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Role of Vein Transposition for Finger Replantation after Crushing Injury

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ABSTRACT

Introduction and Objectives: Finger replantation after crushing injury represents a great challenge for hand surgeons, many techniques were described to reconstruct vascular gaps which resulted after debridement including vein grafts, vein flaps or vein vessels transfer. In this work we evaluate vein transfer to bridge the vascular gaps in finger replantation surgeries.

Patients and Methods: A single or two veins were dissected from the dorsum of finger down to the level of metacarpal's basis and transferred to be anastomosed with the distal vascular stump(s) of the amputated fingers in six patients.

Results: Replantation was successful in five patients (83%) with inconsiderable complication, moreover a significant reduction in operative time was noticed.

Conclusion: Vein(s) transfer is a simple, safe and reliable technique in finger replantation.

Key Words: *Vein graft – Replantation – Vein rerouting – Vein transfer.*

INTRODUCTION

Since Komatsu and Tamai did their first thumb replantation in 1963, the procedure continued to evolve until becomes one of the most requested procedure in trauma centers **[1]**. Nowadays, with advancement of tools and martials of microsurgery, a success rate of finer replantation reached from 80 to 90% in many series **[2,3]**. In order to have a near normal function of replanted finger, preservation of the longest length shall have the same necessities as intact sensation and mobility **[4]**. The main problem in avulsion, degloving or crushing injury is the extensive damage to long segments of vessels which makes the direct suture of the structures difficult unless excessive debridement of the surrounding structure is done which leads to considerable shortening and subsequent functional affection **[5,6]**. In order to overcome this disabling procedure venous grafts were used to bridge the defects **[7]**. Alternatively Dio transferred a healthy vessels from the other fingers to re-establish circulation in thumb replantation **[8,9]**. In this study we will evaluate the value of venous transposition in finger replantation.

PATIENTS AND METHODS

This prospective study was conducted in the plastic surgery unite, Department of Surgery, Zagazig University hospital from January 2013 to May 2015; six male patients with a mean age of 28.66± 8.75 years (range 18-42 years) who had completely amputated fingers by non-sharp object were included in this study. Heavy smokers, patients over 60 years, patients with vascular or systemic diseases (i.e. diabetes mellitus, coronary diseases) as well as those who had sharp or multiple amputations were excluded from the study. The time elapsed between excitant of injury and starting operative work ranged from two to seven hours (in our unit we accept cases up to 12 hours after injury provided that the amputated finger is chilled, Table (1) summarize patients' data.

Table (1): Patients' data.

Patient	Age	Sex	Finger	Amputation cause	Amputation level
1	21	Male	Thumb	Crushing	MP joint
2	27	Male	Thumb	Crushing	Pp
3	18	Male	Thumb	Crushing	MP joint
4	30	Male	Index	Crushing	Pp
5	34	Male	Ring	Ring avulsion	Pp
6	42	Male	Thumb	Crushing	Pp
	28.66±8.75				

Pp = Proximal phalanx.
MP = Metacarpophalangeal.

Operative technique:

Once the decision of replantation was taken, the work was started on a side table for the amputated segment during the time of preparation of patients for anesthesia. Under magnifying loop (5x Keeler) and through mid-lateral incisions neurovascular bundles were explored and debrided to the level suitable for anastomosis, after that the dorsal aspect of the amputated part was explored to find suitable vein and preparing it for anastomosis, effort was spent to find more than one vein. After that the field of operations were changed in terms of the patients, all our patients received general anesthesia and tourniquets were applied and raised 100mmHg over diastolic pressure until proximal ends of vessels were identified and prepared then micro-clamps were applied over the vessels and tourniquets were released. The stage of replantation was carried through the classical steps; after conservative bone shorting, osteosynthesis was done using double K-wires to avoid rotation of distal segment, our preferred position was flexion to make arterial anastomosis easier, most of these wires were removed one and half months post operatively and aggressive physiotherapy was started. After bone fixation, flexor and extensor tendons were repaired. Vascular repair was done under microscope (Zies-S88), through the stander steps; first arteries were trimmed to healthy level, then adventitia were removed, then vessels were mechanically dilated and flushed with heparin-saline solution. Anastomosis were done by 10/0 ethilone or nylon on round tip needle 85 micron diameter. After completion of arterial anastomosis and release of clamps the perfusion was evaluated and if it was sufficient we passed to venous repair. A slight circumferential pressure was applied to proximal forearm to produce venous dilatation and the dilated veins in adjacent finger and dorsum of hand were marked. Through a skin only incision one or two veins were dissected and their side branches were ligated to the level of metacarpals' basis proximally and distally to the level sufficient to make tension free anastomosis, a sterile tap was used to measure the sufficient length, and the directions of ligated branches were used as a marks to avoid venous twist (Fig. 2). The vein (or veins) were transferred to their recipient site through subcutaneous tunnel, and venous anastomosis were done using same suture material and technique for arterial anastomosis (Figs. 3,4). The times of arterial and venous anastomosis were recorded as well as the time for venous dissection. The final steps of procedures were nerve repair followed by skin debridement and closure over a soft drains which were removed after two to five days. Patients received low molecular weight heparin (enoxaparin) 1mg/kg twice a day for five days as a routine therapy combined with IV fluid (3000ml/day), which was replaced by aspirin in next two weeks.

