Original Article

Neurovascular Island Flap Applied to the Tissue Defects of the Thumb

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ABSTRACT:

Introduction: *This study was done to observe the results of neurovascular island flap utilized in the treatment of pulp defects of thumb.* ***Methods:*** *Nine patients were included in the study from 2014 to 2018. Eight of the patients were male and one was female. Mean age was 42.77 (range 28 to 65) years. Seven patients had tissue defects on their right thumb, and two on their left. The sensory and functional outcomes and wound healing on the receiving site were evaluated. Additionally, we determined a 2-point discrimination and cortical re-orientation.* ***Results:*** *In all patients, the flap was healthy and no necrosis was observed. Mobility and stability of the thumb were optimal in all cases. In 2 patients, scar tissue development was observed at the donor site, but there was no functional deterioration. Sensory examination was normal in all patients. Mean value of 2-point discrimination was determined as 6.5 (range 3-10) mm.* ***Conclusion:*** *Littler neurovascular island flap is an effective treatment which re-establishes sensory ability in the thumb injuries with tissue loss.*

Keywords*: Neurovascular island flap, Reconstruction of the thumb, Littler flap.*

(The Planet 2019; 3(1): 25-31)

INTRODUCTION:

Trauma to the hand may result in soft tissue defects which causes functional loss.[1] The thumb is crucial in hand function. Daily activities such as holding, gripping, opposition, circumduction and motions involving the manipulation of the hands are possible because of the unique anatomical properties of the thumb. Thus, damage to the thumb results in greater loss of function compared to the other fingers.[2] Various flap types are used to repair tissue defects of the fingertips. Local V-Y flaps establish good

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sensory function; however, their size and transfer distance are limited.[3] Neurovascular island flap can be utilized in relatively larger defects; however, they may cause dorsal necrosis.[4] Cross-finger flaps may be used for the same purpose, but this method requires a 2-step surgery.[5] Conventional cross-finger flap provides stable padding, but sensory recovery is prolonged and often does not restore tactile gnosis. The main disadvantage of this technique is, it's a two-stage procedure and require finger immobilization for two to three weeks. The Littler flap is widely used in the tip and pulp defects of the thumb because this method flawlessly restores sensory function.[6] In 1956, Littler described an island flap raised from the ulnar aspect of the middle or ring finger based on the ulnar digital neurovascular bundle in order to reconstruct soft tissue defect to the thumb pulp. To reduce donor site morbidity and to achieve a better sensory recovery some authors have proposed to harvest the donor skin from the lateral side of the middle phalanx with the vascular pedicle located on the palmar side of the flap.

METHODS AND MATERIALS:

The nine operations were performed as described by littler in 1960. The operations were performed in a bloodless field and under general anesthesia. By a palmar incision carried distally on the ulnar mid-lateral aspect of the ring or middle fingers to the level of the pulp, which may include the skin from the ulnar side of the middle or distal phalanx. The neuromuscular bundle from the level of the superficial arterial arch is isolated. The proper digital artery to the adjacent finger is cut between ligatures and the common digital nerve is cleaved. The reach of the pedicle is limited by the length of the nerve and not by the extensible artery; it should permit the flap to reach the extended thumb without tension. When mobilized the skin island is passed subcutaneously to the recipient area and sutured. The donor defect is covered with a full-thickness graft.

Nine patients who were applied with defects on the distal tissue of the thumb from 2014 to 2018 were included in the study. In seven patients crushing trauma were the cause of the defect. Two patients had electric burn. Among the patients, 8 were male and 1 was female, mean age was 42.77 years (28 to 65). Mean duration of follow-up was 22 months (10- 60). 7 patients had tissue defects on their right thumb and 2 on their left. In all patients, 2-points discrimination and cortical re-orientation were determined, in addition to the evaluation of sensory and functional outcome and wound healing on their receiving site.

RESULTS:

We did not observe necrosis of the flap or donor site wound problems in any of the patients. None of the patients developed restriction of mobility or contractures in the thumb or donor finger. Only two patients developed scar tissue at the donor site without any functional loss. Three patients had cold intolerance. Sensory examination was normal in all patients. Mean value of 2-points discrimination was determined as 6.5

(range 3 -10) mm. Cortical reorientation was found to be satisfactory in all patients.

