ORIGINAL ARTICLE

A Journey Towards Upper Limb Salvage: Evolving Expertise in Free Tissue Transfer

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ABSTRACT

Background: Free tissue transfer has vastly expanded the reconstructive options which would have been impossible to conceive in the pre-microsurgical era. Retrospective audit help to assess success, evaluate short comings and set future goals in accordance with the international standards; which helpimprove accuracy of decision making and limiting errors; enhance surgical skills of individual clinicians and allocate financial share according to demand.

Material and Method: A retrospective study was conducted and Operation theater record was reviewed for patients undergoing free tissue transfer for upper limb reconstruction, Performa was filled, and the data was compiled by the first author. A total of 87 cases of free tissue transfer surgeries were performed in upper limbat JBRSCfrom July 2015 to November 2017 of which 78 percent were male and 22 percent female patients.

Results: Broadly two main categories including post traumatic or post tumor excision patients required free tissue transfer for upper limb salvage. Most common age bracket of patient is between 26-40yrs. 64 of 87 patients were admitted through emergency. No major complications are encountered except hematoma in six flaps, infection in two and partial flapnecrosis in 3 and major flap necrosis in 1. Smoking remains most common co morbid condition.

Conclusion: With careful preoperative planning, developing surgical skill and vigilant postoperative care the overall success rate can be improved. Good results give positive reinforcement to untiring hard work.

Key words: Reconstruction, Tumor, Flap, Microsurgery, Salvage

Introduction

Reconstruction of hand and upper limb has prgressed over time and major leap was seen during the World War II. However reconstruction of major traumatic injuries of upper limb is still challenging. Progress in knowledge about blood supply of muscle and skin after Taylor's land mark work alongwith improvement in art and science of microsurgical techniques has revolutinized the reconstructive ladder. The reconstructive surgeons have moved to reconsrtuctive tool box which obviates the need to use the reconstuctive ladder to decide about reconstructive requirements of a prticular defect. With the success of first toe-to-thumb transfer in 1960s, the myrid of

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options to reconstruct complex defects of upper extremity have widely expanded.[2] However high energy collisions, firearm injuries, explosions, extrvasation injuries and the industrial accidents continue to challenge the skills of reconstructive surgeon.[10,11]

Industrial revolution has taken its tool in the form of incresaed frequency of upper limb injuries. Wounds resulting from the use of sophisticated automated machines put a major burden on innovative abilities of reconstructive surgeons. Overwhelmed with this burden, the surgeons statred re-considering amputation as an option to manage mangled upper extremities.[1] Body of literature on extremity soft tissue reconstruction is expanding rapidly as an extensive topic because large number of options exist for variety of complex degects involving shoulder, arm, elbow, forearm, wrist, and hand. Most of these defects require well vascualrized flap coverage for resurfacing important structures like tendons, neurovascular structures, bone and to provide supple tissue over joints. [3]

Local and regional flaps have the advanatge of replacing like with like in terms of colour and texture match; however, these flaps may produce donor site morbidity and availabilty of donor tissue is also limited in an already injured limb. Free microvascular tissue transfer is considered suprerior to locoregional flaps due to abundant tissues available and ease of insetting the transferred tissues. [9] Moreover variety of tissues required i.e skin, tendon, bone and nerve can be provided by free flap. This facilitates single stage critical structures. Flow-through free flaps provide added benefit of restoring/improving distal vascularity of the injured limb. Post-operative rehabiltation is also faciltated by free tissue transfer. The downside of free tissue transfer is requirement of highly sophisticated setup of operation rooms, team of surgeons familiar with micrvascular techniques and anaesthesia personells accustomed with anesthetic requirements of patients undergoing free tissue tranfer. .[4]

With the advent and finesse of micro-vascular surgical techniques, the anastomotic success rate has improved to 94-99%5,6. However failure of free tissue transfer can be devastating and occurance of other complications is also formidable. However, timely re-explorations have helped to curb the ruinous outcomes.7,8

This article investigates the complications, survivability, aesthetic and functional outcomes associated with micro vascular free tissue transfer in upper limb reconstruction through an analysis of 87 free tissue transfer cases at our center.

