Birth Related Brachial Plexus Injuries

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NHS Greater Glasgow and Clyde — Baby Plexus / Adult Plexus

NHS The Leeds Teaching Hospitals NHS Trust

NHS Royal National Orthopaedic Hospital NHS Trust

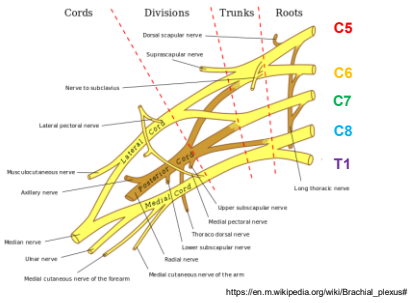
www.rnoh.nhs.uk/services/peripheral-nerve-injury-unit

www.rnoh.nhs.uk/services/peripheral-nerve-injury-unit

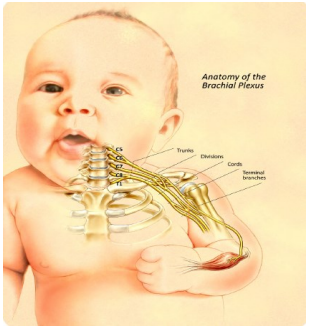
Learning Outcomes:

To provide an overview of:

- Brachial Plexus anatomy
- Consequences of a BRPI
- Assessment
- Interventions
  - ➢ Surgical
  - ➢ Therapy

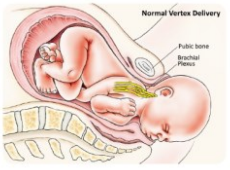


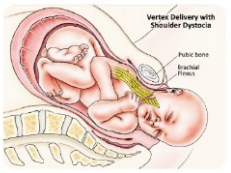
https://en.m.wikipedia.org/wiki/Brachial_plexus#



Patient and Family Education leaflet, Seattle Children's Hospital, Washington.

What is BRPI





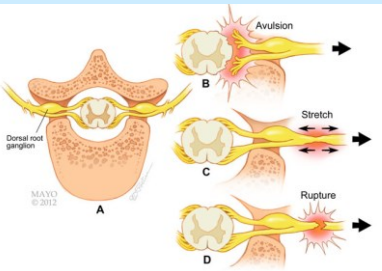
0.42 to 2.6 per 1000 Births
(average - 1 in 2300)

Evans-Jones et al. (2003)

The RNOH is one of the largest tertiary centres in the UK for BRPI.

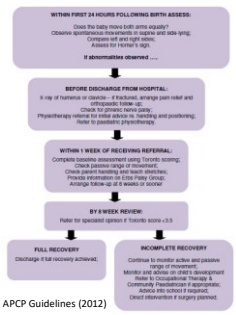
Patient and Family Education leaflet, Seattle Children's Hospital, Washington.

Traction Injury

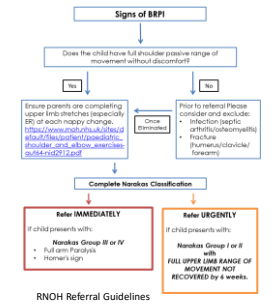


Narakas Classification

Group	Level affected	Symptoms
I	C 5 → 6	Palsy of: Shoulder abduction and external rotation; Elbow flexion; Forearm supination
II	C 5 → 7	Palsy of: Shoulder abduction and external rotation; Elbow flexion; Forearm supination and Wrist extension
III	C 5 → T1	Complete limb paralysis with no active function
IV	C 5 → T1	Complete limb paralysis with no active function **and Horner's Sign**

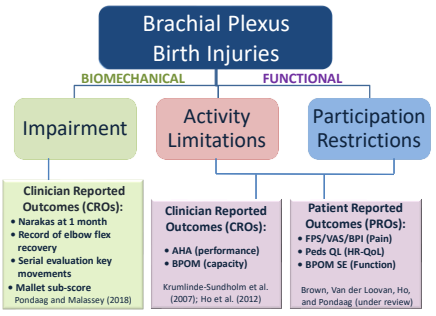


APCP Guidelines (2012)



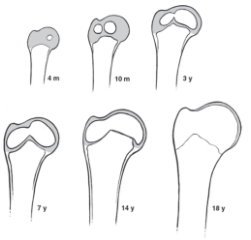
RNOH Referral Guidelines

www.rnoh.nhs.uk/services/peripheral-nerve-injury-unit



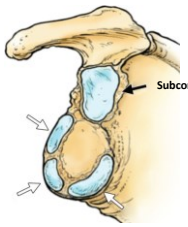
Development of the GHJ

Normal development of the HOH



Kwong et al. (2014)

