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Tunneled Tensor Fascia Lata in Trapezius Transfer–A Novel Technique for Upper Brachial Plexus Injury

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Abstract

Brachial plexus injuries are one of the most devastating injuries and also the most actively researched. The last four decades witnessed significant improvement in the management of these injuries, from a totally pessimistic outlook to a more optimistic attitude. The repair of such injuries is commonly done via multiple nerve transfer methods involving immense technical expertise. Trapezius muscle transfer is an established method to provide stability and function to the flail shoulder joint in brachial plexus injuries after denervation atrophy of the involved muscles. Problems associated with the current technique include longer surgery time, prolonged immobilization, screw loosening, surgical-site infection, and deformities after bony fracture. To overcome these problems, we described a technique using tensor fascia lata for extension of trapezius tendon, tunneled it under deltoid muscle, and sutured it to the deltoid tendon close to its insertion. As no implants were used, there were no implant-related complications. This technique can be adopted easily due to its shorter learning curve, with the only prerequisite being a passive shoulder abduction of at least 90 degrees. Trapezius transfer by this technique is a simple, easy, and convenient method, showing reliable result for shoulder abduction and flexion in cases of upper brachial plexus injury, which require secondary procedures, or those having delayed presentation of more than a year.

Keywords
- ► brachial plexus injury
- ► tensor fascia lata
- ► trapezius transfer

Introduction

Brachial plexus injuries are one of the most devastating injuries and also the most actively researched. The last four decades have witnessed significant improvement in the management of these injuries, from a totally pessimistic outlook to a more optimistic attitude. The repair of such injuries is commonly done via multiple nerve transfer methods involving immense technical expertise.

The persistent instability of the shoulder and the lack of movements in shoulder joint significantly hinders the use of upper limb even if the function of elbow, wrist, and fingers are normal. Recovery of the function of deltoid and rotator cuff muscles is often incomplete, and this results in a poor abduction and limited or no external rotation of the shoulder. When the time since the injury is less than one year, the shoulder abduction and external rotation are reconstructed by means of neurotization and nerve transfers. When these procedures fail or when the time since the injury is more than one year, secondary reconstruction procedures which include tendon-muscular transfers, rotational osteotomy of the humerus and shoulder arthrodesis or a combination of these techniques to improve the function and stability are required. Arthrodesis is a viable option to salvage if muscle transfer fails. A clear understanding of shoulder anatomy and biomechanics is of paramount importance when using

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adjacent muscles for transfer.[1] Options for transfer include the trapezius,[2,3] pectoralis major[4] and teres major, latissimus dorsi,[5] and combined biceps and triceps muscles.

Trapezius muscle transfer is an established method to provide stability and function to the flail shoulder joint in brachial plexus injuries after denervation atrophy of the involved muscles. Two major variants of the surgical technique have been described.[3] Saha's[3] technique includes mobilizing the trapezius muscle insertion along with lateral clavicle, acromion process, and spine of the scapula, followed by their fixation to the humerus with the help of bone screws. Problems associated with this technique include longer surgery time, prolonged immobilization, screw loosening, surgical-site infection, and deformities after bony fracture. Singh and Karki mobilized the trapezius insertion subperiosteally without bony osteotomies. The periosteal sleeve was used to secure the transfer to the deltoid muscle using nonabsorbable sutures. There was no bony fixation with a strong reliance on postoperative splintage. However, this results in gradual stretching of muscle and progressive loss of abduction.

To overcome these problems, we described a technique using tensor fascia lata for extension of trapezius tendon, tunneled it under deltoid muscle, and sutured it to the deltoid tendon close to its insertion. Postoperatively, we achieved 70 degrees of shoulder abduction and 90 degrees of shoulder flexion. Thus, by using this technique, a more anatomical and physiological reconstruction was achieved with better outcome.

Case Presentation

A 25-year-old male suffered a road traffic accident (RTA) in January 2017, resulting in right brachial plexus injury at the level of right C5 and C6 roots. Initial management was done via spinal accessory nerve to suprascapular nerve transfer in February 2017. This procedure however showed negligible improvement in functionality of the right shoulder joint. He was presented for routine review at INHS Asvini in February 2019; on further evaluation, he had no shoulder abduction, adduction, flexion, extension, external rotation and internal rotation (►**Fig. 1**), with good elbow and hand functions. Strength of trapezius muscle preoperatively was 5, as per Medical research Council (MRC) grading. Passive range of abduction of shoulder was 130 degrees. Radiologically, there was no fracture of humerus or scapula.

