

Utility of First Dorsal Metacarpal Artery Flap for Thumb Defects

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ABSTRACT

Background: Thumb defects induced by trauma lead to significant functional disability. The goal of this study was to identify the safety, versatility, and limitations, benefits, and functional outcomes, range of motion and reestablish sensory experience. These characteristics, in addition to a secure soft tissue cover, are needed for thumb restructuring.

Study design: This was a retrospective study carried out in the Plastic Surgery Department of Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi from November 2021 to December 2022.

Methods: The total 17 participants with traumatic thumb defects which insert and treated with island flaps. The participants included 5 females and 12 males, the age group was 20-50 years and the average age (36 years). All patients were evaluated for the occurrence of early post-operative complications in terms of flap necrosis.

Results: The operative time was 1 hours. The 15 participants underwent island FDMA flap except 2 participants which show necrosis but without again treatment recover. To evaluate the esthetic and functional outcome by Kapandji score, 2-PD, SS score and esthetic outcome follow by one year. Regarding the functional recovery Kapandji, 2-PD, the esthetic and subjective satisfactory score outcome was evaluated and show significant changes $p < 0.005$.

Conclusion: FDMA is one of the best choices for reconstituting distal thumb injuries, and it is a simple technique that has the potential to enhance the island's survival and lowering the rate of distal necrosis. The FDMA flap provides good functional results while causing little donor-site morbidity.

Keywords: Cortical reorientation, Metacarpal artery, Island Flap, Two point discriminate.

INTRODUCTION

The first dorsal metacarpal artery flap is nowadays the preferred treatment for thumb defect. The orthopedic surgeons face a major challenging problem in trying to restore functional capacity to the thumb pulp. The most frequently used dorsal nerves and branches to the FDMA flap to rebuild destructive thumb. ^{1, 2} Avulsion injuries was the most common cause of thumb defects. While skin grafts can be used to treat superficial flaps, profound abnormalities are more difficult to repair because there is a shortage source locally tissue. Traumatic distal thumb deformities are treated by preserving sufficient length, sensation, and soft tissue cover and type of tissue lost will dictate the thumb reconstruction technique. There are several options, including free skin grafts, lateral triangular advancement flaps, and FDMA flaps. The radial artery gives rise to the first dorsal metacarpal artery in the first intermetacarpal space, just distal to the extensor pollicis longus tendon. The artery is divided into three branches: the thumb's radial branch, the intermediate branch to the first web space, and the index finger's ulnar branch. ^{3, 4} The destructive crush injury to the thumb and fingers was a severe injury, but no comprehensive suggestion for the best medical treatment for it occurs. ^{5, 6} There are some drawbacks to using a regional or distant flap to repair and reconstruct a severely broken finger in traditional treatments. Abdominal flaps or skin tunnels can be used to cover and reconstruct the injured finger, but the results are frequently unsatisfactory in terms of appearance and improved function. ^{7, 8} Despite this variety, each technique has its own set of drawbacks. Because of its low donor site morbidity, aesthetic compatibility, sensation, and cortical reorientation. The first dorsal metacarpal artery flap was one of the best choice for thumb soft-tissue defects today and developed the FDMAF, which can be raised with sensory innervation from the dorsum of the second finger. ⁹ However, there has been much debate over the past decades about the best soft tissue coverage for thumb defect by flaps. ^{10, 11} Hand trauma is an important aspect of reconstructive surgeon practice. Hand injuries that are not recognized or managed properly can have long-term effects on patients' quality of life, function, and work productivity. The finger, and especially the thumb, are the most important tactile organs. Thumb defects that expose tendons, bone, or joints pose a difficult reconstructive problem. The immediate coverage of the wound is the highest priority for preserving function, sensibility, and aesthetics. A variety

of flaps and the semioclusive dressing technique are commonly used for reconstruction. ¹² The goal of this study is to quantify the safety, versatility, and limitations, benefits, and functional outcomes, range of motion and reestablish sensory experience. These characteristics, in addition to a secure soft tissue cover, are needed for thumb restructuring.

