Therapeutic Management of Brachial Plexus Birth Injury

Occupational/Physical Therapy Assessment and Intervention

Outline

Assessment

- Birth- 3 months
- 3 months – 18 years

Treatment

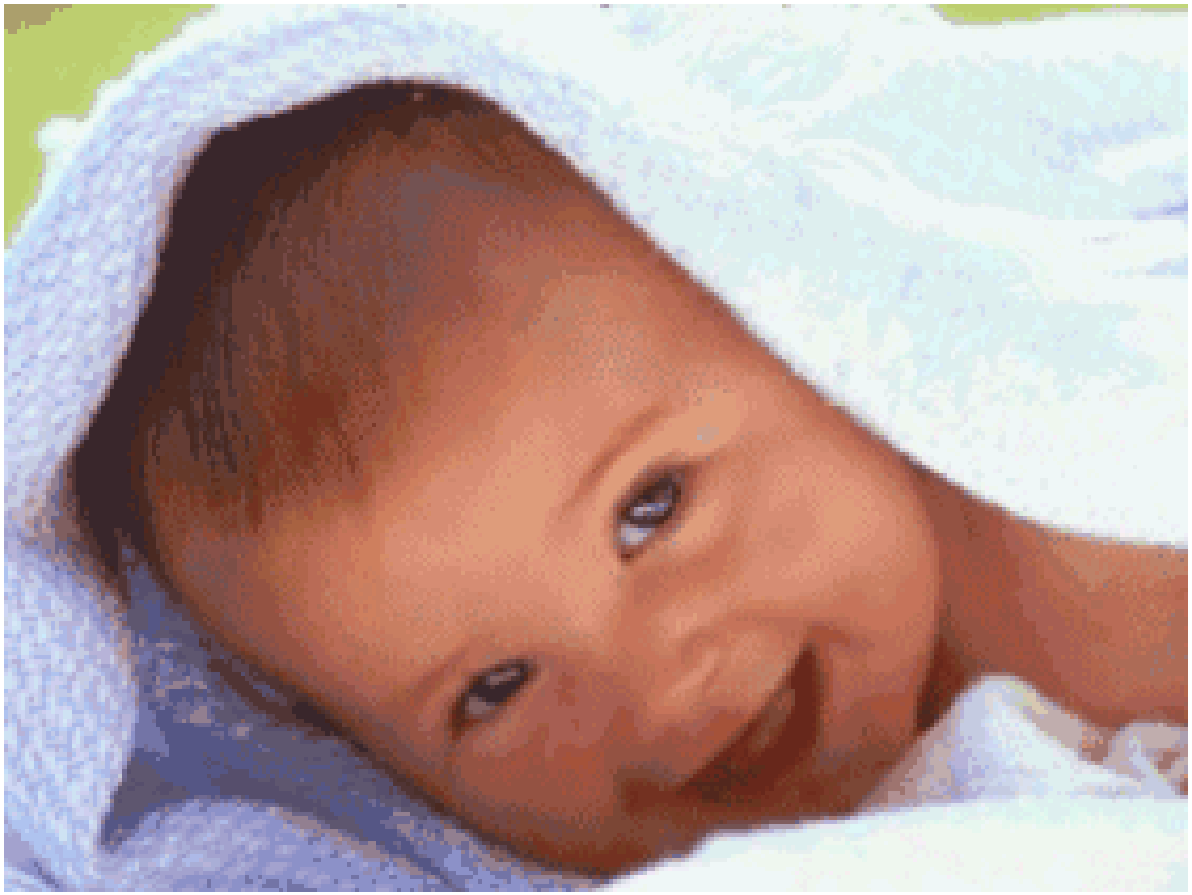
- Birth – 3 months
- 3 months – 18 years