Normal development of the glenoid



Zember et al. (2015)

Narakas Classification

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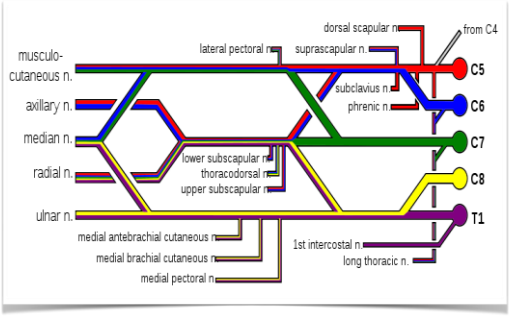
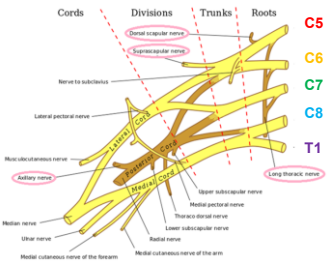


Branches affecting the shoulder



Dorsal Scapular Nerve (C5)

Supplies:

» .....

» .....

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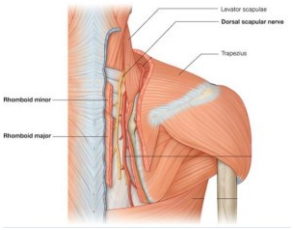

Suprascapular Nerve (C5, 6)

Supplies:

» .....

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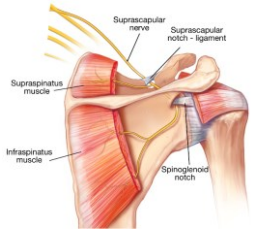
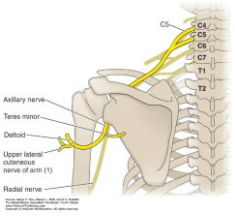


Axillary Nerve (C5, 6)

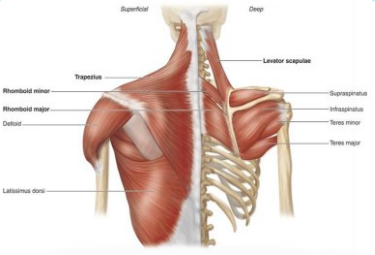
Supplies:

» .....

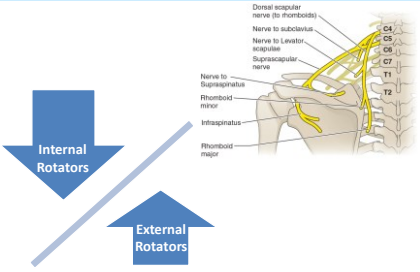
» .....



Soft tissue imbalances



Soft tissue imbalances



Consequences of shoulder contracture

- Imbalance between internal and external rotators.
- Arm held in internally rotated position.

- Shortening of subscapularis and pectoral muscles.
- Secondary shortening of anterior joint capsule, coracohumeral ligament, and rotator interval.

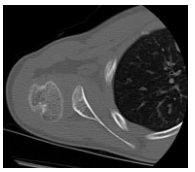
- HOH pulled into IR and faces in posterior direction.
- HOH subluxes posteriorly (especially with flexion of the arm).

Fairbank (1913)

70% of children who present with an internal rotation contracture will have concomitant glenohumeral deformity.

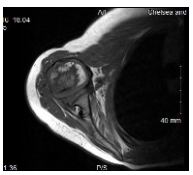
(Pearl and Edgerton, 1998)

Consequences of shoulder contracture




Humeral Head Defects

- Flattening
- Altered size
- Changes in retroversion



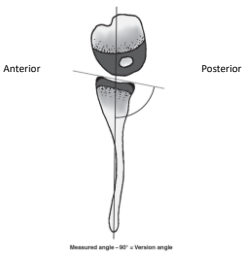
Glenoid dysplasia

Concave-flat

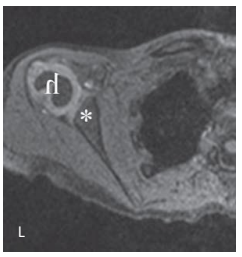
Convex

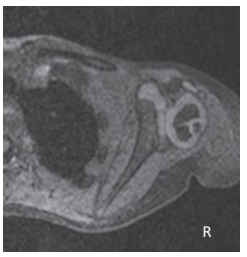
Biconcave (Pseudoglenoid)

