Motor Unit

- Posterior horn
- Anterior horn
- Axon
- Muscle fibers
- Motor end-plates
Polio’s Effect on Motor Units

- Polio attacks the anterior horn cells in the spinal cord
  - kills the motor nerve and axon
  - it selectively targets some motor units in a region and may miss adjacent units

- New nerve branches (from the nerves that remain) make additional branches to “adopt” the unused muscle fibers in the region

- The newly formed motor unit controls many more muscle fibers than the original, producing fatigue at an earlier point of exertion
Neuroplasticity

Many of you have carried something heavy until your arms shake or have done sit-ups until your body shaked at the effort. The shaking was fatigued muscles.

With normal non-fatiguing exertion, the motor units fire asynchronously to produce a smooth excursion of the limb. During this movement, they do not fatigue easily since they are able to have periods of rest.

When fatigued, the motor units fire synchronously to produce the effort needed for the task. At that point, the motor units don’t have a rest period – once fatigue begins, any additional effort causes very rapid fatigue to point of failure.
Post-Polio Syndrome

Diagnosed by recognition of oversized motor units through EMG (Rodriguez et al, 1995; Drost et al, 2004)

One hallmark is fatigue from failure of oversized motor units over time. (Post-Polio International, 2003)

Our concern was providing a good rehabilitation without fatigue and setbacks
Overuse Shoulder Injuries

Rotator cuff

• Controls position of humeral head on glenoid fossa
• If head is not controlled
  - It impinges the soft tissue of the shoulder joint against the acromion causing inflammation and tearing
• Injuries occur from trauma or overuse of weakened rotator cuff muscles that are not able to control the position of the humeral head in the glenoid fossa

Patient’s rotator cuff muscles were atrophied from polio and insufficient to maintain position of humeral head
The Double Whammy

Shoulder joints have degenerative changes with aging and normal use but have increased risk from aging with PPS

- Aging
  - Normal aging $\rightarrow$ loss of motor units
- Overuse for function with PPS
  - Need to compensate for loss of lower extremity function

What does this mean to aging polio survivors who depend heavily on arms to make up for loss of leg function?

- We believe that they will increasingly require orthopedic surgery and rehabilitation as they age in effort to remain functional
History

- Original diagnosis of polio in 1954, with paresis of all four limbs, anterior neck muscles and mild respiratory weakness
- Residual paresis primarily lower extremities
- Good UE recovery with grossly normal function
Post-polio Syndrome

- Diagnosed at age 32 with PPS at The Institute for Rehabilitation and Research (TIRR) in Houston, Texas
- EMG revealed enlarged motor units indicative of PPS in all four limbs
- Advised to limit heavy UE use and retire from work, but chose to continue working with modifications to work duties and lifestyle
Shoulder History

- In her mid-30s, the pt. sustained an injury to her right shoulder which was not treated but resolved successfully.

- During the next decade she experienced several spontaneous episodes of shoulder pain and limitation, successfully treated with rest, exercise and injections.
Presurgical Status

- The last episode failed to resolve with treatment.
- The patient was 48yo, in good health, living independently, working full-time.
- She used powered mobility for distance ambulation.
Presurgical Status

The patient reported constant pain rated at 7 – 9 on a 10 point scale with abduction or flexion of the shoulder, and pain of 5/10 at rest.

She occasionally dropped objects, had moderate difficulty with ADLs and IADLs, and was unable to perform overhead reach.
The Decision-making Process

- People facing shoulder surgery have a period of time when they are dependent on others for help with ADLs.
- The patient, an experienced OTR, also knew that PPS patients permanently lose some function after a major health incident.
- She was also concerned about the possible effects of over-fatigue during rehabilitation.
Insurance Issues

In addition, the rotator cuff injury did not qualify the patient for home health care or extended inpatient rehabilitation, and she was concerned about who would provide care during her total dependency phase. She would be unable to perform any ADLs, transfers, or community mobility for up to 8 weeks.
Additional Issues

Polio survivors are fiercely independent

- A huge fear – what if the surgery causes permanent dependency?
- What if the rehabilitation triggers a fatigue response and destroys additional motor units?
- Should she live with the pain and decreased function or take a chance on the surgery and rehabilitation?
Her Decision

Since her pain was increasing and her function was decreasing, she decided to go for the surgery and rehabilitation.

The surgeon and physical therapist were carefully chosen.