Methodology

Approval of hospital review board was sought to collect retrospective of patients who had reconstruction of complex upper extremity defects with free tissue transfer at Jinnah burn and reconstructive surgery Centre, Lahore from January 2015 to November 2017. Data retrieved from the upper limb Database and operating theatre logbooks identified 87 patients who had free flap reconstructions either after major trauma or tumor resection. Type of the flap was chosen during grand ward round.

Flap markings were done following stnadard described techniques using anatomical land marks and hand held dopller. Flaps were raised using loupe magnidfication to aid in dissection. Arterial anastmosis was done with prolene 9/0 using interrupted suture and triangulation technique. Arterial anastomosis was done before venous anastomosis.

Venous anastmosis was done in end-to- end or end-to-side faishon with prolene 9/0. Topical heaprin solution (100 units/ml normal saline) was used for contnious irrigation. Depending on complexity of anatmosis, systemic heparin was used in redo anatmoses during primary surery and in re-explorations. Postoperative care included keeping the patients ICU for at least 24 hours. Low molecular weight heparin and intravenous antibiotics, based on pre operative culture sentivity reports, were administered to all patients till the 7th postoperative day. Standard flap monotring was done with clinical examination and hand held Doppler one hourly for 3 days then 4 hourly for next 3 days. Data collected retrospective included specifics on age of patient, gender, mode ofadmission, mechanism of injury, defect site and size, donor site and choice of flap, vessels used in microvascular anastomosis, comorbid conditions and preoperative medical and surgical history. The perioperative conditions, which included the presence of coronary artery disease (CAD), smoking, hypertension (HTN), DM, and previous cancer treatment (surgery and/or radiation therapy) were noted.

Complications, associated with microvascular free tissue transfer, were noted. The complications included arterial thrombosis, hematoma formation, venous congestion, infection and partial or complete flap loss secondary to arteral or venous compromise. Complications noted at donor site included infection, hematoma formation and wound dehiscence or skin-graft failure.

Results

Eighty seven patinets were operated during the study period. The age range for the patients was 26-40 years with mean age of 32.5 years. There were 68 (78%) males and 20 (22%) were females. 22%. Ninteen 19 (21.8%) patients were smoker. Four patients (4.7%) had diabetes mellitus and 13 patients (14.9 %) were hypertensive. Patients admitted through emergency department were 64 (73.5%) and through outpatient department were 23 (26.4%). Fourty three patients (49%) had road traffic accident cases, 24 patients (27%) had machine injury and 6 patients (7%) had tumors. Fifty three (61 %) flaps were used for forearm defects, 19 (22 %) were used for hand and 14 (17 %) were for arm defects.

ALT (Antero lateral thigh flap) 40 flap most commonly done flap in upper limb region, followed by latissimus dorsi flap 21, scapular 15, gracillis flap 4, free fibula 5 and 2 gastrocnemius flaps done.

All flaps were assessed one hourly by hand held doppler and clinical evaluation by on call doctor as well as nurse on duty for 3 days, then monitoring of flap done 4 hourly by doppler as well as clinicallyat least 3 days in the first week of surgery. Subcutaneous clexane 40mg BD given for 5 days with overlap of tab loprin 75mg od for total 14 days was our departmental protocol of anticoagulation. IV antibiotics &analgesia given for fist 4- 5 days according to pain threshold of patient.Patients were rehydrated with ringer lactate according to weight and output of patient.

For initial 24 hrs patient remained in HDU then shifted to ward .Post op CBC is mandatory in every free flap patient. Patientswere kept NPO for ist 24 hrs then allowed to sips of clear fluid for next day followed by solid intake in next day.

Of the three (3.4%) flaps lost, one flap was lost due to venous congestion, one due to arterial occlusion, and 1 due to infections within one week after surgery. Re-

exploration was done in 2 flaps with only one flap being salvaged. Hematoma was noted in 6, which was drained immediately, infection in 2 patients, 1 managed with debridement other with daily dressings . Partial flap necrosis seen in 3 and major flap necrosis in 1 patient only.It was noted in cases of failed and compromised flaps from that in a relatively high proportion of patients with intraoperative difficulties of flap perfusion .

