

# Injury underlying obstetrical brachial plexus palsy (obpp)



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## Mechanism of Injury Underlying Obstetrical Brachial Plexus Palsy

### Introduction

Obstetrical Brachial Plexus Palsy (OBPP) is defined as a flaccid paresis of an upper extremity due to traumatic stretching of the brachial plexus occurring at birth, where the passive range of motion is greater than the active (Evans-Jones et al. 2003: F185–F189). Obstetrical brachial plexus palsy results from injury to the cervical roots C5-C8 and thoracic root T1 (Pollack et al. 2000: 236–246). The occurrence of Obstetrical brachial plexus injuries are reported in the medical literature at a rate of 0.38 to 2.6 per thousand live births (S. M. Shenaq et al. 2005).

To understand the mechanism of injury causing OBPP it is necessary to have a fundamental anatomical knowledge about brachial plexus. Five spinal nerve roots C5, C6, C7, C8 and T1 combine to form brachial plexus. These five nerve roots combine into 3 trunks above the clavicle, the upper trunk at the C5-C6 level, the middle at C7 and the lower trunk at C8-T1. The cords end in 5 main peripheral nerves: the musculocutaneous, radial, axillary, median and ulnar nerves. The entire shoulder and the arm is supplied by the brachial plexus that helps in upper extremity function (Laurent et al. 1993: 197–203).

There is a lot of controversy regarding the underlying mechanism of obstetrics brachial plexus injury that is a cause of recent litigious debate (Andersen et al. 2006: 93). OBPP is caused by excessive traction to the brachial plexus during delivery, as in majority of the cases upper shoulder gets blocked by the mother's pubic symphysis (shoulder dystocia). With the <https://assignbuster.com/injury-underlying-obstetrical-brachial-plexus-palsy-obpp/>

traction to the child's head, the angle between the neck and the shoulder is forcefully widened, overstretching the ipsilateral brachial plexus. The extent of injury can vary from neurapraxia or axonotmesis to neurotmesis and avulsion of rootlets from the spinal cord (Pondaag et al. 2004: 138-144). Some studies determine that in certain cases, brachial plexus injuries occur secondary to shoulder dystocia that is associated with high intrauterine forces, not traction injuries (S. M. Shenaq et al. 2005). Though the main theories have been that of compression (either direct or indirect caused by instruments, fingers or between the bony structures) or traction (Sever 1916: 541) some authors proposed that infection or ischaemia is the cause, whilst others proposed postural in vitro causes, this view was strengthened by the apparent coincidence of other congenital malformations (S. P. Kay 1998: 43-50). The biomechanics of the size of the maternal pelvic and the foetal shoulder size and their position during the delivery determine the extent of injury to the brachial plexus (Zafeiriou & Psychogiou 2008: 235-242). Also intrauterine factors, such as abnormal intrauterine pressures arising from uterine anomalies causes obstetrical brachial plexus palsy at the time of pregnancy (Gherman et al. 1999: 1303-1307). Some authors have (ACKER et al. 1988: 389-392) also discussed the possible reasons as to why relatively few OBPP happens during vaginal deliveries without shoulder dystocia; their analysis shifted the focus of OBPP's cause, away from those forces applied by the clinicians towards the endogenous maternal propulsive forces. Both maternal expulsive forces and uterine contractions together form the natural forces. obstetrical brachial plexus palsy may happen in case of caesarean section (Jennett et al. 1992: 1673-1677) or operative vaginal delivery

(Alexander et al. 2006: 885–890) also due to forceful traction and manipulation by the obstetrician.

The risk factors for brachial plexus palsies may be divided into four categories: neonatal (: Birth weight > 4000 gm, Macrosomia, Breech foetal position, Apgar score: (a) 1 min, (b) 5 min), maternal (Age, Body mass index, Gestational diabetes, Multiparity, Maternal pelvic anatomy), labor-related factors (Duration of second stage of labor, Labor management: (a) induction of labor; (b) oxytocin augment; (c) epidural analgesia, Shoulder dystocia , Mode of delivery: (a) vaginal; (b) vacuum or forceps) and Associated Injuries (Clavicular fracture) (Zafeiriou & Psychogiou 2008: 235–242).