Glenoid version



6-month-old boy with Right BPI



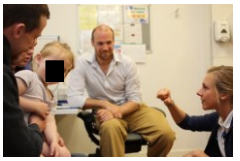


Initial Management

Conservative Approach

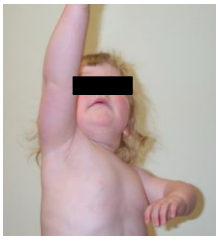
- Observation/Review (monthly)
- Neurophysiology
- Stretches
- Parental education

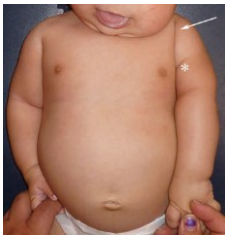
Erb's Palsy Group



Therapists: Assessment and Treatment

Assessment - Observation





Assessment - ROM

RANGE OF MOTION					
	Right	Left		Right	Left
Shoulder			**Elbow**		
1. Flexion			9. Flexion		
2. Abduction			10. Extension		
3. Internal Rotation			**Forearm**		
4. External Rotation			11. Pronation		
5. Internal Rot°. (90°Ab)			12. Supination		
6. External Rot°. (90°Ab)			**Wrist**		
7. Inferior Scapulo-humeral angle (in Ab)			13. Flexion		
8. Posterior Scapulo-humeral angle (in HF)			14. Extension		

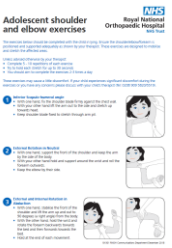
Assessment

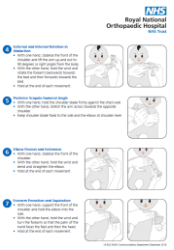
Inferior Scapulo-humeral angle in Abduction

Assessment

Posterior Scapulo-humeral angle in horizontal flexion

Basic Exercises/Stretches





Normal Development

Surgical Options

Decision making

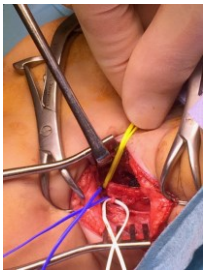
- Observation/Review (monthly)
- Neurophysiology (Birch and Bisenella, 2003)
- Patient and parental compliance and understanding
- Social factors surrounding care

Early Interventions 0-24 months

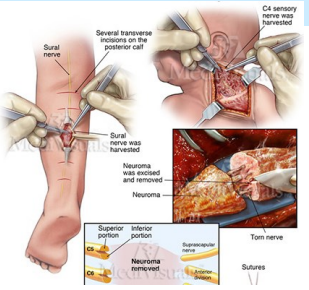
- Supraclavicular Exploration
- Neurolysis
- Nerve Transfer
- Nerve Graft
- Anterior Release
- Botox

Supraclavicular Exploration and Neurolysis

- Visualise the injury
- Neuroma
- Neurophysiology
- Non-degenerative injury
- Removal of constrictive scar tissue

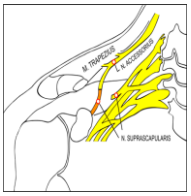


Nerve Graft



Nerve Transfer

- Nerve dissected.
- Identification of sacrificeable fascicles.
- Division of those fascicles.
- Redirection of those neurones into a denervated nerve.
- Muscle activation within months.



Spinal Accessory to Suprascapular Nerve Transfer

Anterior Release

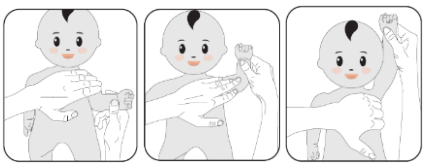
Aims:

- Restore balance.
- Improve function.
- Improve ER.
- Normalise the development of the shoulder.

