ASSOCIATION OF PAEDIATRIC CHARTERED PHYSIOTHERAPISTS

OBSTETRIC BRACHIAL PLEXUS PALSY: A GUIDE TO MANAGEMENT

A Professional Network of The Chartered Society of Physiotherapy

Obstetric Brachial Plexus Palsy

A Guide to Management

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A Guide to Management

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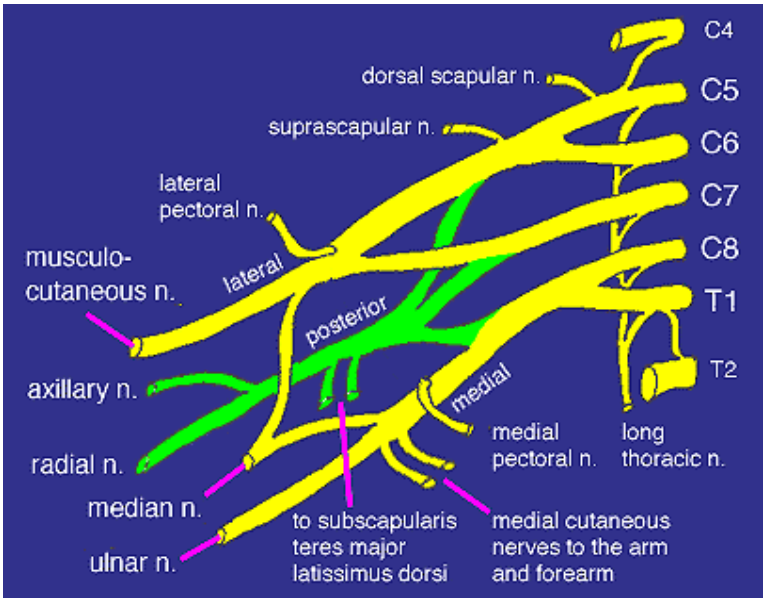
Introduction



The brachial plexus extends from C5 – T1.

Most brachial plexus injuries occur during birth when the complex is put under tension. The aetiology is always a tearing force caused by traction to the head or arm. It may be associated with shoulder dystocia when, following delivery of the head, the anterior shoulder becomes stuck behind the symphysis pubis.

There are two basic types of lesion:

1. Large babies (more than 4kg) with vertex presentation and shoulder dystocia who require excess force by traction, often by forceps or ventouse extraction for delivery. This results in upper plexus injury, most commonly to the C5 and C6, and occasionally to the C7 roots, but never the lower nerve roots.

2. Breech presentation, usually of small babies (less than 3kg) requiring excessive extension of the head and, often, manipulation of the hand and arm in a fashion that exerts traction on both the upper and lower roots. This may cause rupture or avulsion of any, or occasionally all, of the roots (Gilbert A, 2002).

Incidence varies from 0.42 per 1000 live births (Evans-Jones, 2003) to 1.6-2.9 per 1000 live births (Pondaag et al, 2004). A small proportion of children will sustain bilateral involvement.

Rapid return of motor function is a positive sign. Most nerve regrowth and muscle function recovery will occur during the first year. Most babies who spontaneously recover in the early months will have almost full functional recovery, although some residual weakness may remain.

Types of injury:

- an avulsion is when the nerve is torn from where it attaches to the spinal cord - no spontaneous recovery is expected and it is difficult to repair surgically;
- a rupture is when the nerve is torn - this requires surgery;
- a neuroma forms when torn nerve fibres have attempted to re-grow and heal themselves, but scar tissue has grown in and around the injury - surgery is needed to remove this;
- axonotmesis occurs when nerve fibres are ruptured, but the nerve covering is intact - recovery by nerve growth takes time (1mm per day);
- neuropraxis occurs when the nerve has been damaged but is intact - nerve fibres recover on their own and recovery should occur within 3 months.

Severity - will depend on the number of nerves involved and the degree of damage:

- Erb's Palsy affects C5, C6;
- upper-middle trunk involves C5, C6, C7;
- Klumpke's Palsy involves C8, T1;
- total OBPP affects all levels of the Brachial plexus, C5-T1.

Associated problems & injuries:

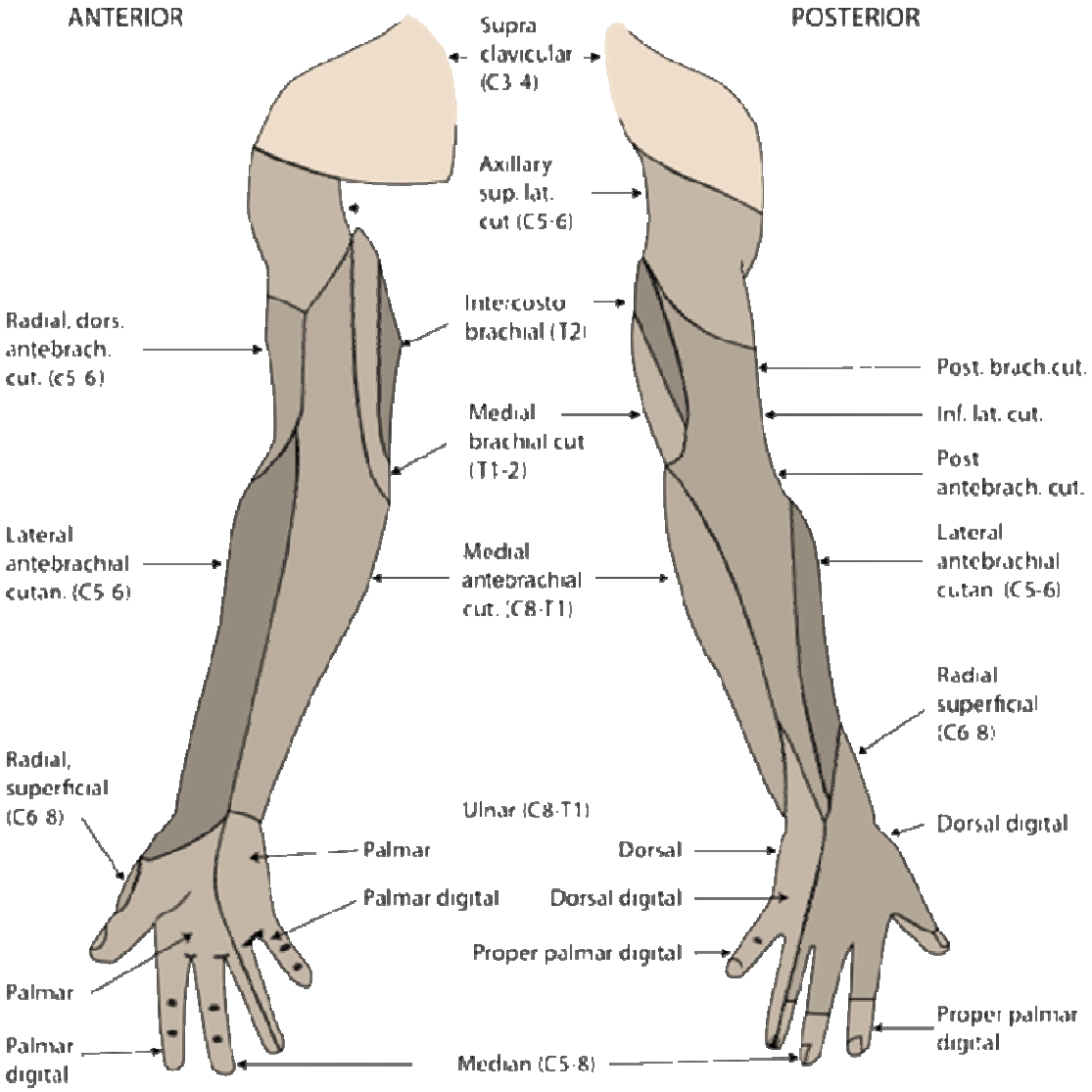
- Horner's syndrome (i.e. miosis, ptosis, anhidrosis) - suggesting injury to stellate ganglion;
- strong association between children with Horner's syndrome and intrinsic hand weakness;
- clavicular and humeral fractures;
- torticollis.
- cephalohaematoma;
- facial nerve palsy;
- diaphragmatic paralysis.