METHODOLOGY

This was a retrospective study carried out in the Plastic Surgery Department of Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi from November 2021 to December 2022. The total 17 participants with traumatic thumb defects which insert and treated with island flaps. The five females and twelve males, the age group was 20-50 years and the average age (36 years). According to inclusion criteria: the age range >20 and ≥ 50 years and crushed injury of thumb. Regarding the functional recovery 2-PD, the esthetic and subjective satisfactory score outcome was evaluated. The approval letter was obtained from ethical committee of hospital.

RESULTS

The first dorsal metacarpal artery island flaps were used for reconstruction of defected thumb in 17 cases. That after general anaesthesia, the flap was highlighted to the defectiv location of the thumb. A protective splint was applied after the suturing and graft dressing were completed. The sutures were removed 12 to 15 days after surgery, and all participants received physiotherapy. For a year, the patients were followed up on every three months. All participants were survived completely. The follow-up period was 1 year.

Table 1: Pre-operative participant's data

Total participants	Frequency n=17(%)	
Age	(20-50) years	38.4±3.8 or average= 36 years
Gender	Male	12(71%)
	Female	5(29.4%)
Affected side	Left thumb	7(41.1%)
	Right thumb	10(59%)
Surgery Time	Emergency time	11(65%)
	Delay time	8(47%)

The 17 participants' average age was 36 years. Men made up 71% of the affected participants, while women made up 29.4%. Compared to the left side, the right side of the thumb sustains 59%

more injuries. Approximately 65% of the procedures were emergency surgeries were shown in Table 1.

Table 2: Post-operative participant's data

Case No#	Sex/age	Flap sizes (cm)	Operative time	Reach Flap size(cm)	Injury complication
1	M/30	3x5.1	45	8.5	No
2	M/22	3x1.3	45	6.5	Distal necrosis
3	M/42	3x5.5	60	7	No
4	M/48	4x6	40	8	No
5	M/20	3.5x3	55	9.5	No
6	F/40	3x3.5	50	10	No
7	M/45	4.6x6	45	10	No
8	M/25	3x5.5	60	7.5	No
9	F/28	3.5x7	60	9	No
10	F/35	4.1x5	40	10	No
11	M/49	3x3.5	55	9.2	No
12	F/38	4x5.5	60	7.1	No
13	M/33	4x6.5	43	6.6	Necrosis
14	F/41	3x1.5	45	6.2	No
15	M/50	3x3.3	55	7	No
16	M/27	3.5x3	60	9	No
17	M36	4.7x2	45	10	No
Mean±SD	35±10	3.2x0.4 x 5.1x0.9	45±5	-----	-----

The all flaps were survived to the grafted donor site taken well. 15 participants' flaps survived completely and two had necrosis appearances that was healed during follow up period. The mean of flap size was 3.2x0.4x5.1x0.9 and flap reach was 8.7±5 observed on the donor site were seen on Table 2.

Table 3: To evaluate functional outcome

Case No#	Functional outcome		
	Kapandji score	S2-PD(mm)	Cortical reorientation
1	8	10	Complete
2	7	11	Complete
3	6	8	Incomplete
4	9	10	complete
5	7	7	incomplete
6	8	8	incomplete
7	5	15	complete
8	9	13	complete
9	7	9	incomplete
10	7	10	complete
11	9	14	complete
12	8	10	Complete
13	8	10	incomplete
14	6	11	complete
15	9	13	complete
16	8	15	complete
17	7	9	incomplete
P=	P<0.04*	P<0.02*	

The functional outcome included Kapandji and 2-PD were shown significant changes (p<0.04*; 0.02*). Static 2-point discrimination (s2-PD) and cortical reorientation testing was used to assess sensory function which stimulation came from the thumb or the index. The Kapandji score 15 was used to assess the mobility of the first ray. Ten (59%) of the participants had completed cortical reorientation were shown in Table 3.

Table 4: To evaluate esthetic outcome and Subjective satisfactory score (SS score)

Case No#	Esthetic outcome	SS score	Follow up months
1	Good	7	8
2	Good	8	9
3	Excellent	10	11
4	Poor	3	4
5	Good	9	11
6	Excellent	10	12
7	Good	8	9
8	Good	6	5
9	Excellent	10	11
10	Good	6	5
11	Good	8	7
12	Excellent	9	10
13	Poor	4	7
14	Excellent	10	12
15	Good	6	7
16	Good	7	8
17	Poor	4	3

The study was followed for a year. The different plastic surgeons objectively assessed the aesthetic outcome and graded it as poor, good, or excellent. The patient's subjective satisfaction was assessed in terms of functional recovery as well as the aesthetic appearance of the flap and donor site were seen in Table 4.