Indications for Surgery

- Primary nerve surgery
- Muscle/Ligament surgery
- Bony surgery

Post –Surgical Interventions

Assessment of the Newborn-3 month old



Initial Assessment/Early Infancy

- **Pertinent medical history:**
  - gestational age, birth weight, delivery history, possible shoulder dystocia, maneuvers used
  - complications after birth: include presentation, possible respiratory issues (phrenic nerve: hemidiaphragm), possible Facial Palsy, Horner's Syndrome, torticollis
  - medical testing: EMG, X-rays, CT Scans, MRI, UltraSound
- ***All newborns with possible injuries should have x-rays of the cervical spine and involved extremity to rule out clavicular and humeral fractures***
- **Developmental history:**
  - parental concerns
  - feeding difficulties
  - other developmental issues

Musculo-Skeletal Assessment/Early Infancy

Important to assess total body control before focusing on affected extremity

- Muscle tone/bulk
- Quality of movement: head and trunk control
- Symmetry: to include not only body symmetry but also visual, auditory, oral symmetry

Primitive Reflexes

- Palmar Grasp
- Plantar Grasp
- Moro Reflex

Involved Extremity

- Observations of extremity at rest: be aware of infant's temperament at time of assessment
  - Position of head in relation to extremity
  - Position of extremity in relation to rest of body. If possible, observe in a variety of developmental positions
  - Spontaneous movement
  - Muscle tone
  - Muscle bulk: may want to take circumferential measurements
  - Limb length; hand size: compare to other side
  - Check for evidence of circulatory issues

Objective Assessment of Involved Extremity

- Joint integrity: check for subluxations, joint capsule tightness, glenohumeral changes
- Passive Range of Motion: take into account physiological flexion, potential shoulder subluxation or radial head dislocation, need to promote scapulo-humeral rhythm when testing
- Active Range of Motion: use of faces, toys, etc, be aware of effects of gravity, may want to restrict movement of body to decrease compensation in order to get “clean movement”

Objective Assessment of Involved Extremity (cont)