Her sister was able to take 8 weeks away from her work in another state to stay with the patient.
Presurgical Physical Exam

Test results

- 1 cm sulcus sign
- +Yergason
- +empty can
- +O’Bien
- Baltimore Therapeutic Equipment (BTE)
  - 49.5% difference score in abduction R vs L
  - 57.7% difference score in flexion R vs L
- Severely decreased abduction ROM
Presurgical Medical Exam

Radiography
- Rotator cuff tear with 2+ clavicular spur
- Narrowed subacromial space

MRI
- Supraspinatus tendon tear with 1.5cm retraction
- May have SLAP (superior lateral anterior to posterior) lesion
- Biceps tendon may be avulsed
- Anterior inferior labral tear
Note the visible difference as patient attempts to lift both arms into abduction: L body lean, elevated R shoulder, reduced angle at inferior R shoulder.
Surgery

- Supraspinatus reattached by way of drill holes through greater tuberosity
- Long head biceps was avulsed but stable so it was not disturbed
- No acromial osteophyte found
- Diffuse synovitis was debrided
- Extensive subacromial bursitis was debrided
- Labrum was stable
Rehabilitation

We wanted to maximize the patient’s recovery of function, strength, and mobility

• Often shoulder rehabilitation involves many strengthening and endurance exercises

• However, if we worked the patient too hard we would initiate fatigue response and possibly destroy some motor units

How can we restore maximum function but protect the patient from fatigue?
Joint Mobilization (Maitland)

This patient received Maitland mobilization technique to her shoulder to restore mobility

- PT stretched the joint capsule without patient effort
- PT was trained by Maitland in New Zealand
- Technique uses communication with constant patient feedback
- Pressure modified according to patient tolerance
The patient was assigned exercises

- restore strength and functional abilities
- strictly limited in how many repetitions
- functional movement patterns only

- PNF (proprioceptive neuromuscular facilitation)
- D1 and D2 patterns
- Added theraband resistance to tolerance
Two Month Tests

Test results

- 1 cm sulcus sign
- -Yergason
- -empty can
- -O’Brien
- Baltimore Therapeutic Equipment (BTE)
  - 21.5% difference score in abduction R vs L (-28)
  - 17.5% difference score in flexion R vs L (-40)
- increased abduction ROM
  - 160° (+105 °)
Two Year Tests

Test results

- 1 cm sulcus sign
- Yergason
- empty can
- O’Brief
- Baltimore Therapeutic Equipment (BTE)
  - 18.3% difference score in abduction R vs L (-31)
  - 9.8% difference score in flexion R vs L (-48)
- increased abduction ROM
  - 175° (+120 °)
Outcome

- This patient recovered full function of the involved shoulder

- She returned to an independent lifestyle

- Two years post-rehabilitation, she maintained her pain-free, functional status and showed some additional minor gains

- She just returned from 3 years in Japan, lives independently, and teaches full-time
Objective was to present a case study of a person with Post-Polio Syndrome who developed a rotator cuff tear from overuse.

Very interesting case for discussion. Obviously the outcome was excellent.

Risks of a worse outcome or rehab not being quite as smooth for folks seen in the post-polio clinics day in and day out, may be higher.

How would you advise using this information in terms of selecting folks who are likely to have as good an outcome?

- This patient had an unusually good potential for recovery, partially because of her expert knowledge. She was able to anticipate potential problems, the recovery period and rehab, the problems of being limited in day-to-day activities and that she would be very dependent on someone for awhile. She was able to solve that by being her own case manager in advance.
- Not every patient can do that.

It would be ideal to have patients get a pre-surgical consult with an OT when this surgery is being considered.

When repair is recommended, a detailed analysis should be done of how the patient goes through the day with pain.

A pre-surgical review should be completed on what will be done for the patient post-op.

Patient in case study did not have a Post-Polio clinic in her community.

It was difficult in some cases to get all the health care professionals on board to understand there were some special circumstances.

When the pain becomes too serious – impairing the patient’s everyday life – and potentially their occupation and the patient is not happy with their quality of life, something needs to be done.

For the case study patient, when the interventions did not work, her function was being significantly impaired as well as her sleep. Her ability to take care of herself was threatening her job.

It was not an easy decision for her to make. It seemed to be worth the risks to have the rotator cuff repaired and get back her quality of life.

For polio patients, there is a terrible feeling of dependency. They really want to do things for themselves and sometimes it overrides common sense.

For this case study patient – one of the major advantages was her knowledge of PPS and movement that she could do safely and not do safely. It was the dedication of the patient cooperating and complying and actually somehow directing the therapist of what to do and not do.

Maitland Technique – constant dialog with the patients and constant adjustments with the mobilizations.