Muscles and Segmental Information

Shoulder	Abduction	Supraspinatus	C4,5,6
		Deltoid	C5,6
		Biceps – longhead	C5,6
	Lateral Rotation	Infraspinatus	C(4),5,6
		Teres Minor	C5,6
		Deltoid – posterior fibres	C5,6
	Flexion	Deltoid - anterior fibres	C5,6
		Biceps	C5,6
		Pectoralis Major – upper fibres	C5,6,7
	Medial Rotation	Deltoid anterior fibres	C5,6
		Pectoralis Major – upper fibres	C5,6,7
		Subscapularis	C5,6,7
		Teres Major	C5,6,7
		Latissimus Dorsi	C6,7,8
	Extension	Deltoid – posterior fibres	C5,6
		Teres Major	C5,6,7
		Latissimus Dorsi	C6,7,8
		Triceps – long head	C(6),7,8,T1
	Adduction	Biceps – short head	C5,6
		Pectoralis Major – upper fibres	C5,6,7
		Teres Major	C5,6,7
		Coracobrachialis	C6,7
		Latissimus Dorsi	C6,7,8
		Pectoralis Major – lower fibres	C(6),7,8,T1
		Triceps – long head	C(6),7,8,T1
Elbow	Flexion	Biceps	C5,6
		Brachialis	C5,6
		Brachioradialis	C5,6
		Extensor Carpi Radialis Longus	C5,6,7,8
		Pronator Teres	C6,7
		Flexor Carpi Radialis	C6,7,8
		Palmaris Longus	C(6) 7,8,T1
		Flexor Carpi Ulnaris	C(6) 7,8,T1
	Extension	Triceps	C6,7,8,T1
		Anconeus	C7,8
Forearm	Supination	Biceps	C5,6
		Brachialis	C5,6
		Supinator	C5,6,7
	Pronation	Brachioradialis	C5,6
		Pronator Teres	C6,7
		Flexor Carpi Radialis	C6,7,8

Wrist, Fingers & Thumb	Extension	Extensor Carpi Radialis Longus	C6,7
		Extensor Carpi Radialis Brevis	C5,6,7,8
		Extensor Digitorum	C6,7,8
		Extensor Pollicis Longus	C6,7,8
	Flexion	Flexor Carpi Radialis	C6,7,8
		Abductor Pollicis Longus	C6,7,8
		Palmaris Longus	C6,7,8
		Flexor Pollicis Longus	C6,7,8
		Flexor Carpi Ulnaris	C7,8,T1
		Flexor Digitorum Superficialis	C7,8,T1
		Flexor Digitorum Profundus	C7,8,T2
	Abduction	Extensor Carpi Radialis Longus	C7,8,T1
		Extensor Carpi Radialis Brevis	C6,7,8
		Flexor Carpi Radialis	C6,7,8
		Extensor Digitorum	C6,7,8
		Abductor Pollicis Longus	C6,7,8
		Extensor Pollicis Brevis	C6,7,8
		Extensor Pollicis Longus	C6,7,8
	Adduction	Extensor Carpi Ulnaris	C6,7,8
		Flexor Carpi Ulnaris	C7,8,T1

Upper Limb Dermatomes



Referral Pathway

WITHIN FIRST 24 HOURS FOLLOWING BIRTH ASSESS:

Does the baby move both arms equally?
Observe spontaneous movements in supine and side-lying;
Compare left and right sides;
Assess for Horner's sign.

If abnormalities observed …..

BEFORE DISCHARGE FROM HOSPITAL:

X-ray of humerus or clavicle – if fractured, arrange pain relief and orthopaedic follow-up;
Check for phrenic nerve palsy;
Physiotherapy referral for initial advice re. handling and positioning;
Refer to paediatric physiotherapy.

WITHIN 1 WEEK OF RECEIVING REFERRAL:

Complete baseline assessment using Toronto scoring;
Check passive range of movement;
Check parent handling and teach stretches;
Provide information on Erbs Palsy Group;
Arrange follow-up at 8 weeks or sooner

BY 8 WEEK REVIEW:

Refer for specialist opinion if Toronto score <3.5

FULL RECOVERY

Discharge if full recovery achieved;

INCOMPLETE RECOVERY

Continue to monitor active and passive range of movement;
Monitor and advise on child's development
Refer to Occupational Therapy &
Community Paediatrician if appropriate;
Advice into school if required;
Direct intervention if surgery planned.

Goals should focus on minimizing bony deformities and joint contracture, while optimising functional outcomes.

Assessment of Active Movement

Physical examination and other investigations, e.g. EMG, are necessary to determine prognosis and the need for operative intervention. It is therefore important to establish a reliable means of classifying upper extremity function in children with brachial plexus nerve palsy to assist in clinical decisions regarding the need for surgical intervention (Bae et al, 2003; Bialocerkowski and Galae, 2006).

Toronto Test Score

The Toronto Test Score quantifies upper-extremity function and can be **used to predict recovery** in infants with brachial plexus birth palsy.

It is designed to predict outcome, and to differentiate between good and poor recovery groups. If the score is less than 3.5 at 3 months of age, poor recovery is expected. Referral to a tertiary centre is therefore required. This group of children may require early surgical intervention.

If the score is greater than 3.5, reasonable recovery is likely.

Michelow et al (1994) presented this grading system for active joint movements against gravity. The measurements of movements are translated into a 7-point grading system. Active movements are observed of the elbow (flexion/extension), wrist (extension), fingers (extension), and thumb (extension). Each of these five movements are then graded on a scale of 0 (no motion) to 2 (normal full motion), and the sum of the values determines the aggregate, or total, Toronto Test Score (maximum 10 points).

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	Muscle Grade	Numerical Score
Gravity Eliminated		
No Contraction	0	0
Contraction, no motion	1	0.3
Motion < ½ range	2	0.3
Motion > ½ range	3	0.6
Full motion	4	0.6
Against Gravity		
Motion < ½ range	5	0.6
Motion > ½ range	6	1.3
Full motion	7	2

Active Movement Scale (AMS)

The Active Movement Scale (AMS) documents upper extremity function **during treatment and/or recovery** (Bialocerkowski and Galae, 2006).

Clarke and Curtis developed this system to produce the AMS (Curtis, 2002), in which movements against gravity and movements independent of gravity are included.

With this scale, each of fifteen different active upper extremity movements are tested, first with gravity eliminated and then against gravity. Each movement is scored on a scale of 0 to 7. The AMS is very comprehensive and tests muscle groups controlled by the entire brachial plexus.

Scores are given for each of the following joint movements: shoulder flexion, shoulder abduction, shoulder adduction, shoulder internal rotation, shoulder external rotation, elbow flexion, elbow extension, forearm pronation, forearm supination, wrist flexion, wrist extension, finger flexion, finger extension, thumb flexion, and thumb extension.