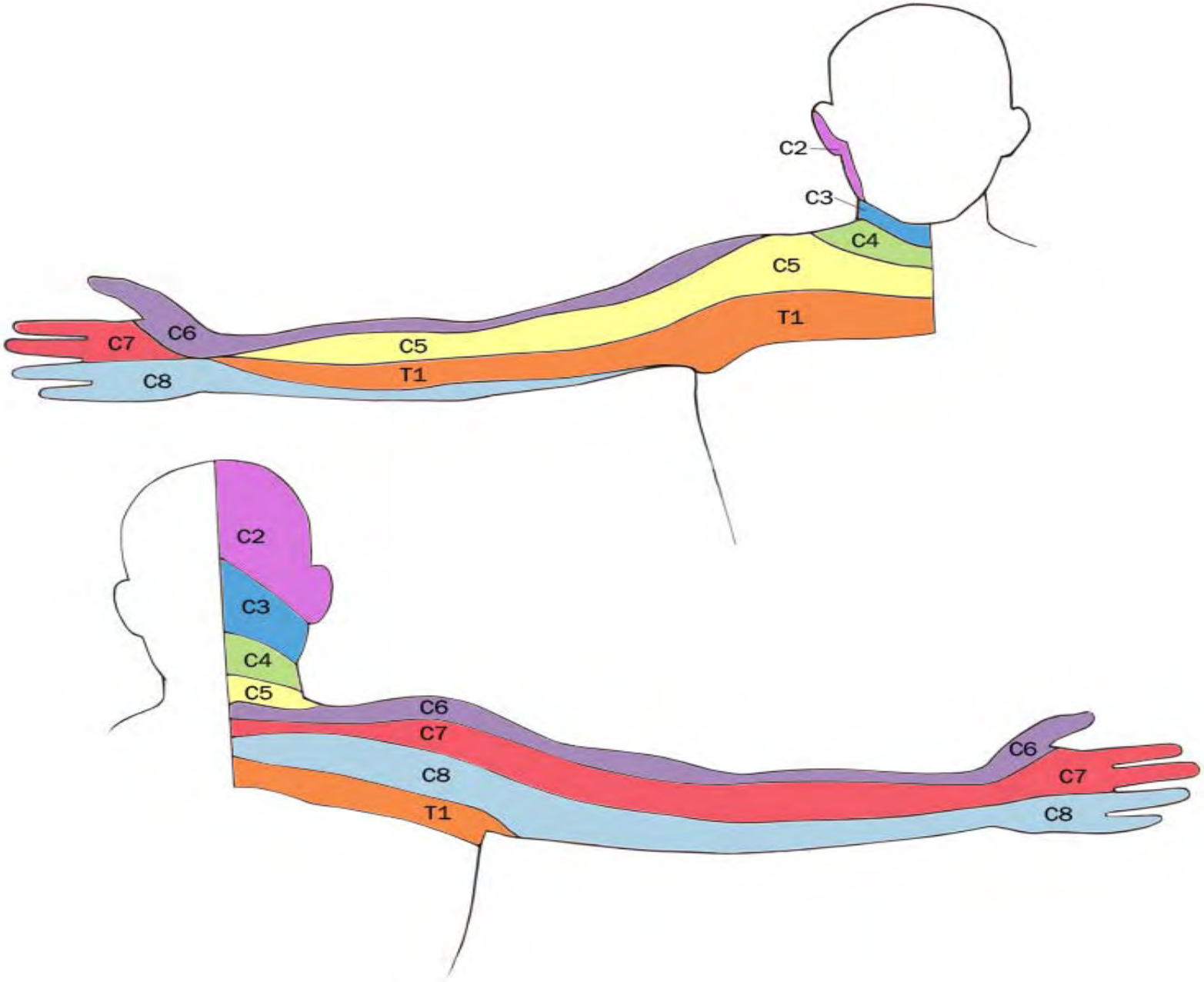
Strength

- Observation
- Palpation – test in different ranges and in different relationships to gravity
- Offer slight amounts of resistance in varied positions

Sensation

- Deep Pressure
- Light Touch
- Temperature

Need to be aware of /avoid Tinel's Line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Assessment of Child (3 months-18 years)

In addition to detailing the effects of the injury on developmental skills and functional movement skills as the child grows, one must consider the following:

Muscle contractures leading to decreased range of motion and joint deformity

Sensory Deficits: both on an integrative basis as well as specific to the extremity

Apraxia: lack of usage of the affected extremity and use of compensatory patterns

Involvement of the unaffected extremity due to overuse

Standardized Assessments utilized specific to this population

- Mallet Scale
- Active Movement Scale
- SHEAR Scale

MODIFIED MALLET SCALE

Active Movement Scale

Shoulder abduction	**Forearm pronation**
Shoulder adduction	**Forearm supination**
Shoulder flexion	**Wrist flexion**
Shoulder external rotation	**Wrist extension**
Shoulder medial rotation	**Finger flexion**
Elbow flexion	**Finger extension**
Elbow extension	**Thumb flexion**
	Thumb extension