RESULTS

Replantation was successful in five patient with uneventful postoperative period. In one patient who had single venous anastomosis, congestion noticed at third postoperative day, patient was transferred to OR and exploration revealed hematoma around the vein and intravascular thrombosis, thrombus was remove and anastomosis was revised but the finger was not salvageable (success rate was 83.3%). We didn't notice any donor site complications. In four patients, two veins were repaired, while in two patients only one venous anastomosis was done. Regarding to arterial anastomosis, in three patients two arteries were repaired and in the remaining patients only one artery was suitable for repair. The total operative time for replantation was ranger 3.5 to 4.3 hours (Mean 3.8 hours). And the time needed for dissection and transposition of a vein ranged from 20 to 25 minute (Mean 24 ±2.7m), statistical analysis using *t*-test reveals a significant difference ($p<0.05$) between the time needed for dissection and transposition for one vein and that needed for single venous anastomosis (Table 2). None of our patients needed blood transfusion either intraoperative or in postoperative period. All our patients restored protective sensation and near normal range of motion in replanted finger after six months.

Table (2): Operative times.

	Total operative time (minute)	Arterial anastomosis time (Number of arteries x minute)	Venous anastomosis time (Number of veins x minute)	Venous transposition time
1	235	2x30=60 m	2x34=68 m	20 m
2	228	1x38=38 m	2x37=74 m	24 m
3	260	2x37=74 m	1x35=35 m	28 m
4	233	2x29=58 m	2x30=60 m	25 m
5	210	1x40=40 m	1x40=40 m	25 m
6	215	1x45=45 m	2x27=54 m	22 m
	230±17 m (3 hours 50m	51.83±13.71 m	55.5±15.3 m	24±2.7

Fig. (1): Pre-operative state.

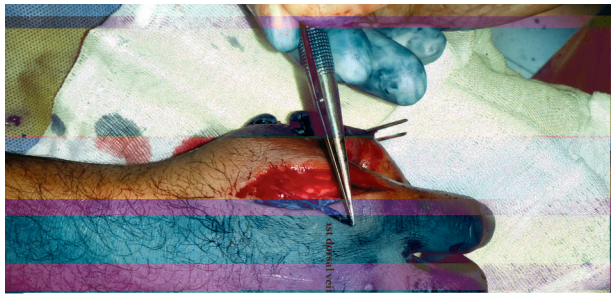

Fig. (2): Dissection of dorsal vein.

Fig. (3): Two venous anastomosis (black and blue arrows) after passage of vein under the skin. (Green arrow).

Fig. (4): Thumb after replantation.

Fig. (5): Replanted thumb after three months.

DISCUSSION

Salvage of amputated fingers is a common surgical procedure in modern surgery **[10]**. Crushing and avulsion injuries produce wide zone of devitalized tissues which need to be debrided and replaced by healthy structures **[11]**. Traditionally vascular defects were treated with free venous graft **[12]**, however other technique were described to solve this problem like vein flap or reversed cross finger flap to exploit their longitudinal vein for bridging the defects, **[13,14]** but vessel transfer remains a good alternative **[9,15]**. As venous engorgement is more often the cause of replantation failure than arterial deficit, its meticulous repair is of paramount importance in replantation, **[16]** moreover effort should be spent to repair more than one vein to ensure adequate venous drainage **[17,18]**. In this work we found that the transfer of veins from the dorsum of finger to reconstruct venous drainage of the amputated fingers is a helpful procedure in the replantation surgery. The time required for vein dissection and transfer was found significantly shorter than the time needed for single venous anastomosis which leads to reduction of replantation time and saving suture material with subsequence reduction in operative cost. Moreover, the chance for development of intravascular thrombus could be decreased with

reduction of the numbers of anastomosis within the vessel **[9]**. Regarding the success rate we have found that our technique has the same rate or slightly higher than other series of replantation after crushing and avulsion injuries (66%-87%) **[10,11,15]**. Safety of any surgical procedure has the same importance of its efficiency, in our work we found that vein transfer is not only a simple procedure but it is also a safe one, as no general or vascular complication (congestion or ischemia) was developed in any patient due to vein(s) harvesting, this finding is supported by the work of Zhang who studied the venous pattern of finger and hand and found that harvesting or transferring of one or two dorsal veins is tolerable and didn't lead to compromising finger's circulation **[19]**.

Finally we conclude that vein(s) transfer is a simple, safe and reliable technique in finger replantation.

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