Ensure the movement is gleno-humeral, not shoulder girdle, when assessing shoulder movement and strength

Hospital for Sick Children Active Movement Scale	Score
Gravity Eliminated	
No contraction	0
Contraction, no motion	1
<50% range of motion	2
>50% range of motion	3
Full motion	4
Against Gravity	
<50% range of motion	5
>50% range of motion	6
Full motion	7

The Medical Research Council (MRC) scale for muscle strength

This can also be used to grade muscle strength and is based on the child's effort on a scale of 0-5.

Grade 0 - no action discernible in the muscle at all

Grade 1 - a twitch as the muscle undergoes a small contraction but is not strong enough to perform any of its specified joint movement.

Grade 2 - a muscle strong enough to perform its designated joint movement when the force of gravity is eliminated, making it much easier to perform.

Grade 3 - a muscle strong enough to perform the joint action to the full range against gravity but with no resistance applied.

Grade 4/5 - a muscle can move the joint through the full movement both against gravity and against some resistance.

See Appendices 1 and 2 for assessment charts

Initial Physiotherapy Advice

Positioning and handling

Parents should be advised to:

- touch and gently move their baby's arm;
- not pull on the affected arm, nor lift under the armpits when lifting their baby; and to ensure that the arm is well supported with the shoulder, elbow, wrist and hand in a neutral position – wrapping the baby in a blanket when moving may make handling easier in the early weeks;
- keep their baby's arm close to its side, or in a forward position when holding or feeding;
- support their baby's arm with a rolled up towel to keep that arm in a neutral position when the baby is lying on its back;
- start with their baby's affected arm first when dressing, and when undressing to start with the unaffected arm;
- hold their baby's affected arm close to the body and to carefully dry under the arm, and in the soft tissue folds when bathing the baby.

Sensory stimulation

Sensory stimulation is important for enhancing motor performance, as well as for minimizing neglect of the affected limb.

Parents should be advised to:

- move and handle both upper limbs equally;
- hold their baby's hand and gently massage the arm;
- place their baby's hand on breast or bottle during feeding;
- bring their baby's hands together, and to their face, drawing visual attention to the affected limb;
- encourage weight bearing through their baby's affected arm as this provides proprioceptive input and can also contribute to skeletal growth, when the baby has developed sufficient head control.

Range of motion exercises

Range of motion exercises are important for:

- maintaining muscle and soft tissue length;
- maintaining joint range of movement;
- aiding the development of joint congruity.

There is currently no consensus as to when these should start. As the healing process for a nerve injury is at a cellular level, it is recommended **not** to start shoulder movements until 48 hours, with a preference for 5 days. For a baby who has sustained a fracture these may be delayed for up to 3 weeks.

The most common contractures and deformities are:

- presence of a clavicular fracture is associated with osseous deformity;
- restriction of shoulder external rotation, due to contracture of subscapularis and the anterior shoulder capsule - in extreme cases this can lead to posterior subluxation of the shoulder;
- restriction of scapulo-humeral angle due to contracture of latissimus dorsi and teres major;
- loss of full elbow extension, exacerbated by dislocation of the radial head through forced supination;
- loss of full supination;
- loss of pronation;
- loss of full extension of wrist and fingers;
- loss of thumb abduction and opposition.

Early Management Guidelines for Parents

Physiotherapy should start soon after your baby has been diagnosed with having an Obstetric Brachial Plexus Palsy (OBPP), sometimes this is also known as Erb's Palsy. Physiotherapy cannot make the nerves grow faster, but aims to reduce problems of stiffness occurring, because your baby cannot move their arm by themselves. You will be instructed in range of motion exercises, which will help to keep muscles and joints flexible and ready to move, if and when nerve and muscle function improves.

The aims of physiotherapy are:

- to prevent stiffness developing in the joints of the affected arm;
- to encourage your baby to move their arm;
- for you to be aware of any reduced sensation your baby may have, and how to increase their awareness of their arm;
- to ensure your baby reaches their developmental milestones at the right time.

A physiotherapy programme may include:

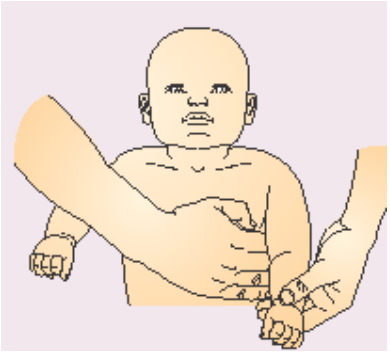
- how to move your baby's arm to stop it from becoming stiff;
- how to move and handle your baby when caring for them;
- positions to use for sleep and for play;
- advice on activities to help with their development.

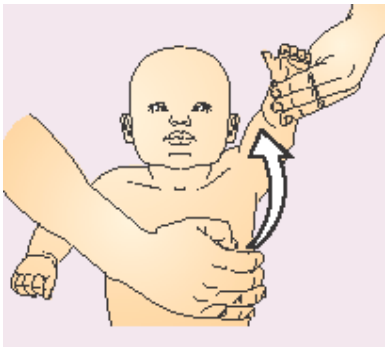
Your baby will have regular assessments which monitor how the nerve and the muscles are recovering. Occasionally, it may be appropriate to refer your baby to a specialist centre if required; this should be done in the first 2-3 months.

Range of Motion Exercises for Infants with Obstetric Brachial Plexus Palsy

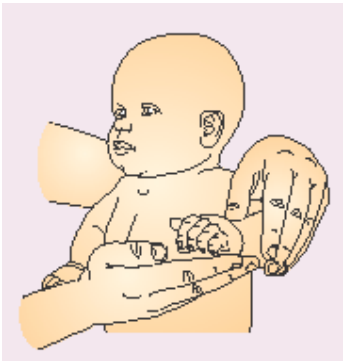
Range of motion exercises are movements done with your baby's arm to ensure that the joints maintain full movement. They should be performed slowly and held at the end of range for at least 10 seconds. The exercises should be done at least **3 times a day** with each exercise being repeated three times unless otherwise directed by your therapist. There will be many more opportunities to do these stretching exercises such as during baths and times when your baby is being nursed, held or changed.

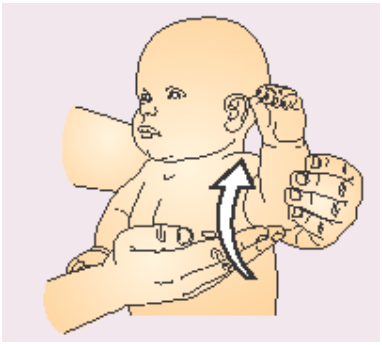
Shoulder Exercises



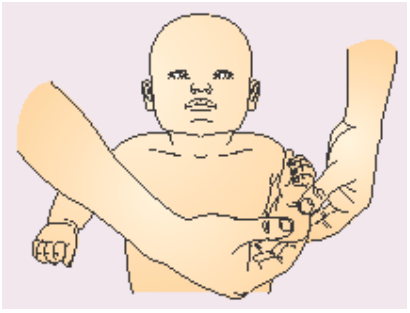


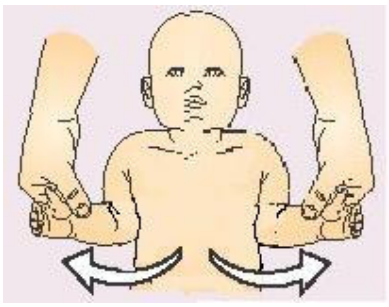
A Gently grasp your baby's forearm and hold their shoulder blade down firmly with the palm of your hand. Then raise their arm slowly up over their head keeping the arm close to the ear and hold.