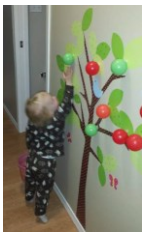
Anterior Release

0-6 weeks PHASE 1: PROTECTION	6-12 weeks PHASE 2: MUSCLE ACTIVATION	12 weeks plus PHASE 3: PROGRESS LOADING & NORMAL MVT
Infant/Child aged 0 – 12 years • Shoulder spica/Abduction External rotation cast) full time for 6/52. • Wound check at 2/52 post op (may be done locally). • Scar massage may be commenced when wound fully healed. • Maintain range of movement in the wrist and hand during this time.	**Advice** • Spica removed at 6/52 post op during surgical review (RNOH Bolsover Street). • Physiotherapist to advise on post operative exercises. • The arm will feel heavy and weak but normal use is encouraged immediately. • May use arm for normal activities but should avoid heavy loading and weight bearing (this does not include crawling) for up to 12 weeks this will be decided at consultant review (e.g. monkey bars, contact sports, gymnastics/cartwheels/handstands). • Encourage good posture with emphasis on normal movement.	**Advice** • Integrate arm into normal function. • Encourage good posture with emphasis on normal movement. • May return to contact sports and heavy activities (if clinically indicated). • Ensure that patient specific goals are set and treatments are holistic. • Continued education regarding the risk of the contracture returning and the importance of continuing with rehabilitation programme into adulthood.
Child/Adolescent aged 12 years + • External Rotation Sling full time for 6/52. • Remove sling for hourly exercises (repeat each exercise 10 times) ➢ Passive external rotation in neutral. ➢ Active external rotation in neutral. ➢ Passive external rotation in abduction. ➢ Active external rotation in abduction. ➢ Active elbow flexion and extension. ➢ Active wrist and hand range of movement.	**Exercises** (SHOULD NOT EXACERBATE PAIN) • Start full PROM programme with increased focus on maintaining gains into external rotation (see left hand box for ideas). • Active exercises into external rotation. • Integrate HEP into play and functional activities (e.g. holding swing, hula hooping, overhead throw, bat and ball). • Consider water based exercises. • May begin light resistance exercises as appropriate (related to the patient's level of muscle activation). • Attempt to retrain muscle patterning (if required). N.B. Muscle patterning can refer to altered recruitment of muscles during a particular movement. It may include compensatory movements.	**Exercises** • Continue to focus on active functional movements. • Progress resistance exercises as appropriate (related to the patient's level of muscle activation). • Continue to retrain muscle patterning as per phase 2 (if required).

Important Shoulder Exercises



2 – 5 years





Assessment

- Observation
- Functional assessment - Play
  - Developmental milestones
  - Weight bearing
  - Gross motor skills
  - Fine motor skills
- Joint ROM
- Sensation?
- Pain?



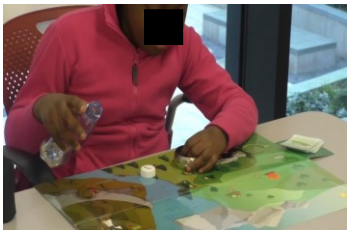


Assessment - ROM

	Right	Left		Right	Left
Shoulder			**Elbow**		
1. Flexion			9. Flexion		
2. Abduction			10. Extension		
3. Internal Rotation			**Forearm**		
4. External Rotation			11. Pronation		
5. Internal Rot°. (90°Ab)			12. Supination		
6. External Rot°. (90°Ab)			**Wrist**		
7. Inferior Scapulo-humeral angle (in Ab)			13. Flexion		
8. Posterior Scapulo-humeral angle (in HF)			14. Extension		

Assisting Hand Assessment (AHA)

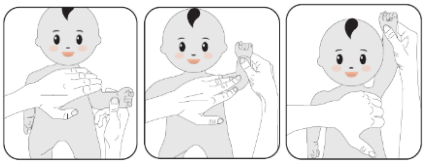
- Semi-structured recorded play session
- 15-30 minutes duration

*Assesses bi-manual function and how the child **usually** uses their affected hand (**performance**)*

Assessment – Modified Mallet

Important Shoulder Exercises



When to worry?

The rapid loss of passive external rotation between monthly examinations is indicative of progressive capsular and muscular contracture, and thus the onset of subluxation or dislocation.

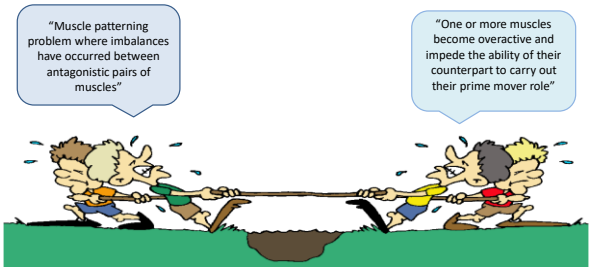
Surgical Options

Late Interventions
2 - 5 years

Anterior Release → true tightness?