Donor site complications were observed in 8 patients. Partial graft loss was noted in 5 patients whereas 3 patients had wound dehescience. Howeve these patients were managed conservatively with regular dressing changes and wounds healed byb secodary intention.

Table 1: Summary of flaps performed and the outcomes.

Flap performed	Frequency	Successful	Failed	Percentage successful
Anterior lateral thigh	40	40		100 %
Latissimus dorsi flap	21	20	1	95.2%
Scapular flap	15	14	2	93.3%
Free fibula flap	5	5		100%
Gracilis muscle flap	4	4		100%
Gastrocnemius flap	2	2		100%
Total	**87**	**85**		**97.7%**

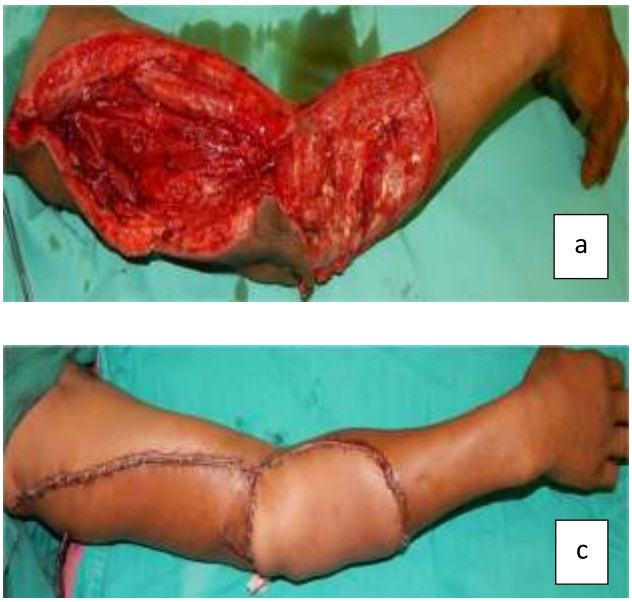

Figure 1 (a). Initial wound after debridement (b).ALT flap dissection (C). Insetting of flap in defect.

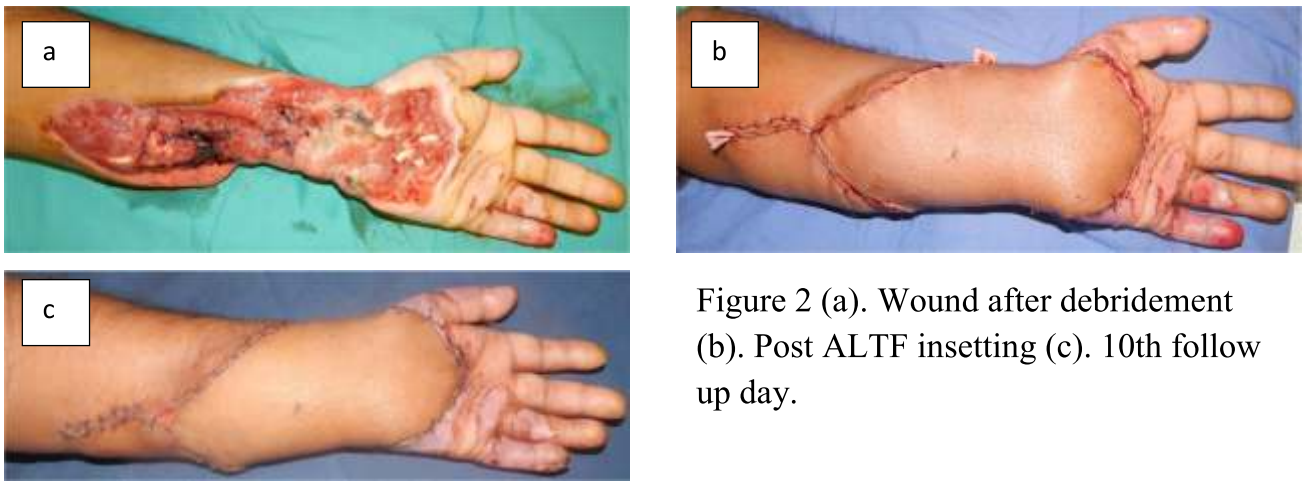

Figure 2 (a). Wound after debridement (b). Post ALTF insetting (c). 10th follow up day.