Brachial plexus injury can be classified according to

- severity : avulsion, rupture, neuroma, and neurapraxia (S. M. Shenag et al. 1998: 527–536).
- anatomical location: upper, intermediate, lower, and total plexus palsy (Sandmire & DeMott 2000: 941–942).
- Upper plexus palsy involves C5, C6, and sometimes C7. Also called Erb's palsy, it is the most common type of brachial plexus injury (Gilbert & Abbott 1995). It presents with an adducted arm, which is internally rotated at the shoulder. The wrist is flexed, and the fingers are extended, resulting in the characteristic 'waiter's tip' posture.
- Intermediate plexus palsy, involving C7 and sometimes C8 and T1, has been proposed by a few researchers (Zafeiriou & Psychogiou 2008: 235–242).

- Lower plexus palsy involves C8 and T1. Also called Klumpke paralysis, it is very rare and accounts for <2% of all reported brachial plexus palsies (Laurent et al. 1993: 197–203). The main clinical feature is poor hand grasp, whereas more proximal muscles are intact (Andersen et al. 2006: 93).
- Total plexus palsy involves C5-C8 and sometimes T1 (J. K. Terzis et al. 1986: 773) and is the second most common type of injury (Laurent et al. 1993: 197–203). It is the most devastating plexus injury: the infant is left with a clawed hand and a flaccid and insensate arm. There is a strong positive correlation between assisted deliveries and total brachial plexus palsy, which indicates that a more severe injury has occurred to the plexus (Michelow et al. 1994: 675–680).

Narakas classified obstetrical brachial plexus lesions 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 limb.
- Group IV: C5-T1; as above with Homer's syndrome (S. P. Kay 1998: 43–50).

The majority of the patient (70%-95%) recovered completely within 3 to 4 months. Rest 5% patients were requiring conservative or surgical treatment according to extent and severity of injury. Physiotherapy and splinting are conservative treatment and nerve reconstruction, grafting, neurolysis, tendon transplantation procedures are in the surgical treatment.

Many classifications and scoring systems for assessing function and predicting outcomes for children with obstetric brachial plexus palsy have been proposed. The most common and clinically useful measures used are mentioned below.

#### *British Medical Research Council Scale*

A number of methods have been used to describe or quantify motor function in children with OBPP. The British Medical Research Council (M R C) system of manual muscle testing is the most recognized scale for the evaluation of strength for patients with peripheral nerve injuries. This test employs the use of limb segment positioning without and against gravity and the use of manual resistance to grade muscle strength on a 6-point scale (0 = no contraction, 5 = normal power). The MRC scale as a measure of strength for infants with OBPP has been reported by a number of authors. This scale falls within the body functions and structures domain of ICF (Ho et al. 2012).

#### *Gilbert and Tassin Scale*

Gilbert and Tassin have suggested a modified MRC scale for the evaluation of children with OBPP to account for the difficulties encountered in examining infants with manual resistance. The MO-M3 scale has been used as an outcome measure in some studies. This scale is limited in the ability to distinguish improvements in motor recovery however, as it has only one grade to classify partial movement. This scale falls within the body functions and structures domain of ICF (Ho et al. 2012).

#### Mallet Scale

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Mallet has described a method of evaluating children with OBPP based on the ability to perform functional positioning of the affected limb. 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 symmetric with that on the contralateral, unaffected side). Although utilized as an outcome measure by a number of authors, this system can only be used with a cooperative, older child. This scale is not suitable for use with infants. It has an excellent intra-observer reliability of kappa = 0.76 and an inter-observer reliability of kappa = 0.78 in this patients. This scale falls within the body functions and structures domain of ICF (Ho et al. 2012).