Figure 1: Case 12. (a) Pre-operative dorsal thumb defect with exposed extensor tendon. 38-year-old female addressed with an injured area on the dorsal aspect of her right thumb near the joint joint. Figure 1 depicts preoperative photographs (a). The patient received therapy with an FDMA flap for the thumb, and the flap managed to live for 3 to 10 months after the procedure, as shown in Figure 1. (b).



Figure 2: Case 8. (a) Pre-operative photograph of exposed dorsal thumb injury. (b) Post-operative photograph displayed flap was transferred to reconstruct the thumb's dorsum. A skin graft were used to cover the donor site. Postoperative photos taken 3 to 5 months after surgery show good flap mobility.

DISCUSSION

The artery was located using a Doppler's probe before the path was marked with a needle to perform the FDMA flap as an island. The flap is drawn on the index finger's dorsum, and both its width and length must correspond to the thumb defect.^{13, 14} As an island flap, the FDMA flap has a high risk of necrosis, most likely from venous congestion, and can be raised. It was believed that the presence of skin extension in an island flap would help venous drainage, preserve superficial veins, and increase flap survival.¹⁵ An additional significant factor could be the flap's inadequate venous drainage, which would result in distal tip congestion and

necrosis. Venous insufficiency, which results in venous congestion, edoema, and other related effects, is one of the most typical side effects of the perforator flap.¹⁶ In our study, we discovered that 17 participants who had injured or crushed thumbs had used the island FDMA technique. The findings revealed less congestion and necrosis in the FDMA flap, with 2 participants (12%) showing necrosis and 15 participants (88%) showing no necrosis at all. We observed the wound healing process in our participants for a month without the use of any additional procedures, and all of the participants' wounds healed properly with tolerable scars and hand function.¹⁷ In a prior study, distal phalangeal defects of the thumb, the FDMA flap has been shown to be useful by a number of authors. The average rating for subjective satisfaction was (9.3). The FDMA flaps to treat thumb deformities and noted that all deformities were treated with acceptable cosmetic outcomes, functional recovery, and little donor site morbidity are also in agreement. Our study discovered that, over the course of a mean follow-up of 12 months, our participants' average Kapandji scores were (7 score). Similar to our study's findings, 17 participants' average Kapandji scores were 7 after a year of follow-up, and it was determined that the FDMA flap is the best treatment option for covering thumb defects. According to our study, the subjective satisfaction score ranged from 7 to 10, and the majority of our patients were happy with the functional and aesthetic outcomes. This study supports earlier research.^{18, 19} Previous research found that this technique, particularly in females, has significant limitations due to the unsatisfactory aesthetic results. Some participants had their thumb defects treated with an FDMA flap, and it was reported that none of the donor site participants experienced any morbidity as a result. In our study, we discovered that a nerve graft made from the proximal part of the proper digital nerve's dorsal branch was used to treat the donor site's defect of the proper digital nerve. Surgeons evaluated the aesthetic outcome and graded it as poor, good, and excellent were shown in fig 1, 2.^{20, 21} The results of the static two-point discrimination test and the total active motions in both the recipient and donor fingers were almost normal at the final check-up.²² With minimal donor-site morbidity, this island flap offers a quick and reliable alternative for treating significant thumb pulp defects. "Cortical reorientation" refers to the brain's capacity to distinguish any stimulation of the flap site as coming from the thumb rather than the index. The 17 participants included 11 (65%) with complete cortical reorientation, which means that after recovery, the thumb and finger could be moved easily, but 6 (35%) with incomplete cortical reorientation did not move.^{23, 24, 25}

CONCLUSIONS

FDMA is one of the best choices for reconstituting distal thumb injuries, and it is a simple technique that has the potential to enhance the island's survival and lowering the rate of distal necrosis. The FDMA flap provides good functional results while causing little donor-site morbidity.

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