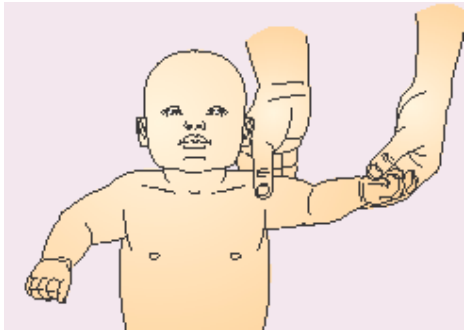
B This exercise resembles a 'high five'. Raise your baby's shoulder out half way and bend the elbow to 90°. Maintaining this position, rotate the baby's arm back so that the arm touches the bed and hold.

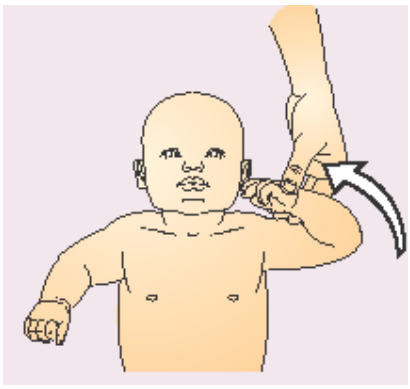




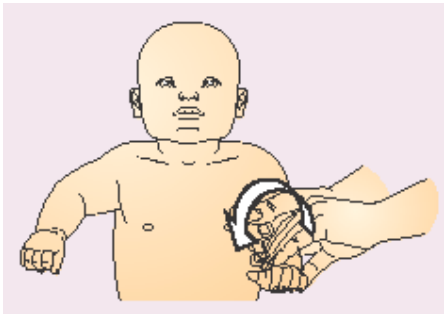
C Bend both your baby's elbows to 90° and keep elbows tucked into the side of your baby's body. Turn the forearms out to the side and down towards the surface and hold. **This is probably the most important exercise.**

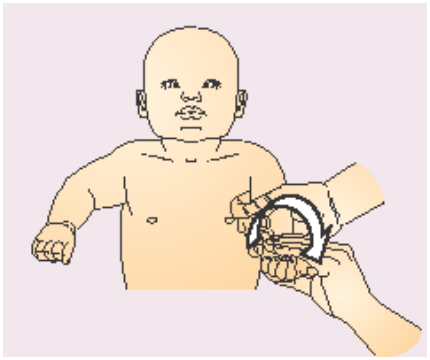
Elbow Exercises





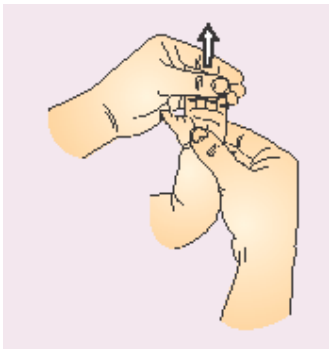
A Keep your baby's palm turned up, hold above and below the elbow, gently but firmly straighten your baby's elbow and hold. Then bend your baby's elbow and hold.

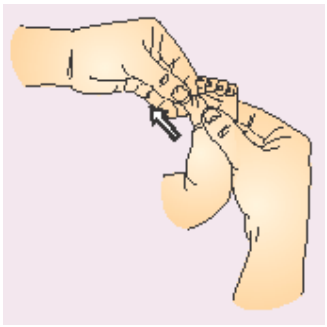




B Keep your baby's elbow bent at 90° with their upper arm against the body. Start with your baby's palm turned down, then turn your baby's forearm up until the palm is facing upwards and hold. Then, turn your baby's forearm until the palm is facing down and hold.

Wrist and Finger Exercises

A 

B 

A Hold your baby's wrist in one hand and their hand in your other hand. Gently bend their wrist backwards and hold, then straighten their fingers and hold.

B Use the same wrist position as above and straighten their thumb and hold.

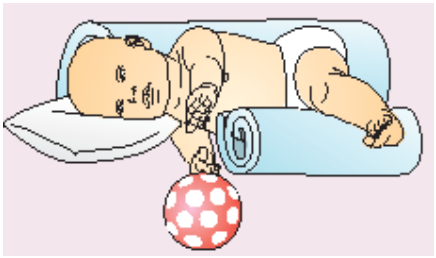
Positioning and Handling

- If your baby's arm is very floppy it should be well supported with the hand, elbow and shoulder in the neutral position. Often a towel under the affected arm during sleep helps to keep the arm in the neutral position.
- Move your baby's arm gently for washing, dressing and skin care. It is helpful to dress the affected arm first and undress it last. When washing and drying, particular care should be taken with skin folds.
- When handling, feeding and cuddling your baby, the affected arm should be well supported.

Activity Exercises

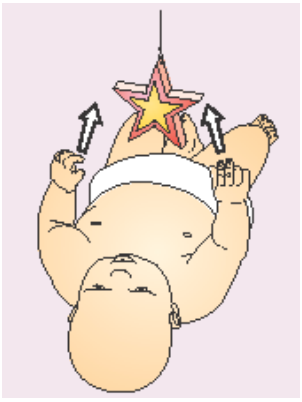
Side lying

Place your baby on their side with their affected arm highest. Place a large rolled up towel snugly at the child's back and another at their front. Put toys in front of them to encourage activity of the uppermost affected arm. This position makes reaching easier because your baby does not have to lift their arm against gravity.



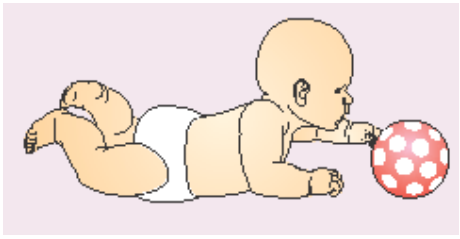
Lying on their back

Place your baby on the floor and then suspend or hold a toy above them. Encourage them to reach upwards particularly with the affected arm. Your baby must be able to reach the toy and you may need to gently hold back the unaffected arm at times. This encourages reaching skills.



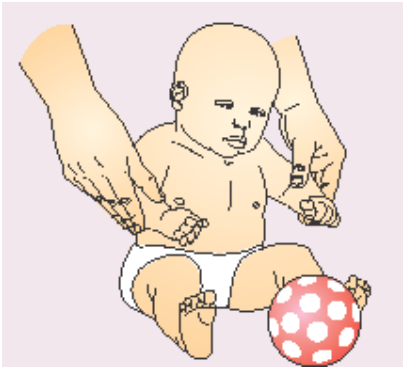
Lying on their tummy

Place your baby on the floor on their tummy with their arms forward. Encourage them to lean on the affected arm and reach for a toy with the opposite arm. Then reverse the exercise so they are reaching for the toy with their affected arm. This allows practise of both supporting and reaching with the affected arm. If your baby's arm is very floppy a small towel/roll may be used under their chest to help support their weight.



Sitting

When sitting for short periods in an inclined position, e.g. a car seat, if your baby's arm falls backwards you will need to support the arm with a small blanket or towel. In sitting place your hands on your baby's arm or elbows and assist them in a two handed activity such as reaching for a toy or clapping. This encourages co-ordination between the unaffected and the affected arms.



As sitting improves and your baby starts to sit without support, it is important to encourage them to support themselves using their arms as much as possible. It is likely that they will find this difficult and you may need to help them do this.

