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6.1 Long-term Results of Isolated Latissimus Dorsi Transfer in Brachial Plexus Birth Palsy

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Purpose: This is a retrospective analysis of the longterm results of isolated latissimus dorsi transfer.

Methods: From 200 to 2010, 52 isolated latissimus dorsi transfers were performed for internal rotation contractures in patients with recovery of infraspinatus power less than 2/5 and teres minor recovery greater than or equal to 4/5, using the Medical Research Council(MRC) scale. Inclusion criteria for the study were patients with a congruent glenohumeral joint, who received an isolated latissimus dorsi transfer into the infraspinatus in addition to release of the internal rotation contracture of the shoulder with greater than 5 years follow-up. 22 patients satisfied the inclusion criteria: 9 global palsies and 13 Erb’s palsies. There were 13 females and 9 males. Failure was defined as a return of the internal rotation contracture and a clinically apparent clarion sign.

Results: The average follow-up was 11 years, ranging from 7.5 to 15.9 years. All 9 global palsies maintained adequate external rotation without clarion sign. 5 of 13 Erb’s palsies failed isolated latissimus dorsi transfer and subsequently required teres major transfer, rotational osteotomy or by patient’s preference, acceptance of their functional status. In these 5 failures, the period from latissimus dorsi transfer to failure average 6.6 years, ranging from 3.4 to 9.5 years.

Conclusion: We recommend isolated latissimus dorsi transfer for global palsy patients who have infraspinatus weakness. However, given the longterm unpredictable and high failure rate in patients with Erb’s palsy, simultaneous latissimus dorsi and teres major transfers are recommended.

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Introduction:
A subset of patients with residual Obstetric Brachial Plexus Palsy (OBPP) suffer from limited shoulder abduction in the presence of good active shoulder external rotation. This restricted abduction in the presence of preserved deltoid girth; innervation is attributed to anterior shoulder instability secondary to shoulder internal rotator weakness. A novel strategy to improve anterior shoulder stability is described; early results are discussed.

Materials & Methods: 22 patients with residual OBPP with active external rotation (ER) more than 45°(arm adducted) and abduction less than 90° were subjected to procedure. Lateral reinsertion of both ends of Clavicular part of Pectoralis Major was done preserving its neurovascular pedicles. Conjoined Teres Major- Lattisimus Dorsi transferred to Infraspinatus if ER was less than 90° (arm abducted). Shoulder range of motion and Modified Mallet Scores were noted before and average 1.5 years after the surgery.

Results: Average age of patients was 6 years (range 2 - 15 years). Fourteen patients had Narakas -1 injury and four had Narakas - 3. Average shoulder abduction improved from 76° to 138°. Average gain in Shoulder abduction was 62° (81.5%). 18 out of 22 patients (87%) achieved Mallet Score IV or V. Aggregate Mallet Score improved by 3.4 points. Average active Shoulder External rotation improved from 46° to 77°.

Conclusion: Trans positioning of Clavicular part of Pectoralis Major seems an impressive strategy to improve shoulder abduction movement in patients with weak shoulder internal rotation and anterior shoulder instability.
6.3 Transfer of the trapezius muscle to restore external rotation in OBPL

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Objectifs

L’objectif de cette étude est de réanimer la rotation externe active, améliorer la stabilité de l’épaule et minimiser la déformation osseuse secondaire. Ceux-ci permettent une grande amplitude du mouvement bras et avant-bras.

Matériel et méthode


Résultat

Le gain moyen en rotation externe active et passive était de 40° (30° à 70°). Ces valeurs sont statistiquement significatives rapport à leur état préopératoire. Dans le postopératoire période, il y a eu une amélioration significative du signe de clairon. La force de rotation externe a été cotée M3 + chaque patient étant capable de toucher leur abdomen, les derniers degrés de mouvement de rotation interne étaient dans la scapulo-thoracique, La force de la rotation interne a été marquée comme M4 pré et postopératoire chez tous les patients.

Conclusion

Transfert de trapèze inférieur pour la réanimation de la rotation externe produit un résultat satisfaisant en ce qui concerne la fonction et la stabilité, c’est technique pratique, simple, sans complications et fiable.
6.4 Derotation osteotomy of the humerus in patients suffering from obstetrical brachial plexus palsy – effects on kinematics of the upper extremity

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Patients with untreated upper brachial plexus lesion (OBPL) frequently develop an internal rotation contracture of the shoulder, deficient active shoulder abduction and especially external rotation. The humeral derotation osteotomy combined with muscle transfers is one of the most common secondary reconstructive procedures to improve upper limb function. 12 children (7 girls, 5 boys, aging 5–13, mean 9 years) with secondary deformities following an OBPL were investigated before and after humeral derotation and muscle transfers. 3 patients underwent derotation osteotomy only, 5 had additionally muscle transfers and 4 an additional release of internal rotators. An optoelectronic motion analysis system was used for assessment.