Botox → co-contraction?

Co-contraction



Botox

Phase 1: IMPROVING RANGE Milestone: 0-3 weeks		Phase 2: MOTOR RELEARNING Milestone: 3 weeks onwards	
Advice • It may take up to 3 weeks for the botox to take full effect. • It is important to improve the available range in the joint during this time. • Below are suggestions for the most commonly injected muscles - if different muscles have been injected the same principles can be followed.		Advice • Patient should see a therapist at 3 weeks post injection either at RNOH or locally (appointment to be arranged prior to receiving Botox injection). • Encourage functional integration of any gains in active movement; through play and activities of daily living.	
Exercises • Ensure passive range is optimised. • Progress through active assisted/active range of movement as able.		Exercises • Integrate home exercise programme into functional activities and play (e.g. assisted elbow flexion bringing cup/glass to mouth). • Continue passive range of movement with a stretching programme. • The therapist may consider the use of a biofeedback machine to assist with motor relearning.	
Triceps	Pectorals/Latissimus Dorsi	Triceps	Pectorals/Latissimus Dorsi
• Passive stretches into elbow flexion and extension (if limited). • Active assisted elbow flexion in context of functional activity (e.g. hand to mouth, buttoning up shirt) • Consider exercising in gravity neutral/eliminated positions if appropriate.	• Passive stretches into shoulder abduction (including inferior scapula-humeral angle if limited). • Active assisted abduction in context of functional activity (e.g. reaching up, sliding hand up wall, pulley). • Consider exercising in gravity neutral/eliminated positions if appropriate.	• Continue passive stretches. • Integrate active functional movements as much as possible (e.g. eating, washing face).	• Continue passive stretches • Integrate active functional movements as much as possible (e.g. brushing hair, putting in earrings, throwing overhead).

The Older Child and Adolescent

Challenges

- Growth spurts
- Body image-problems

Compliance!!!

- Shift of responsibility

Assessment - ROM

Active / Passive				
	Right	Left		Right	Left
Shoulder			**Elbow**		
1. Flexion			9. Flexion		
2. Abduction			10. Extension		
3. Internal Rotation			**Forearm**		
4. External Rotation			11. Pronation		
5. Internal Rot°. (90°Ab)			12. Supination		
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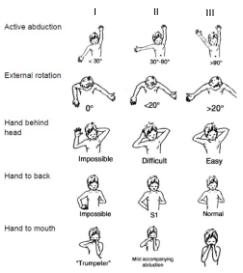
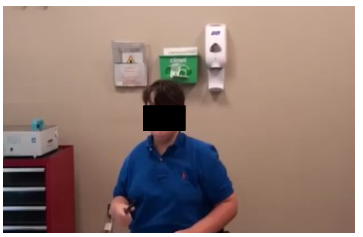
Assessment – Modified Mallet



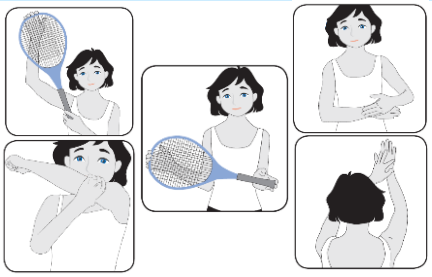
Brachial Plexus Outcome Measure (BPOM)

- Structured recorded session
- 5-10 minutes duration



*Asks the child to **specifically** use their affected arm (**capacity**)*

Self Management



Treatment

Independence in Everyday activities/ School

The Older Child and Adolescent

Elbow contracture

- Bony Block?
- Extension and Supination Stretches
- Serial Casting (6/52)
- Night splint

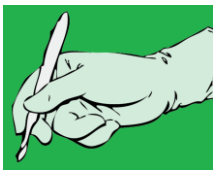
Surgical Options

The Older Child and Adolescent

- Botox
- Anterior Release
- Tendon Transfer
- Osteotomy (Humeral and forearm)
- Glenoplasty

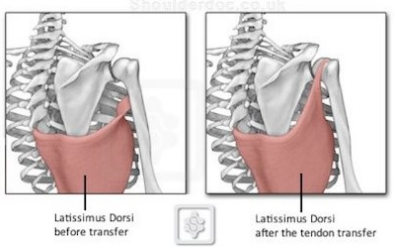
The Older Child and Adolescent Interventions

