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ORIGINAL ARTICLE

Uni-polar Latissimus Dorsi Transfer for Restoration of Elbow Function in High Voltage Axillary Burn Leading to Brachial Plexus Injury

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Introduction

Management of Brachial Plexus Injury (BPI) has significantly improved in recent times with introduction of micro-neural surgery in plexal reconstruction and distal nerve transfers. This has resulted in better functional outcomes in patients presenting early[1]. However, in developing country like India, late presentations are a norm due to varied reasons.

High voltage grade 4 and 5 electrical burns cause soft tissue loss and injury to the nerves and vessels. Most of these injures require flap coverage and maintenance of neural integrity. This article presents two cases of BPI from high voltage electric burns to the axilla with patients presenting more than 12 months after injury. These patients had been managed with multiple wound debridements and split skin grafting (SSG.) Treatment of nerve injury was largely ignored. Subsequently they presented with lack of elbow and hand functions and managed by unipolar latissimus dorsi (LD) muscle transfer.

Patient and Methods

Two patients with infra-clavicular BPI presented to the outpatient clinic between 2013 and 2015 following high voltage electric burns in the axilla sustained more than one year back (Table 1). Both the patients lacked elbow and hand functions. Institution review board approved this case series study in 2016.

Both patients had undergone SSG for the axillary defect without any attempt at primary nerve reconstruction. They presented with stiffness and decreased range of motion (ROM) at shoulder and loss of elbow flexion. Distal pulsations were intact in both the patients.

Both patients were subjected to electrophysiological studies (EMG and NCV, Table 2). Patients and their relatives were informed in detail about the nature of injury, reconstructive options and the functional outcomes.

The primary role of electrophysiological studies was to document the lesion and ascertain the strength of LD muscle.

On clinical examination in both patients the axillary skin was extremely scarred (Fig 1) with decreased active and passive abduction at the shoulder. Unipolar LD muscle transfer were performed in both the the patients as a rehabilitative measure.

Table 1

Age	Side	Dominant hand	Previous Treatment	Distal Pulses
23/M	Left	Right	Multiple Debridement and SSG to axilla	Present
20/M	Left	Right	Head Injury Managed Conservatively Debridement and SSG to Axilla	Present

Table 2

Pt	Shoulder Abduction		Elbow Flexion		Elbow Extension		LD Muscle	
	Clinical	EMG	Clinical	EMG	Clinical	EMG	Clinical	EMG
1	M4	M3	M0	M0	M0	M0	M5	M4
2	M4	M3	M0	M0	M0	M0	M5	M4

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Fig. 1 Post Electric Burn scar axilla with SSG

Surgical Technique

With the patient placed in lateral position, a longitudinal incision was made along the Anterior free border of the LD muscle from the edge of the SSG in the axilla to midway between lower border of the costal cartilage and the iliac crest. Skin flaps were raised and the muscle flap was raised after separating it from the underlying serratus anterior muscle (Fig 2). Multiple intercostal perforators were ligated during the flap elevation. Neurovascular pedicle was identified in the proximal part of the dissection. Extensive axillary dissection was avoided due to dense scarring and previous SSG in the axilla.Lateral half of the muscle was harvested to match the size of the biceps. A subcutaneous tunnel, made in the upper arm, was connected distally to the elbow, where biceps tendon had been exposed through a "S" shaped incision. Flat LD muscle was rolled to mimic the shape of biceps muscle (Fig 3). LD muscle was then sutured to the biceps tendon using strong nonabsorbable sutures with elbow at 100^0 flexion and under maximal supination. Skin closure was done with suction drains at the flap donor site and in the arm. Elbow was immobilised in a plaster cast.

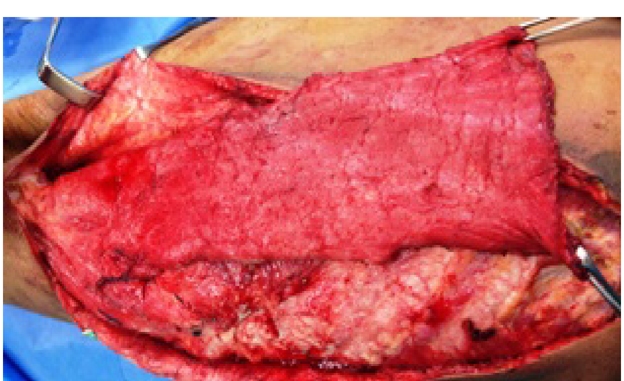

Fig. 2 LD muscle raised from the bed after detaching from the origin.