Results of the motion analysis document dynamic improvement of the involved shoulder, but not to normal range. While elbow flexion was not influenced even pronosupination increased. The average effective external derotation of the upper arm was 49°, from 57 to 9°, compared with an average of 27° resting position of the humerus for healthy probands, meaning an overcorrection which clinically caused loss of some useful internal rotation based ADL function. Concerning the different procedures there was no difference between the 3 groups. Derotation of the humerus produced functional improvement at the shoulder and influenced kinematics of the whole upper extremity. The actual amount of humerus-derotation was about 15-20° too high, meaning a change in amount of derotation for the future. The missing statistical difference between the 3 surgical groups gives indication to proceed with an individualised surgical strategy according to the preoperative presentation of the patient.
6.5 Glenohumeral Fusion in adults with sequelae of obstetric brachial plexus palsy: A Report of 8 Cases

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Objective: Deformation of the gleno-humeral joint resulting from obstetrical brachial plexus palsy includes glenoid retroversion and loss of the humeral head sphericity. As a result, patients may show posterior dislocation of the humeral head and significant upper limb functional impairment. There is no consensus as to the optimum treatment of the residual paralytic shoulder after the end of the growth. The purpose of this study was to assess the surgical and functional outcomes of glenohumeral fusion performed in adulthood.

Methods: We reviewed eight patients with complete obstetric brachial plexus palsy who had shoulder arthrodesis. The mean age of patients was 30 years old (19-55). All patients had active periscapular muscles and elbow flexor muscles. Preoperatively, glenohumeral morphology was analyzed with computed tomography scanning of the affected shoulder. Mean shoulder flexion, abduction and external rotation were respectively 26°, 25° and -13°. Postoperatively, upper limb was splinted in abduction for six weeks. Outcome assessment included a video-assisted measurement of the active range of motion of the shoulder, patients' satisfaction and time to fusion.

Results: At an average follow-up of 7 months (2 to 17 mo), the active range of motion in flexion, abduction and external rotation of the affected shoulder were respectively 78° (0.005), 67° (0.005) and 21° (p=0.03). All the patients were satisfied with the intervention. Fusion was obtained between 3 and 6 months and no patient had residual pain.

Conclusions: Shoulder fusion improved the active arc of rotation, flexion and abduction in adults with residual obstetric brachial plexus paralysis.
6.6 Results: Medial triceps nerve transfer to axillary nerve in high energy shoulder trauma

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Background:

Radial to axillary nerve transfer is an established method of restoring function to the deltoid and teres minor following brachial plexus injuries. The use of the long head of triceps branch was reported by Leechavengvongs. However, the medial triceps branch allows co-aptation closer to the denervated muscles and maintains the stabilising function of the long head.

Methods:

Review of 40 patients from 2012-2018 who underwent medial triceps to axillary nerve transfer. A subset of 22 patients with high energy trauma (HET) was evaluated for clinical outcomes.

Results:

Demographics: Male: Female: 47:3; Mean Age: 43 (Range: 16-80 years); Injury mechanism: 22 patients had HET, of which 20 had Motor Vehicle Collisions; 1 GSW; and 1 RPG blast. 7 patients had spinal pathology; 4 had simple falls; 2 had neuritis; 3 had other pathology. The HET subset mean age was 33.6 whereas that of the 6/7 patients with spinal degenerate problems was 68. Of the whole group 21/40 patients had adequate follow-up with 67% achieving =grade 4 power. Within the subset of 22 patients, 16 had shoulder girdle fractures (73%). The mean time from injury to transfer was 6.7 months. 11/22 completed follow up with mean 18.5 months (Range: 8-36). Of these, 82% achieved =grade 4 power of deltoid shoulder abduction and 83% (n=6 with adequate follow up) achieved =grade 4 external rotation.

Conclusions:

Over 50% of patients had HET and the majority of these had fractures of the shoulder girdle. Despite this, over 80% achieved functional abduction and external rotation.
6.7 Shoulder abduction reconstruction for C5-7 avulsion brachial plexus injury by dual neurotizations: spinal accessory to suprascapular nerve and partial median or ulnar to axillary nerve

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Results of shoulder abduction reconstruction in partial avulsion brachial plexus injury (BPI) are better when a triceps nerve is neurotized to the axillary nerve in addition to the spinal accessory to suprascapular nerve. However, in C5-7 avulsion BPIs, a triceps nerve is unavailable for transfer. We report the results of an additional neurotization to the axillary nerve utilizing either a partial median or ulnar nerve as donor nerve.

