase I Use imagery to rebalance excitation and inhibition and prepare the nervous system for learning
- Phase II Retrain sensory discrimination skills to improve normal motor outputs
- Phase III Maximize cognitive processing by learning something new each day and doing specific learning based cognitive training
- Phase IV Emphasize dynamic sensorimotor training with accuracy and error biofeedback

Retrain the brain

Progression of Learning Based Sensorimotor Training

- Phase V Develop normal graded motor movements in different environments, postures and objects
- Phase VI Practice small increments of performing fine motor tasks using non-task objects
- Phase VII Practice fine motor control on the target task
  - Performed components of the tasks normally
  - Ultimately progress quality, efficiency and difficulty of task performance

Retrain the brain

Examples of Training Techniques

Sensory Assistance (tape) to Allow Normal Performance for a Guitarist with FHd
**Sensory: Address Recognition of Hand Laterality and Hand Shaping**

- Learn to look at “hands or involved limb” without abnormal movement or pain
- View the hand and determine laterality (Recognise, Noi.com)
  - Perceive accurate laterality (right/left) at faster speeds
  - Visualize different hand contexts
  - Move / copy the different positions (Moseley)

Retrain the brain

**Let Object Shape Hand**

**Let Sensation of Object Shape and Guide the Hand Movement**
LBSMT: Improve Sensory Discrimination

- Eliminate vision
- Incorporate all sensory modalities (tactile, proprioception, sound, vibration, gravity, temp)
- Use active and passive stimuli
- Make all tasks a forced choice
- Do all training activities in all positions
- Have sensory objects everywhere
- Add time as a variable

Retrain the brain

Improve Sensory Discrimination (Graphesthesia)

- Draw designs on the palm, dorsum and fingers
  - Deliver the tactile stimulation
  - Make all tasks a forced choice
  - Do sensory discrimination activities in all body positions (supine, prone, sitting, standing)
  - Add size as a variable (make drawings smaller)
  - Add time as a variable (draw items faster or patient has to reproduce the figures more quickly)

Retrain the brain

Sensory Discrimination (Graphesthesia)

Progress from writing letters and numbers to words and designs
Getting increasingly complicated. Must reproduce accurate (orientation, size, design); Reproduce on hand or paper.

Retrain the Brain

Improve Sensory Discrimination (Stereognosis)

- Touch patient with different objects and ask to identify the object or locate where touched
- Touch skin of hand/arm with different textured surfaces and ask to discriminate rough/smooth
- Make auditory sounds in different locations and ask to point to location
- Make sounds of different amplitudes and patient has to identify loud/quiet
- Touch skin with 2 points and approximate points

Retrain the brain
**Improve Sensory Discrimination (Stereognosis)**

- Learn to read Braille (may have to learn with unaffected hand first); learn one finger braille; play poker with Braille cards
- Paste buttons on cards and match buttons
- Put stickers on cards, and match stickers
- Feel and spell words with small alphabet letters
- Sort by size, surface coarseness

**Emphasize Feedback in Sensorimotor Discrimination Activities**

- Using braille cards, eyes closed
  - Play poker with braille cards and bet small amounts of money as in poker
  - Play Solitude by yourself
- Play scrabble/dominoes/dice games with others blindfolded and keep track of winners
- Play virtual games with feedback about accuracy (eg. Wii) and compete with others (Kinect)

**Emphasize Feedback and Sensory Discrimination Training**

- Eyes Closed
  - Find 10 quarters in the beans (increase speed/accuracy)
  - Feel letters; spell words
  - Work sensory puzzles

**Improve Cognitive Processing and Perceptual Motor Skills**

- Learn something new each day
- Avoid habitual activities
- Do cross word puzzles
- Join Posit science and perform Brain HQ
- Do new activities which are fun
- Watch the news; discuss with friends/family
- Watch for new learning based games (eg. Neuroracer)
Learn to grade movements

- Place hand on scale at different weights; tap finger changing only small amount of wt
- Practice using smooth movements
- Use limbs in stress free way
  - Use limb in good biomechanical alignment
  - Use sensory information to guide movement (rough, sticky, vibratory)
  - Strengthen the muscles inside the hand
  - Emphasize proximal movements

Practice Grading Movements

- Place hand on treadmill
  - Maintain the normal arches of palm and digits
  - Let belt move under hand with no finger grabbing
  - Perform simple functional tasks on the moving belt
- Touch fan blades; do not stop blades
- Let weight of hand drop on keyboards