Curtis C et al. 2002

Active Movement Scale

Gravity eliminated

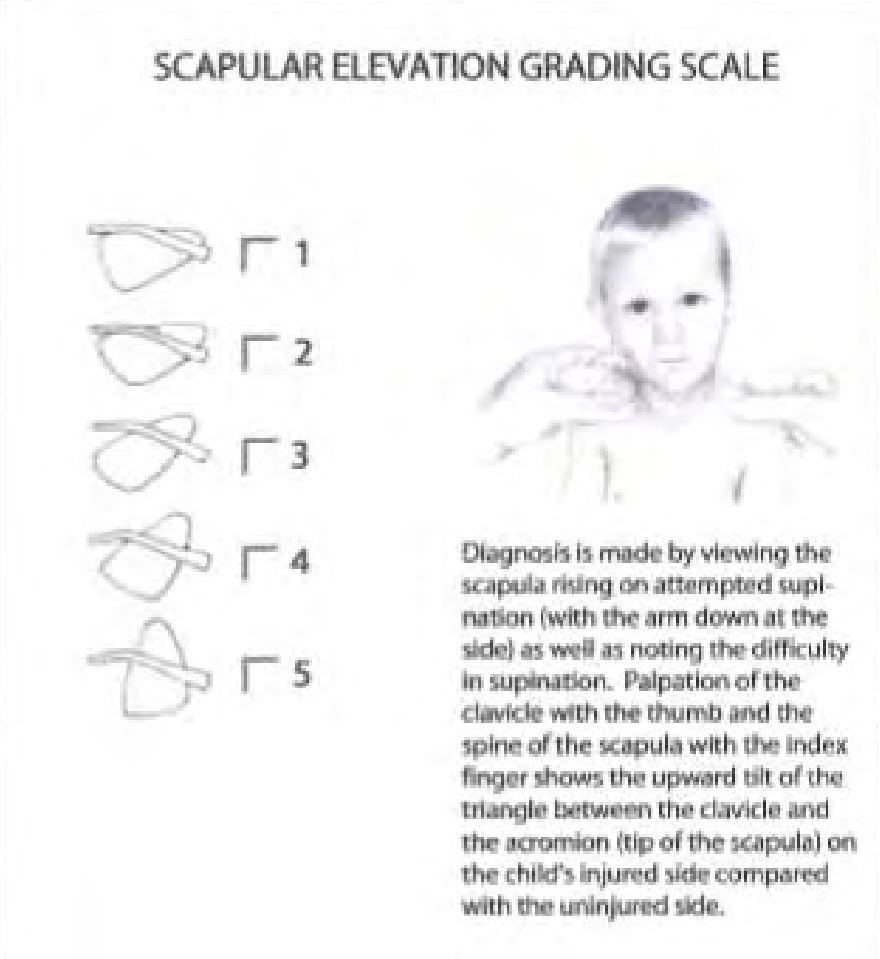
- 0 no contraction
- 1 contraction, no motion
- 2 <50% motion
- 3 >50% motion
- 4 full motion

Against gravity

- 5 <50% motion
- 6 >50% motion
- 7 full motion

Curtis C et al. 2002

Clinical Grading Scale for SHEAR Deformity



Treatment of the Newborn (0-3 months)

- Family Education is the most important aspect of treatment at this time.

  Positioning/Handling to maintain alignment
  Activities of Daily Living to maintain alignment and promote usage
  Controlled Sensory Input
  Passive Range of Motion Techniques/Precautions
  Facilitation of movement and all developmental skills
  Splint Wear/care if needed

Treatment Goals

Focus of treatment throughout childhood beginning at newborn:

ALIGNMENT, ALIGNMENT, ALIGNMENT

preserve joint integrity in the face of muscle imbalances

maintain PROM

facilitate AROM

****need to have a clear understanding of upper extremity skill acquisition month by month****

HOWEVER,

Time is of the essence:

Importance of Developing Appropriate Motor Patterns in the face of Muscle Imbalances and Bony Sequela

Starting in infancy:

- Promote sensory awareness of affected extremity
- Promote visual awareness of affected extremity
- Use positioning and handling to build bilateral usage within efficient motor patterns
- Prevent/minimize compensatory patterns of movement

Importance of Core Stability

Work should begin immediately at the core level. Trunk provides a base of stability out of which comes all extremity function.

Balance between extensors and flexors as well as symmetry is crucial for the development of adequate movement patterns.

As child begins to attempt to utilize his affected extremity, core stability becomes threatened and must be monitored closely.

Consideration of lower extremity function

- Lower extremities, dependent as well on core stability, must be closely monitored as well.
- It has been noted throughout the literature that children with a brachial plexus birth injury often lack usage not only of the affected upper extremity but also of the same side lower extremity. This may be due to the involvement of the spinal cord in a severe injury but can also be found in the child with a more mild injury.