The surgeries were performed through a supraclavicular and an anterior axillary approach. Patients were assessed for recovery of shoulder abduction and external rotation. Motor power was graded with the Medical Research Council grading scale.

9 patients (mean age = 26.7 years) underwent dual nerve transfers for shoulder abduction reconstruction from March 2005 to April 2013. 6 patients had partial median nerve transfers, and 3 had partial ulnar nerve transfers to the axillary nerve. The mean time to surgery was 4.5 months. All the patients recovered active abduction and external rotation. Abduction averaged 114.4° (range 90°–180°) and external rotation averaged 87.5° (range 80°–90°). Final shoulder abduction power was M4-5 in 5 patients and M3 in 4 patients. 1 patient with a partial median nerve donor had residual hypoesthesia in his thumb and index finger, and another had a residual M4 power in his fingers and thumb flexors. In C5-7 avulsion BPIs, dual nerve transfers of spinal accessory to suprascapular nerve and partial median or ulnar nerve transfer to axillary nerve are good options for shoulder abduction reconstruction; with minimal morbidity.
6.8 Comparison of approach in transfer of spinal accessory nerve to the suprascapular nerve in adult patients with upper type traumatic brachial plexus injury

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Eighteen patients with upper type traumatic BPI underwent surgical reconstruction with spinal accessory nerve (SAN) to suprascapular nerve (SSN) transfers. The anterior approach was used in 10 of them (anterior group) and posterior approach was used in 8 of them (posterior group). The mean age of anterior group was 38 and that of posterior group was 34. The anterior group was composed of 9 male and 1 female, and all patients of the posterior group was male. The time interval between injury and surgery was 6.2 month in anterior group and 6.4 months in posterior group. The active external rotation (ER) was 2 in the anterior group and 13 at postoperative 6 months, which was significantly different. In addition, the anterior group showed M2 in only one patient and M0 in nine, while the posterior group showed M2 in 5 and M3 in 4 at postoperative 6 months, which was significantly different. The active ER was 38 in the anterior group and 66 at postoperative 24 months, which was significantly different. In addition, the anterior group showed M3 in 2, M2 in 4, and M0 in 4, while the posterior group showed M4 in 2, M3 in 3, M2 in 2, and M0 in 1, which was significantly different. The posterior approach of SAN to SSN outperformed recovery of ER at the early postoperative period and this trend was continued until midterm follow-up.
32 cases with traumatic plexus injuries underwent spinal accessory nerve (SAN) transfer to suprascapular nerve (SSN) through posterior route. Median of age was 39.3 years and operative delay 5.2 months. Nine had avulsion of C5C6, ten of C5C6C7 and 13 of C5-T1. The reasons of the posterior route procedure included combined scapular fracture, deep severe scar in the supraclavicular incision for which the distal stump of SSN was unavailable, and large area scar of the supraclavicular region with dissection here extremely difficult. 12 of the 32 patients were found to have combined SSN rupture around the suprascapular notch, of whom nine were complicated with scapular fracture, accounting for 40.9% (9/22) of all cases with scapular fracture. SAN was directly transferred to the SSN in 20 cases and to the infraspinatus branch of SSN by nerve grafting of average 4.5cm length in that 12 patients. Patients were followed up for a median of 38.7 months (minimum 11 months). Median of shoulder abduction in the 20 cases with SSN neurotization was 69.0° (55.0-88.0°), which was significantly greater (<0.05) than that in the 12 cases with transfer to the infraspinatus branch (55.7°, 42.5-67.5°). Median of shoulder external rotation in the 20 cases was 68.5° (55.0-85.0°), which was similar (>0.05) to that in the 12 patients (65.0°, 51.3-73.8°). It is concluded that SAN transfer to SSN by posterior route may gain good results, and for patients with concomitant scapular fracture this posterior route procedure should be performed routinely.
6.10 The pathoanatomy of the posterior spinal accessory to suprascapular nerve transfer after traumatic brachial plexus injury

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Background:

Spinal accessory (XI) to suprascapular (SSN) nerve transfer is an established method of restoring function to the rotator cuff following brachial plexus injuries (BPI). The anterior approach, although popular, is associated with denervation of the lateral trapezius and poor restoration of external rotation. Concomitant pathology of the SSN at the notch may be missed resulting in poor reinnervation of the rotator cuff. The posterior approach allows decompression and visualisation of the SSN at the notch and nerve transfer co-aptation closer to the motor point with shorter reinnervation. The medial XI branch may be used preserving lateral trapezius function.