Activities

In the above positions you can encourage:

- exploring and grasping textured baby toys;
- your baby to explore their own hair, face, body, legs and feet, assisting their arm movements if they are unable to do it themselves;
- reaching out to 'bat' toys, helping your baby reach out as necessary;
- your baby to put two hands together, this can be on the breast or on the bottle when feeding;
- holding small rattles and toys, initially you will need to place these in your baby's hands.

Sensation

To increase your baby's body awareness you can:

- rub a variety of textures against your baby's skin, e.g. velvet for soft sensations, a bath towel for rough ones;
- gentle stroke and massage;
- gently rest your baby's hand on your breast/bottle during feeding;
- bringing your babies hand to their mouth;

This may not be tolerated by some children because of increased sensitivity, but in others it will increase the awareness of the affected arm.

Early Management Guidelines for Physiotherapists

Key Points:

- explain diagnosis, role of physiotherapy and reason for referral;
- discuss possible prognostic outcomes and management plan;
- baseline x-ray completed to assess for fracture of clavicle and humerus, and diaphragmatic paralysis;
- initial assessment, using standardised scoring system, e.g. Toronto score, Active Movement Scale (AMS);
- initial advice regarding handling, positioning and passive movements;
- provide ongoing assessment regular monitoring of joint range of movement, muscle length, functional ability and sensation.

Consider referral to a tertiary centre at 8 weeks if:

- Toronto score <3.5;
- shoulder abduction / flexion are less than grade 4 AMS;
- recovery is slow, or beginning to plateau.

Aims of Physiotherapy:

- to maintain full and equal passive range of movement in all joints and full soft tissue length in the upper limb;
- to encourage active movements and improve strength and endurance against gravity;
- to be aware of any sensory deficit and advise appropriately;
- to introduce developmental activities at an age appropriate time;
- to advise and educate parents on appropriate management.

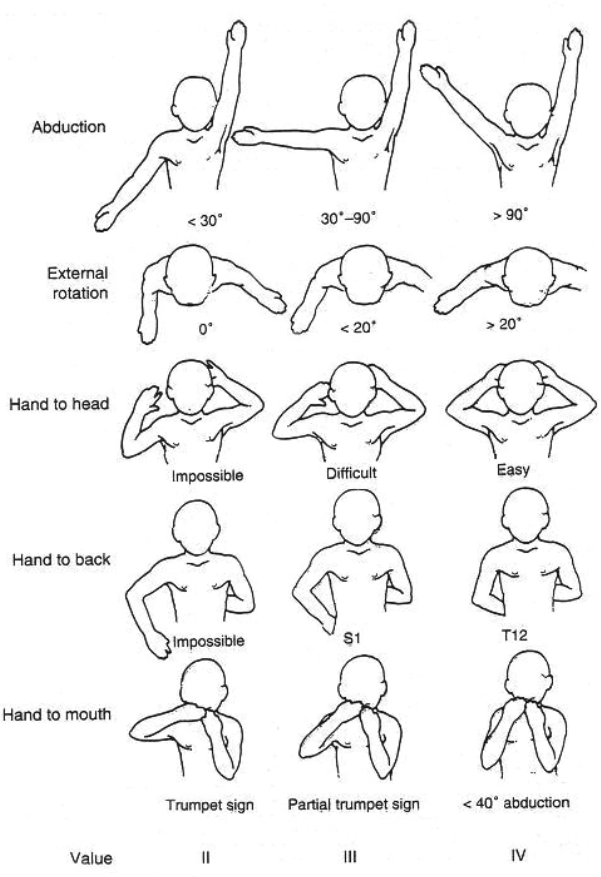
Important Clinical Notes:

- children who have sustained a humeral fracture demonstrate pseudoparalysis secondary to pain;
- the prevalence of shoulder contracture and osseous deformity is high, and can be present even in those with complete neurological recovery. The incidence increases if recovery is delayed or incomplete;
- once a shoulder contracture develops, it can be difficult to manage conservatively;
- an important prognostic sign is the time interval to biceps and deltoid muscle recovery;
- complete recovery is unlikely if no improvement is noted in the first 2 weeks;
- muscle atrophy from a neurotmesis begins 3-6 months after injury and by 1½ - 2 years is irreversible;
- reduction in shoulder abduction is related to weakness of deltoid and reduced external rotation;
- compensatory and substitute movements should be avoided, as they may perpetuate weak muscles and deformity.