Treatment Sequence

- Building of core stability followed by facilitation of rotational skills
- Consideration of lower extremity function
- Preparation for function: decreasing tightness in non-affected muscles through a variety of techniques:
  - Craniosacral Therapy
  - Myofascial Release
  - Passive Range of Motion
  - NMES: only on muscles that are fully innervated

  May want to consider use of heat as a preparation as well

- Facilitation of Bilateral Scapular Stability
  - Due to the closely-lying dorsal scapular nerve and long thoracic nerve, the rhomboids and serratus anterior muscles are often affected in children with a C5, C6 injury. Close attention must be paid to these muscle groups. Will usually require external support in the form of Theratogs, DAMOs, Spios, Super Wrap, Support Tape, etc. Kinesiotape may be used as well to facilitate these muscles or to inhibit the excessively strong ones
  - Unaffected scapula is prone to overuse injury due to muscle compensation so must be closely monitored throughout treatment.

- Facilitation of Shoulder Function
  - Again following preparation for function and determining that there is adequate muscle length in the unaffected muscles, one can begin working directly on the shoulder.
  - If there is not adequate muscle length following preparation, therapist should isolate out those muscles as contractures and should no longer be doing passive range of motion or facilitation of active usage. Passive range of motion or asking child to utilize a contracted muscle, can ultimately cause joint deformity and long-term compensation.
  - These children should be referred immediately for surgical consideration.

- After determining that the unaffected muscles have adequate length, therapist must isolate out specific muscle weaknesses. Manual muscle testing can be utilized but is often not an option due to the child's age and level of cooperation.
- Treatment should concentrate on building symmetry around the shoulder joint by lengthening the unaffected muscles and strengthening the weak muscles.

- While working on the shoulder joint , it is imperative that the rest of the body be in good alignment. This may entail simple positioning or can necessitate the use of external supports.
- One must also look at the position of the more distal elements of the affected extremity. Use of braces, splints, serial casting to place the elbow and wrist in alignment will facilitate better usage of the muscles around the shoulder joint.

- When working on shoulder movement, need to look at total body position to inhibit any compensatory patterns. This must be looked at early in infancy and throughout recovery and growth as patterns learned early will remain if not inhibited. New patterns available to the child as the nerve recovers will be inhibited by these old patterns if not discouraged early. (concept of Developmental Apraxia)
- Therapist must look at the actual capabilities of the child before requesting that they complete an activity. Any compensations or movements out of alignment must be discouraged.
- Therapists who use “constraint-induced movement” should be diligent in promoting alignment and structuring the activity in order that all movements be clean and without compensation.

- Facilitation of Overall Extremity Function
  - Although we are concerned with the affected extremity function, integration of the extremity into bilateral activities of daily living is imperative.
  - This should start with facilitation of equilibrium responses in all planes.
  - One can then move to bilateral midline control followed by bilateral reaching.
  - Only when the child has integrated the extremity into their body schema do we isolate out the affected extremity for reaching and use as a assist in function.
  - Specific domains such as grasp and release should be worked on in the context of function.
  - When working on specific hand skills, one should again align the body, scapula, and shoulder as a preparation for function.

Indications for Primary Nerve Surgery

Infants who have no biceps by 6 months of age AND have failed a test of Botox to the triceps

NOTE:

There is excellent peer-reviewed literature that nerve grafting is needed a small minority of time, 5% or less.

Primary Nerve Surgery

- Several recent studies have demonstrated that children with/without nerve surgery have same functional outcomes at age 5.
- In fact, shoulder development has been found to be worse in those children that have been nerve grafted.

Nath RK, Liu X. Nerve reconstruction in patients with obstetric brachial plexus injury results in worsening of glenohumeral deformity: A case control study of 75 patients. J Bone Joint Surg (BR), 91(B), No. 5, May 2009. 649-654.