Table-1

Case no	1	2	3	4	5	6	7	8	9
Age (years)	36	49	28	32	47	29	65	54	45
Sex	Male	Male	Male	Male	Male	Female	Male	Male	Male
Etiology	Cut injury	Electric burn	Machine injury	Machine injury	Cut injury	Machine injury	Electric burn	Machine injury	Machine injury
Period of observation (m)	54	48	36	42	18	24	11	7	16
Dominant hand	Right	Left	Right	Right	Right	Right	Left	Right	Right
Paraesthesia	-	-	+	-	-	-	+	-	-
Reorientation	+	-	+/-	+	+	+/-	-	-	+/-
Pick-up test	-	+	-	+	-	-	+	+	-
Donor finger	Ring	Ring	Ring	Ring	Ring	Ring	Ring	Ring	Ring
Defect size Flap size (mm)	30x20 40x30	42x20 47x30	35x20 45x30	25x20 35x30	45x20 50x28	28x20 35x30	45x20 50x30	36x20 40x30	50x20 55x30
Two point discrimination (mm)	10-11	6-7	4-5	3-4	9-10	6-7	5-7	7-9	8-10
Pain	+	+	+	+	+	+	+	+	+
Touch	+	+	+	+	+	+	+	+	+
Temperature	+	+	+	+	+	+	+	+	+
Cold intolerance	-	-	-	+	-	-	-	-	-
Callosity formation	-	Donor	-	-	-	Donor	Donor	-	-
Trophic change	-	-	-	-	-	-	-	-	-

Contracture	-	Donor	-	-	-	-	-	-	-
Subjective judgment	Good	Good	Fair	Good	Good	Good	Good	Fair	Good

All nine patients were re-examined by an author. The observation time was between 6 months to 5 years. The results are as stated in Table1. Some of the points are commented upon below.

Dominant hand: None of the patient changed the dominant hand

Paraesthesia: patient no 3 and 7 complained of paraesthesia in the donor finger whenever the flap was touched.

Reorientation: Three patients had no cortical reorientation. Three stated that they felt stimuli of the flap as coming both from the thumb and from the donor finger. Three had complete reorientation but stated that sudden, unexpected painful stimuli of the flap area were felt as coming from donor finger. All patients with complete and partial reorientation stated that even several years after the operation the orientation was continuing to improve.

Cold intolerance: One patient had cold intolerance; most patients mentioned a slight, albeit not annoying cold intolerance.

Pick-up tests: These were performed without the patient's visual control. Four patients had some delay. And five gave up during the test.

Two points discrimination: The test was performed by an ergo therapist experienced in 2-point discrimination testing and with no prior knowledge of the patients.

Pain: All patients were able to distinguish between the sharp and the blunt end of a needle.

Touch: All patients could feel anything in the flap area.

Temperature: All patients could distinguish hot and cold in the flap area.

Trophic change: All flaps were vital, with no sign of atrophy.

Callosity formation: This was present in the margin of the grafted area on the donor finger in three patients.

Contracture: contracture developed on the donor finger in one case.

Subjective judgment: the patient's own estimation of the functional value of the thumb is described as good(G), fair(F) and poor (P).

Figure1 : Neurovascular island flap for left thumb

Figure2:Reconstruction of defect thumb

Figure 3: Neurovascular island flap for right thumb

DISCUSSION:

The thumb plays a very important role in hand function. It is important to take any kind of measure to restore the mobility, stability, length and sensory properties of the thumb after hand trauma. The Littler heterodigital neurovascular flap and Foucher first dorsal metacarpal artery flap are methods used to achieve this purpose.[7] Iraklis and colleagues compared these two methods and came to the conclusion that they were similar in terms of the potential for the development of necrosis, contracture and reflex sympathetic dystrophy. However, they found that the Foucher flap was significantly superior in regard to cortical re-orientation and stereognosis.[7]

Peraut et al. reported the results of Littler flap in 2 patients who had ring avulsion trauma. Both patients were reported to have satisfactory 2-point discrimination and cortical re-orientation.[8]

The primary complications of heterodigital neurovascular island flaps have been identified as follows: cold intolerance, low somatosensory cortical integration and weakened sense of discrimination.[9]

In a study by Hashem et al., the results of 6 patients who received Littler's flaps were presented and all flaps were reported to remain healthy. Two points discrimination was found as 8.3 mm's and 3 of the patients had cold intolerance.[10]

In a study, Svend Boe reported that a 2-point discrimination value better than 15mm was found in 8 patients out of 9, according to Moberg, a condition of tactile gnosis.[11]

Krag et al reported, all 6 patients referred pin-prick in the flap to the donor finger; all had absent 2-point discrimination corresponding to the flap, although it had been present within normal limits a few months after operation; And all had better touch, pain and temperature sensibility in the flap.[12]

In our study, no flap or donor site necrosis was found in any of the patients. Six patients described the result as good or fair. It is seen that all these patients have complete or partial reorientation. Two points discrimination was found as 6.5 mm. No connection between the numerical value and the functional result was found; thus patient no-3 had poor 2-point discrimination but was functionally among the best. The picking -up test is valuable but is very much affected by the sequel of associated lesions. One patient had cold intolerance. Major complaints from the donor finger were not found but one of the patient donor finger developed contracture which was corrected by multiple Z-plasty.

CONCLUSION:

The neurovascular island flap is effective in treating volar pulp defects of the thumb because it can sufficiently restore distal sensory ability and help preserve crucial hand function. The most important factor leading to a good result is cortical reorientation. Therefore the method can be recommended for young patients who are able to cooperate in the training of cortical reorientation and also postoperative

sensory training is important.

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