Patient underwent trapezius transfer in supine position under general anesthesia by placing a S-shaped incision, extending from medial part of spine of scapula up to deltoid insertion; skin flaps were raised, trapezius and deltoid muscles identified, upper and middle trapezius muscles lifted from acromion process by subperiosteal dissection, extending throughout spine of scapula and trapezius muscle raised from spine of scapula. Trapezius muscle positioned in shoulder abduction of 100 degrees and deficient length from trapezius free end till deltoid insertion were measured. Tensor fascia lata of that length was measured and harvested from ipsilateral thigh and extension of trapezius tendon done with polyester 2–0 (►**Fig. 2**). A tunnel was created under deltoid muscle (►**Fig. 3**), and extended trapezius tendon sutured with vicryl 0 close to insertion of deltoid with closure of tunnel of deltoid with vicryl 3–0 (►**Fig. 4**). Postoperatively, he was given shoulder splint for 6 weeks with 100-degree abduction and thereafter physiotherapy.

The results in this case were evaluated in the form of range of motion around joint, muscle power and overall regaining of function. Shoulder abduction of 70 degrees (►**Fig. 5**) and 90 degrees of shoulder flexion (►**Fig. 6**) were achieved at the end of 3 months. Artistic representation of technique is shown (►**Fig. 7**).

Discussion

Secondary surgery in brachial plexus palsy is often required for the restoration of shoulder movement. The loss of function at the shoulder joint results in crippling deformity of the upper limb even if other joints of the upper limb are functioning well. In such cases, the secondary reconstruction of shoulder function includes muscle transfer or shoulder arthrodesis.

The advantages of muscle transposition are the possibility of a greater range of motion at the shoulder joint, minimal or no interference with the passive range of motion at the shoulder joint, and the shoulder fusion can be done at a later date if the muscle transfer fails. The only prerequisite is passive range of shoulder abduction of at least 90 degrees.

The advantages of shoulder fusion are the greater chance of success and the greater strength and power of the functional

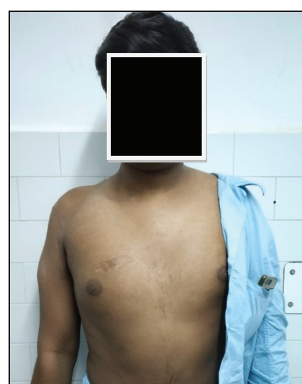

Fig. 1 Preoperative picture.

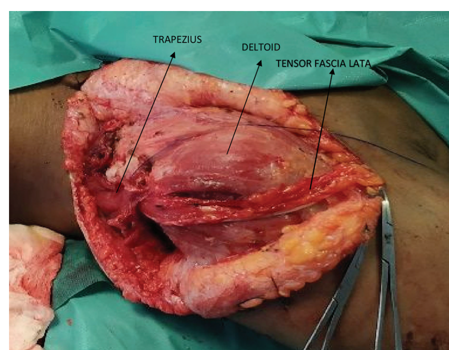

Fig. 2 Extension of trapezius tendon by tensor fascia lata.

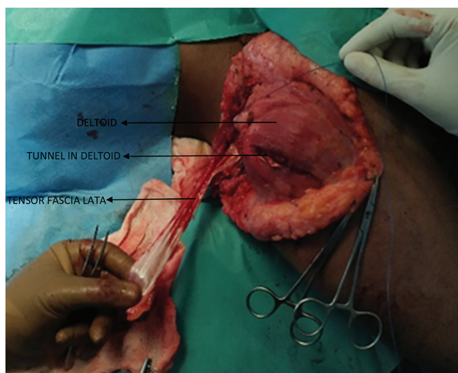

Fig. 3 Tunnel created under deltoid muscle.

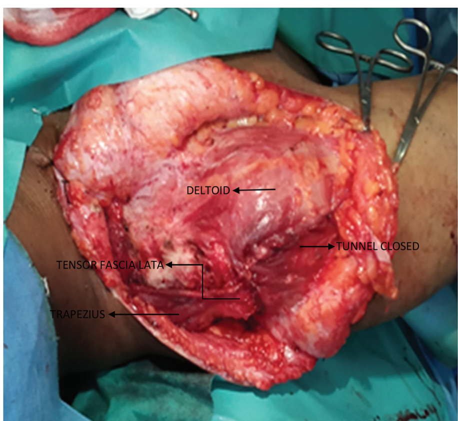

Fig. 4 Suture of trapezius tendon close to insertion of deltoid with closure of deltoid tunnel.

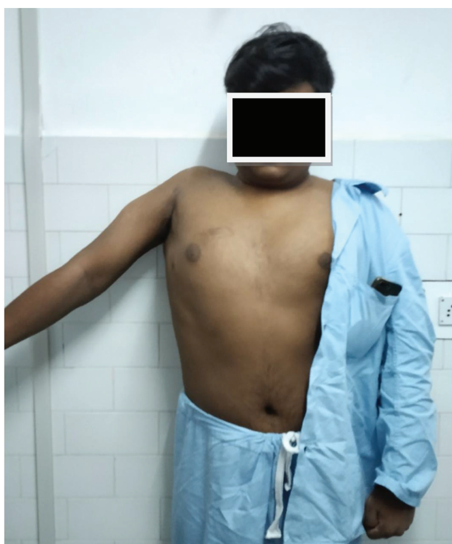

Fig. 5 Shoulder abduction of 70 degrees.