Indications for Muscle/Ligament Surgery

- Varies with different brachial plexus surgeons
- Aspects to consider:
  - 1. Limitations in function/pain (discomfort) with movement
  - 2. Presence of contractures
  - 3. Presence of possible shoulder subluxation; usually posterior or inferior subluxation of the humeral head

General Post Surgical Rehabilitation

Parents will be given protocol sheets specific to the surgeon/type of surgery.

These instructions are to be followed with no exceptions.

Therapists with questions should refer them to the surgeon and/or therapist affiliated with the surgeon.

No changes should be made until discussed.

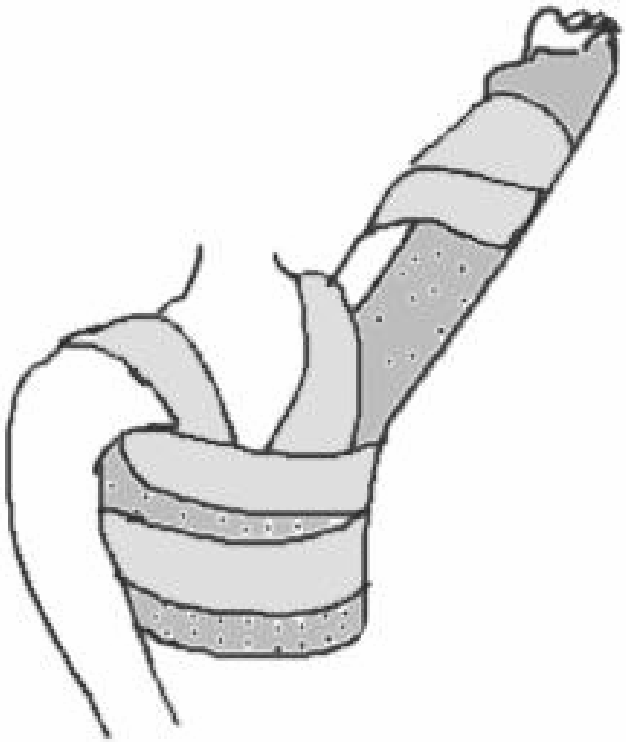
Post Surgical Rehabilitation following Primary Nerve Surgery

- Specific to the nerves being transferred/grafted.
- Do not expect to see any volitional elbow flexion before 6-8 months.
- Splinting following this surgery is variable ranging from total immobilization to none at all.
- Please keep in mind that primary nerve surgery is in essence creating a new injury and should be treated as such.
  - All protocols initiated in infancy can be utilized at this time as well.

Post Surgical Rehabilitation following Muscle/Ligament Surgery

- Child is placed into splint/cast in the OR by the surgeon.
- Splint/cast wearing times vary among surgeons and cases (age of child, etc). Always refer back to surgeon if parent is unsure of wearing schedule.
- Need to explain to parent that child is immobilized both for healing and pain control.
- Older children(12+) may have a pillow splint at a 80-90 degree angle to prevent numbness

Immobilization following Surgery for Muscle Complications



Post Surgical Rehabilitation (3-8 wks.)

- After splint is taken off, begin PROM/AROM as tolerated to all shoulder and upper extremity muscles paying close attention to shoulder abductors, flexors, and external rotators. Can begin scar massage or silicone gels at this time.
- All ROM should be done cleanly attempting to discourage any compensatory patterns
- All medial rotation, horizontal adduction across midline, and depression of the shoulder girdle movements to be discouraged.
- Need to encourage usage of the extremity in all bilateral and ADL activities

Post Surgical Rehabilitation (8 wks +)

- Assess scapular stability bilaterally: consider the use of support devices to maintain alignment of the scapulas
- Assess all musculature of the shoulder girdle and upper extremity both in terms of ROM and weakness to formulate treatment program.
- Sensibility should be addressed at this time as well as children after surgery can be hypersensitive, particularly around scars.

Post Surgical Rehabilitation (8wks+) cont.