Other Grading Systems

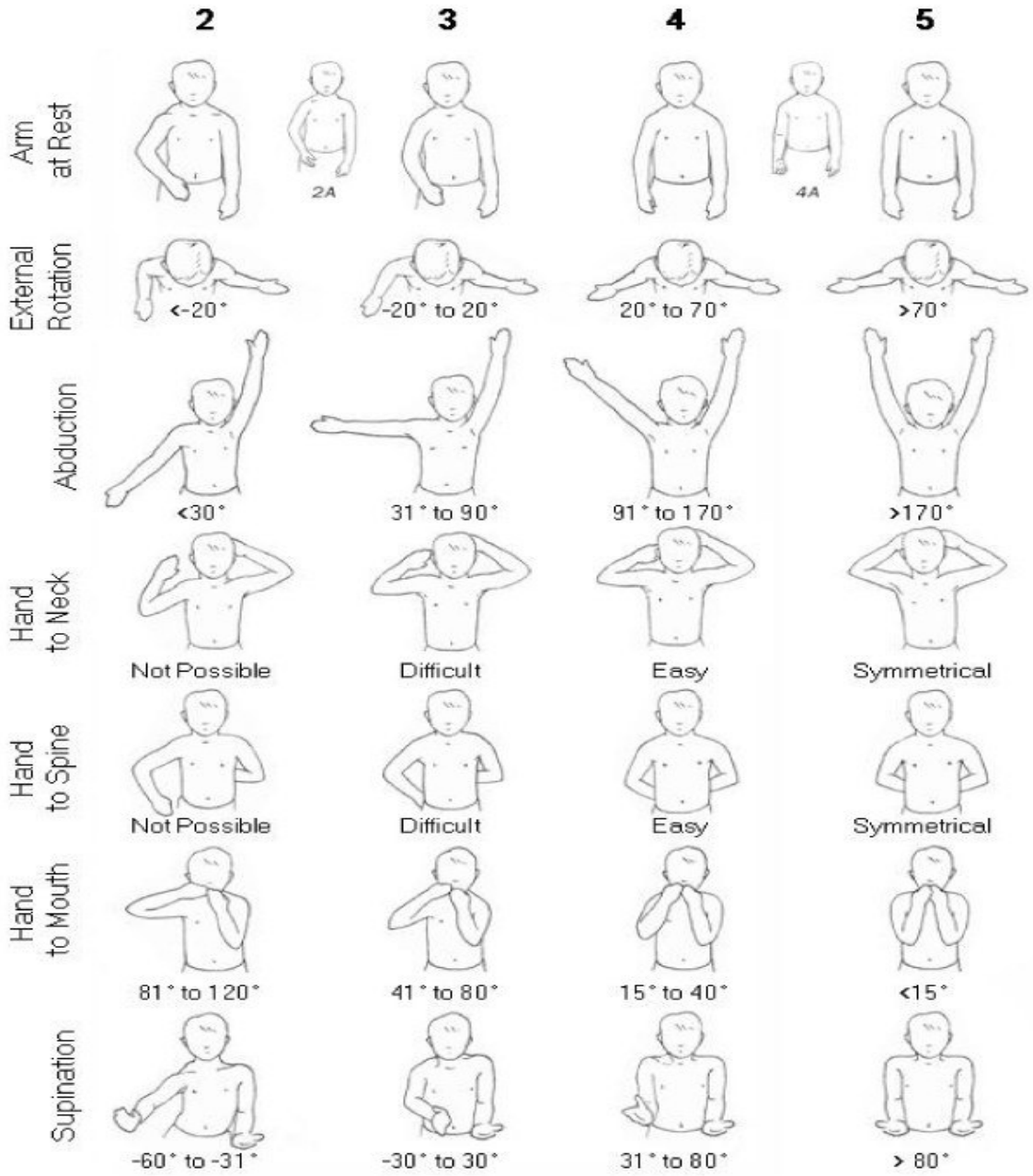
Mallet Classification

The modified Mallet Classification has been widely used to classify shoulder function, in infants and children with obstetric brachial plexus palsy. With this classification, patients are asked to actively perform five different shoulder movements: abduction, external rotation, placing the hand behind the neck, placing the hand as high as possible on the spine, and placing the hand to the mouth. Each shoulder movement is subsequently graded on a scale of I (no movement) to V (normal motion that is equal with that on the contra-lateral, unaffected side). Grades II, III, IV are depicted for each category. It is practical only with children of 3-4 years of age and above who can perform voluntary movements reliably on command (Clarke and Curtis, 1995).



Modified Mallet Scale Evaluation of Function and Arm Appearance

In addition to assessing the shoulder functions of the classical Modified Mallet System, supination and the resting position can be evaluated. In the resting position, medial rotation at the shoulder is scored on a scale of 1 to 5. Fixed forearm supination and lateral rotation are noted in the resting position. A total Mallet score is calculated from the scores of abduction, hand to neck, hand to spine, hand to mouth, and lateral rotation, giving a maximum score of 25 (Nath et al, 2009).



Assisting Hand Assessment (AHA)

The purpose of the AHA is to measure and describe how effectively children who have a unilateral disability use their affected hand (assisting hand) in bi-manual activity performance. The AHA is a standardized criterion-referenced test intended for children between the ages of 18 months and 12 years with a brachial plexus palsy or cerebral palsy (CP) hemiplegia (Krumlinde-Sundholm et al, 2007).

Narakas

Narakas classified OBBP lesions initially into five groups and then into four, based on the examination 2-3 weeks after birth:

- Group I - C5-6: paralysis of shoulder and biceps;
- Group II - C5-7: paralysis of shoulder biceps and forearm extensors;
- Group III - C5-T1: complete paralysis of the limb;
- Group IV - C5-T1: as above (group III) with Horner's syndrome.

Gilbert- Raimondi Score for Elbow Function

This is a scale of evaluation of elbow active movements (Haerle and Gilbert, 2004).

Movement assessed	Evaluation	Points
Flexion	No contraction or inefficient	0
	Partial flexion	2
	Complete flexion	3
Extension	No	0
	Weak	1
	Good	2
Lack of extension	0–30°	0
	30–50°	–1
	>50°	–2

Gilbert-Raimondi Hand Score

This is a score of hand and wrist active movement (Haerle and Gilbert, 2004).

Grade (Function)	Criteria
0 (none)	Complete paralysis or slight finger flexion of no use, useless thumb—no pinch, some or no sensation.
1 (poor)	Limited active flexion of fingers; no extension of wrist or fingers; possibility of thumb lateral pinch.
2 (fair)	Active extension of wrist with passive flexion of fingers (tenodesis)—passive lateral pinch of thumb (pronation).
3 (satisfactory)	Active complete flexion of wrists and fingers—mobile thumb with partial abduction—opposition intrinsic balance—no active supination; good possibilities for palliative surgery.
4 (good)	Active complete flexion of wrist and fingers; active wrist extension—weak or absent finger extensor; good thumb opposition with active ulnar intrinsics; partial prosupination.
5 (excellent)	Hand IV with finger extension and almost complete prosupination.

General Information That is Useful When Working In Schools

Many school age children with residual OBPP do not seem to receive ongoing physiotherapy on completion of early intervention. However, as they grow their condition changes in terms of muscle tightness, bony configuration and the functional goals they need or wish to achieve. Transition times to nursery or between infant, junior and secondary school often present as times when management advice would be useful both to the youngsters themselves and those working with them.

From work previously completed by APCP the consensus of opinion gathered from paediatric physiotherapists suggested that all children with residual OBPP should be monitored on a yearly basis with active intervention as appropriate following the development of any muscle tightness or secondary surgical intervention. However, given the current financial restraints in service delivery although this is desirable it is possible that it may not be achievable in all areas.

Referral to physiotherapy for school-aged children, if it is not a direct transfer from pre-school services, might be sought from several sources:

- parents may contact the Erbs Palsy group for re-referral advice;
- schools may be able to refer directly via school health or specialist teaching services;
- GPs and consultants may refer at any time;
- direct referral may be made following secondary surgical intervention;
- self referral.

For older children the frequency of physiotherapy is likely to be relatively low. However, as any child with even a minimal residual OBPP grows there are often situations where functional and cosmetic concerns arise as they become older and need to achieve more.

These may present in one or any combination of the following:

- progressive loss of range of movement – typically, glenohumeral, external rotation, elbow extension, supination and pronation;
- insufficient recovery of muscle strength – commonly elbow flexion and wrist extension;
- malformation of some articular surfaces due to muscle imbalance – most commonly the shoulder joint complex;
- decreased growth both in terms of the length and girth of the affected limb;
- pseudo-winging of the scapula;
- the affected arm pulling spontaneously into abduction at the shoulder when the elbow is flexed;

- possible shoulder dislocation – usually posterior, due to muscle tightness (Dunkerton, 1989);
- occasional ulna head dislocation;
- loss of spontaneity of movement of the affected arm when trying to balance or later when running.

School Services

If a child starts school with residual problems from their OBPP these may have varying implications for:

- classroom management;
- access to PE and sport;
- leisure activities;
- confidence;
- self-esteem;
- the need for secondary surgical intervention in the future.

Each child will present individually and will need different coping strategies to manage their difficulties and achieve their maximum potential. It is important that school staff (with parental consent) are made aware of the child's difficulties to allow them to support the child adequately.

Information should include:

- background information regarding OBPP;
- information regarding the child's specific difficulties;
- strategies to allow the child to participate and integrate fully into the curriculum.

Depending on individual service structures this may be in collaboration with colleagues in Occupational Therapy.

It is unusual for children/young people with OBPP to have a statement of special educational need. However if they do have a statement, the physiotherapist should submit written advice as suggested in the APCP publication 'Guidance for Physiotherapists: Giving Advice for Children and Young People with Special Educational Needs'.

It is obviously essential to identify those children/young people new to the UK who have previously not been within our models of healthcare. They could appear at any age and with variable levels of difficulties.

In the early school years general muscle strengthening should take place as part of daily activities and regular structured PE sessions. It is essential that children continue with appropriate stretching exercises throughout the entire period of their growth. These stretches will need to have been taught, reviewed and up-dated by a paediatric physiotherapist.

Many children with a residual OBPP and their parents will have been given advice in this area as part of their early intervention, especially if primary surgical intervention has been necessary.

How can you help a Young Person in your School who has an Obstetric Brachial Plexus Palsy?