Methods:

Review of 23 patients from 2013-2018 who underwent XI to SSN nerve transfer via a posterior approach. A subset of 19 patients with traumatic BPI was evaluated for SSN pathology and clinical outcomes.

Results:

7/19 (37%) of patients had pathology identified at the suprascapular notch during the posterior approach. There were 2 SSN ruptures, 2 neuromata-in-continuity and 3 ossified suprascapular ligaments (2 with evidence of scarring around the SSN).

Conclusions:

XI to SSN transfer using a posterior approach allows visualisation of the nerve and a nerve co-aptation close to the target muscles. Following trauma 37% of cases have posterior pathology identified during nerve transfer. These findings may explain why some patients have a poor functional outcome from surgery performed through the anterior approach.
6.11 External rotation in extensive partial brachial plexus injuries

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Incomplete brachial plexus injuries with only T1 root functions preserved often have avulsions at each of the injured levels. It is common practice to transfer the spinal accessory nerve to the suprascapular to attempt restoration of the rotator cuff functions. However, most often, only 30-45 degrees abduction is regained while there is little or no external rotation. The author will present five cases in whom two intercostal nerves (5th and 6th) were transferred to the long thoracic nerve along with the other nerve transfers. Their ages ranged from 18-30 years. Each of these patients was operated upon within six months from the accident. The followup ranged from 18-114 months. While the abduction restored was limited to 45-70 degrees, each of these patients demonstrated return of full external rotation beyond neutral. This dramatic improvement appears to be due to the addition of a nerve transfer to the long thoracic nerve.
6.12 Lower subscapular nerve transfer for axillary nerve repair in upper brachial plexus palsy.

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Restoration of shoulder function is one of the main priorities of brachial plexus surgery. The potential to utilize the lower subscapular nerve has been suggested by many anatomical studies. To date, however, we know of no studies in the literature describing the use of the lower subscapular nerve for axillary nerve reconstruction. The aim of this study was to examine the effectiveness of this nerve transfer in patients with upper brachial plexus palsy and compare this technique with other possible donors.

Of 1,340 nerve reconstructions in 568 patients with brachial plexus injury performed by the senior author (P.H.), a subset of 18 patients (14 male and 4 female) underwent axillary nerve reconstruction using the lower subscapular nerve. The median patient age was 48 years and the median time between trauma and surgery was 6.5 months. To maximize the effectiveness of the neurotization procedure, the anterior branch of the axillary nerve, which is predominantly motor and supplies most of the deltoid muscle, was selected as the recipient nerve in our study.

Thirteen patients completed a minimum follow-up period of 18 months. Axillary nerve reconstruction was successful in 9 of 13 patients, which represents a success rate of 69.2%. No significant postoperative weakness of shoulder internal rotation or adduction was observed.

Conclusion: The lower subscapular nerve can be used as a safe and effective neurotization procedure for upper brachial plexus injury, having a success rate, in our study, of 69.2%, for axillary nerve repair.
6.13 Reconstruction of the Spinal Accessory Nerve with Selective Fascicular Nerve Transfer of the Upper Trunk

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Object: Spinal accessory nerve palsy is frequently caused by iatrogenic damage during neck surgery in the posterior triangle of the neck. Due to late presentation, treatment regularly necessitates nerve grafts, which often results in a poor outcome of trapezius function due to long regeneration distances. Here we report of a distal nerve transfer using fascicles of the upper trunk related to axillary nerve function for reinnervation of the trapezius muscle.

Methods: In this study five cases are presented where accessory nerve lesions were reconstructed using selective fascicular nerve transfers from the upper trunk of the brachial plexus. Outcomes were assessed at 20 ± 6 months after surgery, documenting AROM as well as pain levels using VAS.

Results: All five patients regained good to excellent trapezius function (three M5, two M4). The AROM of shoulder abduction improved from 55°±18 before to 151°±37° after nerve reconstruction. In all patients unrestricted shoulder arm movement was restored with loss of scapular winging when abducting the arm. Average pain levels decreased from 6,8 to 0,8 (VAS) and subsided in four of five patients.

Conclusions: Restoration of spinal accessory nerve function with selective fascicle transfers related to axillary nerve function from the upper trunk of the brachial plexus is a good and intuitive option for patients who do not qualify for primary nerve repair or present with a spontaneous idiopathic palsy. This concept circumvents the problem of long regeneration distances with direct nerve repair and has the advantage of cognitive synergy to the target function of shoulder movement.