### *The Active Movement Scale*

The Active Movement Scale is an eight-grade ordinal scale that was developed by the candidate and the head of the Brachial Plexus Clinic at The Hospital for Sick Children (HSC) for the specific purpose of evaluating infants (newborn to one year of age) with obstetrical brachial plexus palsy. This tool is used to quantify upper extremity strength by observing spontaneous, active movement both without and against gravity. Each movement is scored on a scale of 0 to 7. The fifteen movements include shoulder flexion, shoulder abduction, shoulder adduction, shoulder internal rotation, shoulder external rotation, elbow flexion, elbow extension, forearm pronation, forearm supination, wrist flexion, wrist extension, digital flexion, digital extension, thumb flexion, and thumb extension. The use of this scale for clinical and <https://assignbuster.com/injury-underlying-obstetrical-brachial-plexus-palsy-obpp/>

scientific evaluation has been reported in a number of publications. It has an excellent intra-observer reliability of kappa = 0.85 and an inter-observer reliability of kappa = 0.66 in this patients. It has established good psychometric properties in this population. This scale falls within the body functions and structures domain of ICF(Ho et al. 2012).

#### Gilbert and Raimondi scale

Elbow flexion was graded by the system of Gilbert and Raimondi which ranges from 0 (paralysis) to 5 (complete active flexion and extension). Function of the hand was graded from 0 (paralysis) to 5 in which there is complete active flexion and extension of the wrist and fingers, strong intrinsic muscle function and active pronation and supination in excess of 90°, as described by Raimondi (Birch et al. 2005: 1089-1095). This scale falls within the body functions and structures domain of ICF(Ho et al. 2012).

#### Toronto Test Score:

Michelow et al. proposed the Toronto Test Score to quantify upper-extremity function and to predict recovery in infants with brachial plexus birth palsy<sup>9</sup>. With this scoring system, patients are prompted to actively flex the elbow and extend the elbow, wrist, fingers, and thumb. Each of these five movements is 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). The Toronto Test Score was designed to predict outcome in patients with brachial plexus birth palsy. It has an excellent intra-observer reliability of kappa = 0.73 and an inter-



observer reliability of kappa = 0.51 in these patients. This scale falls within the body functions and structures domain of ICF (Ho et al. 2012).

#### Literature Review:

Julia K. Terzis and Kokkalis (2008) conducted a retrospective study to see the effect of primary and secondary shoulder reconstruction in obstetric brachial plexus palsy. 96 children with OBPP were recruited in the study. 30 cases underwent primary reconstruction alone, 37 underwent both primary and secondary procedures, and 31 late cases underwent only palliative surgery. From this population, 23 cases were diagnosed with classic Erb's palsy, 22 cases with Erb's palsy and C7 involvement and 53 cases with global palsy (C5-T1). British Medical Research Council grading system and modified Mallet scale were used as outcome measures. The mean follow-up period was 6.7 years. Significant improvement was seen in the entire population according to modified Mallet scale and mean score improved from 8.8 points (range, 6-19 points) preoperatively to 20.9 points (range, 13-24 points) postoperatively ( $p < 0.001$ ). Patients with Erb's palsy achieved significantly better shoulder abduction and external rotation than those with Erb's + C7 palsy and global palsy ( $p < 0.001$ ). Early plexus reconstruction (< 3 months) offered the best functional results and reduced the need for secondary reconstructions.

They used large population. The inclusion criteria was not proper. They used long follow up period. There can be selection bias present.

Nehme et al. (2002) conducted a retrospective study to see the prediction of outcome in upper root injuries in OBPP. 30 children with unilateral upper  
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obstetrical brachial plexus injuries were recruited in this study. The age of this group was between 1 week and 2 months. The mean follow-up was 14 years. Each child was examined every month in the first year and every 3 months in the second year. Mallet scale was used to assess the functional recovery and classification of Tassin was used to assess the muscle power. Result showed that three patients had achieved a “ good recovery”, at 3 months and 12 patients had made a “ good recovery” at 9 months with conventional physical therapy. The best predictor of outcome was elbow flexion at 9 months with 13% error, and not 3 months with 36% error rate for brachial plexus reconstruction. A “ good result” at final assessment was predicted by the recovery of M2 elbow flexion at 3 months (Student t-test:  $P < 0.05$ ), M3 elbow flexion at 6 months (Student t-test:  $P < 0.02$ ) and M3 shoulder abduction at 6 months (Student t-test:  $P < 0.02$ ) according to Tassin’s classification. Mallet scale is not appropriate outcomes measure for infants. They used small population. Method was not clearly described. According to this study mallet scale is giving a higher sensitivity if used 9 months post surgery rather than 3 months post surgery.