Included below is advice that may be useful in the classroom as these young people are desperate to succeed in all tasks given to them. In addition young people with obstetric brachial plexus palsy (OBPP) may have poor balance and co-ordination difficulties as a result of their poor arm function, postural asymmetry and some possible sensory involvement, which will need addressing. Although all strategies do not suit everyone with OBPP, they may benefit by adopting some or all of the following:

- being allowed the choice of which hand they use as dominant for function. This may not necessarily be the hand of natural dominance. Whichever hand they choose will bring its own particular difficulties. These could have implications of perceptual nature (if the chosen hand would not have been that of natural dominance) and on the position they may choose to sit in, in the classroom;

- a flexible use of coping strategies they have developed to complete a task. This may not necessarily be the way their peers would complete the same task and may take longer to complete the task to their satisfaction;

- the opportunity to try several strategies before finding the best approach for them to complete activities effectively, efficiently and safely;

- extra time to complete tasks;

- task differentiation as appropriate, e.g. a young person may not be able to reach the top of a large piece of paper on the table top for art or DT but would be able to if it were placed on an easel, or possibly even placed the other way round;

- correct positioning at the table or desk with a chair of the right height to give maximum working space. Often a young person needs their affected arm to be on the outside rather than up against that of their neighbour especially if desks and tables are paired, allowing more effective function. A working space to themselves may be beneficial if the work in progress is larger than average or needs spreading out;

- young people may need extra time for going to the toilet, especially if their hand function means that managing clothes and fastenings is awkward. Ideally this need should not be left as a matter of urgency. They may also need extra time and possibly privacy for changing for PE;

- these young people are not wilfully untidy with their work presentation, but allowances need to be made in this area. The use of a computer may help to address such difficulties and deal with the need to increase the speed of recording and the need to produce work presentation which is pleasing to the eye. However, they need lots of practice before this is transferred to a pressured situation such as work to be presented to others or an exam;

- build a young person's confidence by allocating them with useful and appropriate jobs around school that are praiseworthy but do not single them out.

- bluetac and dycem (non-slip material) may be helpful to secure books and papers. Pencil grips, specialised rulers and spring loaded scissors may also be useful;

- sloping boards may also help if handwriting difficulties persist and computer use is not appropriate. They are sometimes helpful in other situations such as art or technology where it is necessary to use fine hand function;

- carrying heavy kit around may be a problem; a strategically placed locker at an accessible level may help;

- travelling to and from school with lots of kit may also be difficult. A duplicate set of text books for school and homework use may solve many of these difficulties;

- if it is not possible to use a backpack to transport kit to, from and around school then a wheeled case or trolley may be an option;

- activities involving the use of hot or sharp objects and machinery may require physical help with either a reliable and sensitive buddy system or possibly an adult.

PE Guidelines for Young People with Obstetric Brachial Plexus Palsy:

- always encourage these young people to join in with PE and outside activities even if task differentiation is necessary. This will ensure the natural development of all motor skills with maturity;

- the safety of the young person and their peers must be a priority;

- introduce new skills requiring upper limb use gradually and with sensitivity and differentiation as necessary;

- these young people often know their own capabilities and should be encouraged to actively lead the way towards what they can achieve;

- two handed activities should always be encouraged;

- activities needing a strong grip should be closely supervised (especially if the OBPP is bilateral);

- hanging and climbing activities require strong arms for pulling. Take care if a young person chooses to do this, there is an outside chance that the affected shoulder may dislocate;

- throwing and catching activities may need to be modified if there is weakness, absence of movement or deformity (changing the size, weight or texture of the ball can help);

- some equipment may need modification due to weakness of grip, e.g. bat, racquet and hockey stick handles may need to have extra thick grips applied, wrapping round the commercially available towelling grips in extra layers can often achieve an efficient handle which has not been modified in any obvious way;

- swimming is an excellent sport although some strokes need to be modified;

- if young people rotate through a selection of sports activities during a school year, it may be necessary to allow them to partake in the set activities more than once and opt out of those that they cannot achieve;

- substitute sports such as table tennis and horse riding may be worth considering if it is not possible for participation in the sport set for any part of the curriculum;

- be aware that a young person may not be able to save themselves effectively. Use crash mats when working above floor level to ensure safety;

- if a young person does fall allow them to get up by themselves and in their own time. If this is not possible advice should be sought from a first aider, or in special circumstances the relevant set policy should be followed if there are known complicating factors;

- these young people may need extra time for dressing and undressing and possible help with activities such as tying shoe laces, although Velcro or self-tying shoe laces may often be a useful option to encourage independence;

- Disability Sport Events - **www.disabilitysport.org.uk** - is an organisation which provides competitive sport for young people with a disability who may wish to follow this route but are unable to achieve at the level of their more physically able peers.

In conclusion children/young people with OBBP should be encouraged to become responsible for the management of their own condition and participate in all the activities of their peer group in an age appropriate way. They should be in receipt of any advice or equipment that will allow them to reach their full potential with confidence and self assurance. If you are uncertain about any aspect of PE and games contact the physiotherapist who supervises the young person's management who will be happy to advise you.

Heading Towards Adolescence

Adolescence is never easy for either boys or girls and can normally cause a degree of angst. A young person with residual OBPP may experience a fairly traumatic time if their condition is not well managed. One or more of the following difficulties may present at this time:

- obvious truncal asymmetries;
- residual unsightly scarring;
- poor body image;
- peer pressure;
- preferring to use the muscles you have rather than continuing to manage those that are affected may cause difficulties towards the end of growth;
- everyday tasks become more complex and bilateral, leading to difficulties achieving reasonable functional levels;
- moving large amounts of kit around in a large busy secondary school environment.

Fashion can also be a problem. Not only is there the obvious school tie, which has to be just so to avoid trouble but you have to get the right school bag to carry that vast amount of bulky and often heavy kit just to be one of the crowd. These difficulties should be fairly easy to manage but what about the little off the shoulder number that everyone is wearing this year? Do you show your scars and cope with the looks or do you cover up but not be one of the group? Peer pressure can be a real problem and issues need to be handled sensitively.

It also needs to be remembered that scars can be easily burnt by the sun and if having a tan is a must, the use of complete sun block over the area is essential but leaves tan lines.

Young adolescents are often encouraged to go to the gym with their peers as this is considered a good way to achieve muscle strengthening without having an individual physiotherapy activity programme. This is useful to a point, but these individuals often just use the working groups of muscles they have to achieve tasks continuing to strengthen these, rather than the muscle groups that really need the work, leading to further muscle imbalance. It is especially important to avoid pectoral and upper trapezius muscle strengthening. Therefore if a young person chooses to attend a gym, this should be encouraged but it needs to be carefully monitored and liaison between the physiotherapist and the relevant personal trainers and gym staff is of considerable benefit. It is also essential for the young person themselves to have a good understanding about what they need to achieve.

Musculoskeletal Complications

There is a high incidence of musculoskeletal complications stemming from the initial nerve injury. Shoulder contracture and osseous deformities may be found, even in those with complete neurological recovery. When a clavicular fracture is present there is a significant risk of an osseous deformity developing at a later stage.

Medial rotation contractures at the shoulder will rapidly lead to changes in the shoulder joint, not necessarily related to the age of the child. Shoulder dysplasia may start in infancy and leads to dislocation of the shoulder at an earlier age than previously appreciated. In posterior dislocation the humeral head can be palpated posteriorly with a passive range of lateral rotation restricted to around 10°. In simple posterior dislocation the humeral head can be seen and palpated behind the glenoid. Fixed medial rotation contracture at the shoulder is noted and there is a loss of active supination beyond neutral.

Complex subluxation/dislocation may lead to the development of a false glenoid. Other bony changes include elongation and posterior inclination of the coracoid process (palpable) with elongation and downward hooking of the acromium process.