- Can begin active strengthening at this time.
- Be aware of the need to utilize external supports to maintain alignment while treating the scapula/shoulder. This can range from total body support to taping of specific muscle groups to splinting/bracing/casting of the forearm and wrist.
- Biofeedback, E-stim, and TES can be implemented at this time. May begin constraint-induced treatment as well.
- NO MEDIAL ROTATION, HORIZONTAL ADDUCTION ACROSS MIDLINE, OR SHOULDER DEPRESSION.

Types of Bony Surgery

- Triangle Tilt Surgery: Texas Nerve and Paralysis Institute
  - Realigns the shoulder complex
- Humeral Osteotomy
  - Changes position of the extremity by rotating the humerus into a neutral position
- Ilizarov Procedure
  - Lengthens and/or rotates the bone

Post Surgical Rehabilitation after Triangle Tilt Surgery

- SARO brace worn 24/7 without removal for 3-6 weeks. This may be adjusted by surgeon depending on severity of the SHEAR deformity.

- Position in SARO brace should be monitored:
- elbow crease is generally positioned with palm facing up; however, may be positioned in neutral by surgeon

  axillary area should be clear..without pressure

  brace should be sitting above hip joint unless it is a female with breast development

- Elbow, wrist, and hand PROM begins at two days post-op to prevent stiffness. Instructions on how to unwrap/rewrap straps and complete ROM given by therapist at discharge from hospital.

Immobilization following Triangle Tilt Surgery: SARO Brace

Post Surgical Rehabilitation after Triangle Tilt Surgery (3-8 wks)

- SARO brace is removed: no night wear until functional AROM at shoulder regained
- Heat modalities are recommended: hot pack, bath, etc
- Expect loss of ROM at shoulder and possibly at elbow due to immobilization
- Scar Massage/Silicone gel pads may be warranted at this time

Post Surgical rehabilitation (3-8 wks) cont.

- Direct therapy intervention should begin at this time. Frequency to be determined on a specific case basis.
- Full PROM and AROM as tolerated. Be aware of compensatory patterns. May need to use external supports to maintain alignment.
- Treatment Goals:
  - Enable child to adjust to new extremity position
  - Enable child to see changes since before surgery: important that they become invested in therapy
  - Increase “clean” AROM of the shoulder abductors/flexors, external rotators, and elbow extensors

Post Surgical Rehabilitation after Triangle Tilt Surgery (8-12 wks)

- Continue/Upgrade AROM activities. Important to encourage usage in all bilateral and ADL activities.
- Continue to assess/provide supports to maintain alignment at all joints
- May begin TES, Biofeedback, NMES at this time
- Serial Casting of the elbow may be started if elbow flexion contracture present (will be prescribed by surgeon)

Post Surgical Rehabilitation after Triangle Tilt Surgery (12+ wks)

- Assess bilateral scapular alignment on rib cage
- Assess alignment and mobility of the gleno-humeral joint
- Assess sensibility of both the upper trunk and shoulder girdle
- Full assessment of ROM/muscle weakness throughout the trunk and upper extremities
- Full ADL/functional assessment

Post Surgical Rehabilitation after Triangle Tilt Surgery (12+ weeks)

- Focus to be initially placed on core stability. Work should be done on an on-going basis to build symmetry.

  May require external support in the form of theratogs, SPIOs, DAMOs, support taping, etc

- Treatment then focuses on strengthening of the scapular stabilizers to promote scapulo-humeral rhythm while maintaining overall alignment.

  Again may require taping, e-stim, biofeedback or external support.

Post Surgical Rehabilitation after Triangle Tilt Surgery (12+ wks)

- When you have proximal alignment: core, scapula, you can then begin strengthening of the shoulder musculature.
- It is easier to strengthen shoulder musculature when the forearm and wrist are in alignment. This may require use of splints/braces, taping, or casting.
- Once you can get alignment at the shoulder, strengthening of the elbow, wrist, and hand can be implemented.