Anterior Release
(Guidelines)

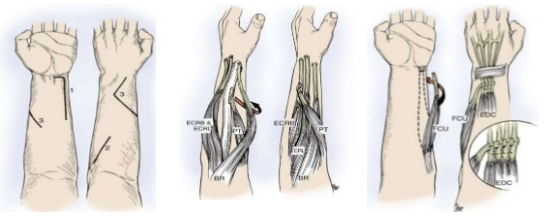


Botox
(Guidelines)

Latissimus Dorsi Tendon Transfer



Pronator/Flexor to Extensor Tendon Transfer



Forearm TT

Tendon Transfers: Hand and Wrist Extensor Tendon Reconstructive Surgery

Tendon transfer (TT) surgery is performed in the hand in order to improve lost function. This surgery involves moving a functioning tendon from its original attachment to a new one to restore the action of the extensor tendons. The aim of this surgery is usually to improve independent grasp and release of the hand; pre-operative function will need to be considered. Pre-operative assessment of the patient by a therapist is important to identify specific functional goals for surgery and provide patients with an understanding of the rehabilitation process.

Please note: This is a guideline of rehabilitation for therapists; any limitations and restrictions recorded in the patients' operation note should take precedence. These guidelines should be used in conjunction with your assessment of the patient. Your treatment should be clinically reasoned and adapted to the individual patient's needs. Time frames are approximate; progress as clinically indicated, only moving onto the next phase once the patient can comfortably achieve phase appropriate exercises and tasks, unless the operation note specifies otherwise. The exercises offer ideas rather than being a prescription.

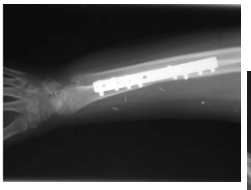
Post-op: 0-2 weeks	2-4 weeks	4-8 weeks	8-12 weeks	12 Weeks onwards
• Immobilised in cast • Elevate operated limb • Maintain ROM of all joints not protected by cast • Functional advice	**Splinting** • Cast to be removed between 2-6 weeks depending on operative findings. • Upon removal of cast: - dynamic splint for daytime use and/or static splint to maintain correct tendon length. • Splint(s) to be worn at all times (including at night).	**Splinting** • Removal of splints for light' activities and home exercise programme (HEP). • Continue with splint at night. • If not already provided and if appropriate consider: - dynamic splint to encourage activation of TT. - dynamic splint for function.	**Splinting** • Discontinue night splint (unless reduced ROM/ extension lag/patricio-morbidities). • Continue with dynamic splint to encourage activation of TT/function only if required.	**Splinting** • Splinting not essential. • Night splint only if required to address ongoing issues. • Dynamic splint only if required to optimise activation of TT.

Bony Deformity Reconstructions:

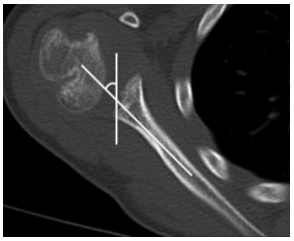
- Rotational Osteotomy of the Humerus
- Rotational Osteotomy of Forearm
- Glenoplasty

Rotation Osteotomy - Humerus

Rotational Osteotomy Forearm



Glenoplasty



Summary

Treatment Goals:

- Maintain PROM/prevent contracture.
- Facilitate bone growth, shape and development.
- Maintenance of a concentric, stable GHJ.
- Strengthen weak muscles.
- Promote normal function.

Final Points

- If no signs of recovery or only limited signs at 6 weeks **REFER TO TERTIARY CENTRE**!!
- Encourage DAILY SHOULDER STRETCHES no matter what age the child is!

Resources

RNOH website – Guidelines
www.rnoh.nhs.uk/services/rehabilitation-guidelines

www.rnoh.nhs.uk/our-services/peripheral-nerve-injury-unit

Scottish National Brachial Plexus Injury Services
www.brachialplexus.scot.nhs.uk/

Leeds Teaching Hospitals NHS Trust
www.leedsth.nhs.uk/a-z-of-services/erbs-palsy/

APCP Management Guidelines
http://apcp.csp.org.uk/publications/obstetric-brachial-plexus-palsy-guide-management

Erbs Palsy Group
http://www.erbspalsygroup.co.uk/

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