The presence of muscle imbalance and contractures leads to these typical bony changes affecting the shoulder, including the scapular hypoplasia, elevation and rotation (SHEAR) deformity. The SHEAR deformity commonly occurs in conjunction with medial rotation contracture (MRC) of the arm. OBPP also causes muscle imbalances at the level of the forearm. This may lead to osseous deformity of the radial head and thus lead to a fixed supination deformity (SD) in a small number of patients. Both MRC and SD will cause severe functional limitations without surgical intervention (Nath et al, 2009).

Clinical Implications

Therapists should be aware that the presence of a medial rotation contracture will limit the ability to actively supinate fully, even if this muscle has full power, due to the altered biomechanics.

Checking for shoulder stability:

- asymmetry of skin creases;
- blocks to external rotation;
- palpation of head of humerus posteriorly.

Plan

Request a shoulder x-ray in both a neutral and abducted position.

Surgical Procedures

Although most babies with OBPP will have a spontaneous recovery from their injury, the natural history of those that do not is influenced by contractures of uninvolved muscle groups and subluxation or dislocation of the shoulder. It is important for physiotherapists supervising those children who do not have a complete recovery to be aware of the surgical procedures available to manage resultant problems and enhance function.

Nerve Reconstruction

Referral to a specialist centre is essential if there is no recovery of biceps by 8 weeks of age / Toronto score <3.5. Assessment at this time will provide a more accurate diagnosis and advisability of nerve reconstruction surgery.

Surgical intervention for cases of avulsion are tailor-made and may involve neurotisations from the long thoracic, accessory, thoraco-dorsal or pectoral nerves; or from C5, or even C7, to the upper trunk. It is considered that it is better to concentrate on reconstruction of the upper nerve roots to gain useful shoulder and elbow movement.

With the advances in microsurgical repair; primary nerve repair; nerve grafting or nerve transfer to re-innervate paralysed muscles, improved outcomes have been demonstrated compared to conservative treatment in babies with avulsion or rupture of the brachial plexus (Dumont et al 2001; Grossman et al; 2003).

Post-operative care will be dependent on the surgeon's protocol but the child will be in a cowl dressing or cast for the first few weeks to avoid stretching of the reconstructed area. Physiotherapy after cast removal will encourage voluntary movement and gentle passive exercises. It is important to continue to counteract retraction and medial rotation contractures at the shoulder and flexion contracture at the elbow. Recovery is slow and may take more than 2 years in upper plexus lesions and more than 3 years in complete lesions.

Management of Late Deformity

It is generally agreed that physiotherapy should be started as soon as possible after the birth injury (minimum of 48 hours with a preference for 5 days) to try to prevent contractures developing and becoming established. Secondary problems are due to a combination of paralysis, cross innervations, muscle contracture and joint deformity, particularly noted at the shoulder as well as the elbow and forearm. Problems may also occur at the wrist and hand. Surgical procedures to correct deformity and improve function of the limb should be considered, when appropriate.

Shoulder Subluxation and Dislocation

Dysplasia of the shoulder starts in infancy and may lead to dislocation of the shoulder at an earlier age than previously appreciated (Van der Sluijs et al, 2001; Muokoko et al, 2004; Nath et al, 2007; Dahlin et al, 2007).

Surgery to relocate the shoulder will always be accompanied by release of subscapularis and any other tight structures that may be compromising shoulder stability. The arm will be held in an abducted and externally rotated position in a plaster spica including the chest and the affected arm for 4-6 weeks.

On removal of the cast physiotherapy will concentrate on mobilising the shoulder and encouraging external rotation and shoulder elevation as well as general functional and bimanual activities. Regular stretches to prevent reoccurrence of the medial rotation contracture must be carried out daily.

Subscapularis Release

Progressive contracture of subscapularis, particularly in upper plexus injuries, produces a rapid loss of external rotation at the shoulder and a fixed contracture within a few months, which may lead to deformation of the humeral head and subluxation/dislocation. Release through the axilla is carried out and can restore 70°- 80° of external rotation. The arm is held in a plaster cast, in external rotation, for 4-6 weeks. Early subscapularis release is usually successful and less likely to relapse.

Stretches to maintain the improved range of external rotation are essential as well as activities to strengthen the external and abductor muscles, whose weakness is more apparent following the release. Release of subscapularis has been shown to improve the range of external rotation and the strength of supination of the forearm (Savva et al, 2003).

Botulinum toxin injections into pectoralis major (and also latissimus dorsi) may be used as an adjunct to the surgical management of medial rotation contractures (Grossman et al, 2003; Price et al, 2007).

Tendon Transfers

Tendon transfers are sometimes used in combination to augment functional abilities but benefit may be unpredictable in severe cases.

Transfer of latissimus dorsi to the rotator cuff may give a pleasing improvement in abduction and external rotation. In cases where there is a flail shoulder it may be necessary to augment the latissimus dorsi tendon transfer with trapezius (and sometimes pectoralis major or levator scapulae). The limb will be immobilised in a plaster cast, the arm abducted and externally rotated for 4-6 weeks. Gentle stretches to maintain range of lateral rotation are essential, as well as progressive land and water based activities to encourage the child to move its arm upwards and outwards.

Osteotomy

External osteotomy of the humerus is advised in cases where there is deformity of the shoulder joint itself and lack of external rotation impinges on function. If indicated, changing the arc of rotation at the shoulder will improve the ability to use the arm for personal care such as getting the hand to the face or facilitating dressing. Humeral osteotomy is usually best carried out after the age of seven.

Glenoplasty of the shoulder joint can be used to remodel the shape of the glenohumeral joint (Sinisi, 2011; Mascio et al, 2011).

Elbow

Function at the elbow may be compromised by paralysis of flexion (rare) or extension or progressive bone and joint deformity.

Tendon transfers to improve elbow flexion:

- latissimus dorsi - if not needed for shoulder reconstruction;
- Steindler's flexorplasty – flexor carpi ulnaris release and transfer attached more proximally to the humerus.

If there is a fixed flexion deformity - if more than 40° an anterior release and lengthening of brachialis may be indicated. Lengthening of biceps may reduce elbow flexor power.

Forearm

A supination deformity at the forearm may lead to bony deformation and dislocation of the radial head. Surgical reduction is not advised but a distal rotation osteotomy will place the forearm in a better functional position.

Wrist and Hand

Tendon transfers around the wrist and to improve hand function are rarely indicated. Results may be disappointing.

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Appendix 1: Obstetric Brachial Plexus palsy – Passive Range Assessment Chart

Child's Name **D.O.B.** **Unit Number**

Date:							
Age:							
Shoulder lateral rotation							
Shoulder elevation with scapula fixed							
Horizontal flexion with scapula fixed							
Elbow flexion							
Elbow extension							
Pronation							
Supination							
Wrist and finger extension							

Name: **Signature:**

Designation:

Appendix 2: Obstetric Brachial Plexus Palsy – Active Movements Assessment Chart

Childs Name: **DOB:** **Unit Number:**

	Birth or first contact													
Date:														
Age:														
Movement Assessed	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**	**AMS**	**Toronto Score**
Elbow Flexion														
Elbow Ext														
Wrist Ext.														
Thumb Ext														
Finger Ext														
Total														
Shoulder Abd														
Shoulder Flex														
Shoulder Add														
Shoulder ER														
Shoulder IR														
Forearm Pronation														
Forearm Supination														
Wrist Flexion														
Finger Flexion														
Thumb flexion														

NB. Movements below total line are not included in Toronto calculation

Name: **Signature:** **Designation:**

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