Discussion

Outcome of management of complex woundsof upper extremity have been tranformed with the use of free tissue transfers. Wounds once considered to end up in subotimal outcome, are now manged successfully with good surgical outcomes [12,13,14]. Limb salvage in advanced tumours involving upper extremity has become a reality with the use of free flaps. State of the art reconstruction of complex defects has resulted in restoration of form, function and aesthetics. However, in many developing countries, the surgical practice of microsurgery has failed to keep pace with complexity of defects. However such countries face the incresaing burden of defects rrquiring composite reconstruction that can be accomplished with the use free tissue transfer. The docile nature of progress in microvascular surgery is attributable to suboptimal trainng opportunities and lack of requisite equipment to carry out the surgeries. However, the results of current study show that microvascular sugery can be performed successfully with basic surgical instuments such as loupes. Outcome of microvascular anastmosis with the use of loupes and microscope is comparable.[15,16,17]

As the saying goes " practice makes a man perfect"; anybody keen to learn the basic techniques of microvascular surgery can do so free in any center where it is frequently practiced.

Antrelateral thigh flap was done in one third of study population. The flap was used for hand and forearm reconstruction. It provides large surface area,with soft reliable vascular pedicle. The flap is noted to be effective in large and extensive defects. Although 80% perforator needs intramuscular dissection, but with ALTF two team approach can easily be commenced. Large surface, optimum thickness, long pedicle with large caliber vessels of Latissimus dorsi muscle along with availabilty of skin component, make it first choice for wounds with extensive soft tissue loss . Funtional reconstruction is also possible if nerve is harvetsed with the flap and coaptated with suitable donor nrerve. [18,19,20.]

Four patinets, requring bone replcement, had fibula oseocutaneous. The majority of these were for forearm bony defect. In limited number of four cases, we did not find the circulation of skin paddle as reliable for flap monitoring. Gracilis flap was used for pan plexus injury patients, while

gastrocnemius flaps were used for functionalreconstruction of flexors of hand .

Perioperative monitoring of the flap was probably the biggest challenge in doing free flaps in different setup. Although we have a dedicated team of our junior doctors and nurses round the clock. Monitoring was based on clinical examination and audible hand held doppler. Compare to our failure rates (3.3%) , Klosterman T et al analyzed 136 free flap reconstructive cases at a tertiary care academic program over 20 years with 7.4% failure[21] while Kim H et al analyzed 150 head and neck free flaps with anterolateral thigh flaps over 9 years with overall failure rate of 9.3%.[22]

The incidence of hematoma formation was high in patients who received intravenous injection of heparin. The hematoma resulted in compression of the veins leading to venous congestion. Topical irrigation of heparin on the other hand seems to be a safe procedure.

In conclusion, good outcome can be expected with use of free flaps even with limited resources. Adhering to basic principles of microvascular surgery and use of surgical loupes can bring about acceptable outcome. Involvement of other disciplines like orthpedics early in the course of management can make mjor diffrence in outcome. Members of multidisciplinary team must be familiar with their strenghts and limitations; and should be supportive to each other.. They should have adequate training in micro- surgery before starting on the surgeries. The training can be imparted through fellowship programs or by faculty exchange programs. Beginers should use flaps which are easy to raise and have vascular pedicles of adequate length and caliber. This can be followed by use of newer flaps and advanced to use of perforator based flaps. Paying attention to details while raising the flap, sharp focus on anastmosis and carefully observing the flap on table and in the postopertaive period remain the mjor caveats of successful outcome. The saying that “flaps are lost on the table” is probably truer in such an environment than anywhere else. The team must also learn to support each other in the event of flap failure and regroup again to try again, for that is the only sure way of being perfect with free flaps.

Conclusion

With careful preoperative planning, developing surgical skill and vigilant postoperative care the overall success rate can be improved. Audit and research work allows departmental accountability and helps to highlight shortcomings and ways to overcome them. Regular audits are required to keep surveillance. Good results give positive reinforcement to untiring hard work. More parameters can be evaluated for further rectification of mistakes.

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