Bisinella and Birch (2003) conducted a prospective study with 74 children with OBPP to see the incident of recovery. The mean age of children was 3. 2 months and follow up period was two years. Mallet scale and Gilbert scale used for shoulder function, Gilbert and Raimondi scale used for elbow function and Raimondi’s system used for measuring hand function. Patients underwent to conventional or surgical intervention according to severity. Result showed that very good recovery in 39 cases, useful arm with residual

deficit in 29 cases, some function in 4 cases and very poor result in 2 cases. Mallet scale is not appropriate for this age of children.

They used large population. Methodology was not good.

Grossman et al. (2004) conducted a prospective study to assess the shoulder function following late neurolysis and bypass grafting for upper brachial plexus birth injury. 11 children in age from 9 to 21 months were recruited in the study. Modified Gilbert system used for measuring shoulder function. All patients were followed for 2 or more years. In spite of some limitation, modified Gilbert system is accepted as a reliable outcome measure following surgery. Significant improvement was seen in all patients.

Sample size was too small. Methodology was not explained properly.

Inclusion criteria was not mentioned properly.

Birch et al. (2005) conducted a prospective study to see the improvement after repair of obstetric brachial plexus palsy. 100 children were recruited in the study. Operation was advised when poor clinical recovery was matched by unfavourable neurophysiological predictions. The mean duration of follow-up was 85 months. Gilbert's system and Mallet system was used to assess shoulder and Gilbert and Raimondi system used to assess elbow. Result showed that good improvement was obtained in 33% of repairs of C5, in 55% of C6, in 24% of C7 and in 57% of operations on C8 and T1.

Discussion:

The debate whether and when to operate on OBPP is still active because it is difficult to predict the natural history for recovery of nerve lesions, because <https://assignbuster.com/injury-underlying-obstetrical-brachial-plexus-palsy-obpp/>

this depends on the severity of the injury (stretch, rupture, avulsion) and on the levels of injury (partial or total plexus lesion). The challenge now lay in deciding which children would recover spontaneously, and which would need direct nerve surgery to aid their progress. Some author proposed three indications for surgery; complete palsy with flail arm and Horner's syndrome; complete C5 C6 palsy without muscle contraction by 3 months and with a negative EMG (often, they say, corresponding to a complete root avulsion); and C5 C6 palsy with no recovery in biceps at 3 months (biceps alone is chosen because examination of deltoid to the exclusion of pectoralis major is difficult at this age). Zancolli and Zancollf suggested that for each level of involvement of the plexus there was a different key muscle to consider as an indicator for direct nerve surgery. For the upper plexus the key muscle was biceps and deltoid, whilst for the middle plexus it was triceps and for the lower plexus, the finger flexors and thumb extensors. In general the decision about surgery in their recommendations is delayed until between 6 or 8 months when absence of clinical or electrophysiological signs of recovery in key muscles, or the cessation of recovery at a value of M2 or less on the British Muscle Movement Scale indicated the likelihood of poor spontaneous recovery and an indication for direct nerve surgery.

According to literature review, Julia K. Terzis and Kokkalis (2008) proposed that early plexus reconstruction (<\_3 months) offered the best functional results and reduced the need for secondary reconstructions. Nehme et al. (2002) proposed that the best predictor of outcome was elbow flexion at 9 months with 13% error, and not 3 months with 36% error rate for brachial plexus reconstruction.