force at the shoulder. The disadvantages are limited range of abduction, normal mobility of the scapulothoracic joint is a prerequisite, this is an irreversible procedure, it inhibits the passive mobility of the joint, making some useful movements like dressing or putting the hand in the pockets, back of the head or to the opposite side of the body difficult, and it is associated with a high incidence of complications, such

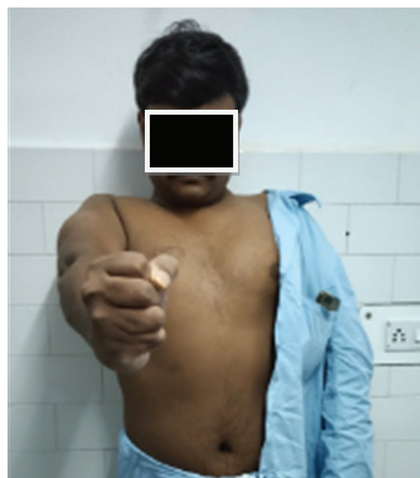

Fig. 6 Shoulder flexion of 90 degrees.

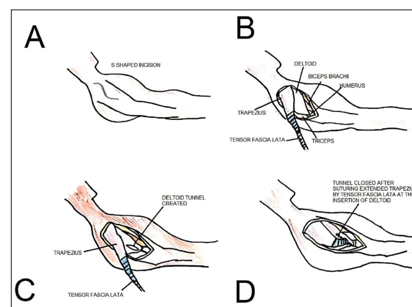

Fig. 7 Artistic representation of the technique.

as fractures and pseudoarthrosis. Pain in the shoulder region is common after arthrodesis, and many patients are dissatisfied, with some feeling worse than before surgery.

The major problem in traumatic brachial plexus is the availability of fully functional muscle for transfer. The levator scapulae, rhomboids, and trapezius muscles are spared in almost all cases of traumatic brachial plexus injuries. The lever arm of the transferred trapezius is lesser when compared with other transfers, and in spite of this, it is better than other muscle transfer because the movement takes place in the plane of the scapula and this provides the stability and mobility. The trapezius muscle is found to be hypertrophied in most of the patients with paralysis of the deltoid muscle. An additional advantage of the trapezius transfer procedure is the correction of the inferior subluxation of the shoulder joint.

Many methods of trapezius to deltoid tendon transfer were published: Mayer, Ober, Harmon, Bateman,[2] and Saha.[3] The surgical technique was initially described by Mayer, who also used a fascia lata plasty to increase the length of the trapezius insertion. Bateman[2] described the transfer with acromion osteotomy and other experiences were later published by several authors (Saha,[3] Karev, and Aziz et al). Some studies have achieved excellent functional results with more than 75°average shoulder abduction and forward flexion, but in large series, the average gains in postoperative range of motion were comparable to our study (►**Table 1**).

Table 1 Showing comparison of results with different studies

Authors	Shoulder abduction mean in degree (range)		Shoulder forward flexion mean in degree (range)	
	Preoperative	Postoperative	Preoperative	Postoperative
Aziz et al	4 (0–30)	45 (20–120)	4(0–50)	35 (0–20)
Mir-Bullo et al	13 (0–30)	76 (50–100)	18 (0–40)	78 (45–110)
Rühmann et al	7 (0–45)	39 (25–80)	20 (0–85)	44 (20–90)
Singh et al	13 (0–30)	116 (45–180)	24 (15–30)	107 (90–180)
Agrawal et al	7.5 (0–30)	85 (45–140)	5.63 (0–15)	55.2 (40–90)
Severo et al	–	75.8	–	77
Elhassan[1]	–	70 (50–130)	–	–
Our technique	0	70 (0–70)	0	90 (0–90)

There was no increase in operative time as compared with traditional techniques, and as no implants were used, there were no implant-related complications. This technique also obviates the need of identification of spinal accessory nerve. Thus, this technique can be adopted easily due to its shorter learning curve and the only prerequisite being a passive shoulder abduction of at least 90 degrees.

Conclusion

We have proposed a novel technique for trapezius transfer, which obviates the problems of previous transfers as well as avoids osteotomy and its related complications. The tunnel under deltoid helps in proper gliding as well as avoids adhesions. The suturing close to the insertion of deltoid corrects the inferior subluxation of shoulder joint. Trapezius transfer by this technique is a simple, easy, and convenient method, with a shorter learning curve showing reliable result for shoulder abduction and flexion in cases of upper brachial plexus injury, which require secondary procedures, or those having delayed presentation of more than a year.

Ethical Approval

The procedure was performed after obtaining proper ethical approval and patient's consent.

Funding

None.

Conflict of Interest

None declared.

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Note: References 6-23 are available online.

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