Retrain the brain

Practice Grading Motor Movements

- Think about sensory aspects of performing functional tasks; let texture of object guide the movement of the hand
- Use a mirror image to facilitate normal sensory information and movement
- Progress non-target task to completion with normal movements and good sensory awareness; progress difficulty
- Begin performance of part of the target task

Retrain the brain

Practice Grading Motor Movements

- Improve sensory perception of affected and unaffected limbs without eliciting abnormal signs/symptoms
- In different positions and postures
  - Restore ability to place hand on target instrument
  - Explore surfaces without creating abnormal signs and symptoms

Retrain the brain
**Grading Motor Movements**

- Challenge the regulation, quantity and quality of sensory processing
- Practice sensory initiated functional movement tasks and fine motor movements
- Restore normal sensorimotor gating, activation thresholds and feedback gains
  - Hear metronome and match the speed (slow-fast)
  - Hear sound and perform defined task

  Retrain the brain

**Fine Motor Control (Nontarget task or Unusual Environment)**

- Attend to the position of the trunk when working on fine motor tasks with affected hand (posture and balance)
- Train the unaffected side to perform the target task
- Perform the target task with an unusual object or in an unusual environment (e.g. write in shaving cream, draw with finger paints)
- Perform simple non target and then target task while performing gross motor task (e.g. walking on treadmill)

  Retrain the brain

**Fine Motor Training at Near Target Task**

- May need to stabilize the hand
- In a splint, leave one finger free at a time
- May need to support adjacent fingers to enable control of involved digit
- Begin motor retraining in unrelated postures without task specificity
- Progress to getting in typical postures used for target task, but stay practicing nontarget task

  Retrain the brain

**Target Fine Motor Task (Using Alternative Modality)**

- Retrain the brain
Grading Movements of the Fingers

- Non target task
- Smooth movements
- Keep object balanced on fingers

Retrain the brain

Grading Movements: Painting

Grading Movements with Painting/Coloring
**Dual Tasking: Fine Motor Target Task During Aerobic Exercises**

- Perform target task in unusual/challenging environment
  - Example: Walk on treadmill with or without harness: eyes open/closed; walk forwards, sideways, backwards while performing target task (eg. Writing)

**Fine Motor Control Target Task**

- Practice normal fine motor movements slowly on the target task (use metronome and slowly increase speed)
- Provide feedback regarding accuracy and speed
- Use biofeedback to help minimize abnormal muscle firing patterns
- Progress complexity of fine motor control on target task
- Increase endurance of normal performance at fine motor task
- Integrate performance of task at workplace
- Progress speed (consider metronome)

**Fine Motor Skills (Target Task)**

- Change the way or performing the task (unusual keyboard); use mirror; move from the shoulder and elbow (not the hand)

**Fine Motor Training at Target Task (with biofeedback)**

1. Use biofeedback for activation or inhibition
2. Use pressure into the palm to round the hand
3. Use lumbar roll to facilitate good posture
Fine Motor Target Task (Simulated Instrument)

Simulate activities on the target task with normal position and movement.

On the target task, move from the shoulders and elbow; use the intrinsic muscles in the hand.

Retrain the brain.

Effectiveness

- Only RCTs available on FHD and botulinum toxin injections
  - Weaken muscles for about 12 weeks
  - Must be repeated
  - Does not specifically retrain brain
- No large randomized clinical trials on effectives sensorimotor rehabilitation strategies

Effectiveness Sensorimotor Rehabilitation for FHD

- Many case studies and small clinical trials
- Generally, patients report improvement but objective kinematic testing does not change
- Some individuals report a cure
- Many will benefit over years of participation in retraining
- Difficult for musicians to return to full performance

Effectiveness: Positive Prognosis

- Patients who expect to improve (limbic system), and are willing to improve life style, quiet nervous system and then retrain the brain
- May be able to prevent focal dystonia if can reduce stress and reduce musculoskeletal risk factors
  - modify joint mechanics
  - focus on sensory processing
  - improve stability
  - correct anatomical defects (if present)
- minimize excessive, forceful repetitions
- prevent aberrant or excessive neural adaptation
Example of Dance to Reduce Cervical Dystonia

https://www.youtube.com/watch?v=DwkHK3rfKO0

Important to match intervention to patient needs and expectations

Story of Cure

- https://www.youtube.com/watch?v=Non1KSId0bI

Thank You

- My sharing is a way of learning for me
- I enjoy hearing ideas from all of you