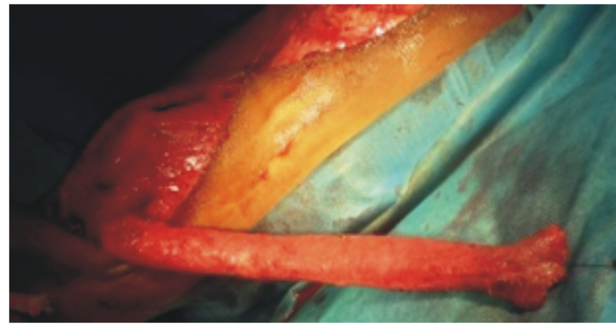

Fig. 3 LD muscle rolled into a tubular form to mimic Biceps Muscle in the arm

Post Operative Care

Immobilisation was continued for 6 weeks followed by splinting and passive ROM exercises and extension blocking splint for another three weeks. At the final follow up, 18 months later, both patients had MRC 3-4 power and could lift 2 kg of weight with an active ROM of 120^0. Both had an extension lag of 20^0 which was left uncorrected as it improved the hand to mouth function (Fig 4). Both patients underwent wrist fusion and CMC joint arthrodesis to improve the hand position at a later stage.

Fig. 4 Good ROM at the elbow joint at three months post operatively

Discussion

With the advent of microsurgery post operative results have significantly improved in brachial plexus surgery. However in late presentations and following failure of primary nerve surgery, tendon and muscle transfers and joint arthrodesis, have been used as secondary procedures. Restoration of an active elbow flexion with hand to mouth movement is one of the important goal in rehabilitation process. A M3 or more power with active ROM >80^0 is considered adequate following muscle transfer surgery[2]. In secondary elbow reconstruction, pedicled muscle transfer (latissimus dorsi/pectoralis major/triceps) and Steindler flexorplasty are used apart from free functioning muscle transfer[2]. Latissimus dorsi muscle (LD), innervated by ventral rami of C5 to C7, with its origin from the T7-T12 vertebrae and iliac crest and insertion into the humerus, is generally spared in infra-clavicular injuries.

Bipolar LD transfer has been preferred in restoration of elbow flexion with M0 biceps muscle. Steindler flexorplasty works when biceps power is M1/M2. Pectoralis major muscle transfer requires a fascia lata graft and provides an average of 60^0 elbow flexion[2,3]. Free functioning muscle transfer using gracilis muscle is preferred in total palsy however is avoided in many patients due to complexity of the procedure and a delayed recovery[2].

Both the patients reported herein had suffered infraclavicular brachial plexus injury with preserved shoulder function and complete loss of elbow movements. LD muscle function was intact as confirmed preoperatively on clinical and EMG examinations. The axilla and the adjoining area in the vicinity of LD insertion was extremely scarred with split skin graft replacing the normal skin. This resulted in stiff shoulder joint with restricted passive shoulder abduction to less than 120^0. Both the patients were manual workers and desired an early return to work. We preferred LD muscle transfer over other reconstructive measures. Due to extensive axillary scarring with inevitable risk of injury to the LD neurovascular pedicle, we preferred a unipolar LD transfer.

Both bipolar and unipolar LD transfers have been used for elbow flexion. While the ROM of elbow flexion is same with both the procedures, unipolar transfer provides an indirect line of pull. Unipolar transfer also has limited supination. Bipolar transfer provides an added shoulder stabilization due to fixation of the LD insertion to the clavicle[2]. As both the patients had stable shoulder, unipolar transfer provided an adequate elbow flexion. With unipolar LD transfer, since the neurovascular pedicle is not manipulated, complications like haematoma, thoracodorsal nerve injury, and vascular compromise of the pedicle are very less, making it a safe and easy procedure[2].

Conclusion

Reconstruction of elbow flexion is an important goal in rehabilitation of brachial plexus injury patients and an ipsilateral latissimus dorsi is an excellent transfer in achieving this function. Unipolar LD transfer provides similar range of motion as a bipolar transfer and recommended in patients with stable shoulder. This procedure is quick to execute and safe with minimal risk to the neurovascular pedicle. However, this study being a retrospective one with a small group of patients, requires a larger cohort to prove its efficacy in restoration of biceps flexion in brachial plexus injury patients.

References

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