

Dorsal Metacarpal Artery Flaps

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ABSTRACT

Background:

The dorsal metacarpal artery perforator flap is a versatile solution for resurfacing soft-tissue defects of fingers, dorsum of the hand and web space. The author presents his experience in applying this flap for a variety of finger wounds for which conventional means may not be amenable.

Soft-tissue defects in the fingers, dorsum of the hand and web space are common and usually require adequate reconstruction with flaps to prevent functional deficits.

Objectives: The aim of this article is to review published anatomy of the dorsal metacarpal arteries (excluding the first) and present the author's experience in using various types of dorsal metacarpal artery flaps for reconstruction of fingers, thumb, dorsum of the hand and web space. The author presents his experience in applying these flaps for a variety of finger wounds and contractures.

Methods: A total number of twelve cases of various types of dorsal metacarpal artery flaps were done in Shebin Elkom Teaching Hospital from March 2013 to March 2015 with age ranges from 2 years till 65 years with mean age was 30.3. Ten cases were males and two cases were females. Seven cases were second dorsal metacarpal artery flap. Two cases were double pivot for thumb reconstruction after trauma and first web space reconstruction and three cases were classic type for dorsal hand reconstruction. Other two cases of extended second dorsal metacarpal artery flap for reconstruction of the fingers. One case of Boomerang flap from the dorsum of the third dorsal finger to reconstruct the tip of the second finger. Two cases of third dorsal metacarpal artery flap for reconstruction of the dorsum of the hand. Two cases of fourth dorsal metacarpal artery flap for reconstruction of the dorsum of the hand and little finger. All flaps survived completely with adequate postoperative results. Follow for at least 3 months.

Results: All flaps were survived with good functional results and acceptable cosmetic appearance.

Conclusion: The dorsal metacarpal artery flaps are good alternative for reconstruction of soft-tissue defects of the fingers, dorsum of the hand and web space. Its advantages are simple technique, thin tissue, and minimal donor site morbidity.

Key Words: Dorsal metacarpal artery flap – Hand flap.

INTRODUCTION

The first author who used an axial pattern flap from the dorsum of the index finger was Hilgenfeld [1] who employed the flap in thumb reconstruction. Later Holevich [2] and Fouchearnd Braun [3] refined the concept by narrowing the pedicle until finally true island flap based on the first dorsal metacarpal artery was developed.

The second dorsal metacarpal artery did not enjoy the same popularity: First experiences were published by Vilain and Dupuisin 1973 [4] Iselin [5]. The first true second dorsal metacarpal artery flap was by Lister [6]. This flap used a perforator branch between dorsal and palmar system frequently found in the web space [7]. The dorsal metacarpal artery flap is classified as a fascio-cutaneous flap. The dorsal network communicate with the superficial arch via constant anastomoses. These anastomoses form the basis of the reverse metacarpal flaps [8,9] which have further enhanced the versatility of this arterial system. More communicating vessels are found in the web space and the proximal phalanx thereby creating new options of flap design.

Antegrade metacarpal flaps:

The presence of the dorsal metacarpal artery is decreasing from the radial to the ulnar aspect of the hand. The fourth dorsal metacarpal artery may be missing in 17-30% [10]. Therefore, Doppler examination prior to flap elevation is mandatory.

The second dorsal metacarpal artery flap can be raised as a single lobe flap or can be raised as a bi-lobed flap using the branching vessels in the web space [10,11,16,17]. The arc of rotation of all dorsal metacarpal flaps allows for coverage of proximal defects of adjacent fingers and of smaller defects of the dorsum of the hand or the wrist area.

Reversed (extended) metacarpal artery flap:

Anatomical studies by Early [12] and others [19,20] have demonstrated constant arterial anasto-

mosis between the dorsal digital network and the superficial palmar arch at the level of the metacarpal heads. Another anastomosis are found between this network and palmar digital arteries. The reverse metacarpal artery flaps have been based on these findings [9,10,18,21].

Anatomy:

The second to fourth dorsal metacarpal arteries arise from the dorsal carpal arch. Near their origins they anastomose with the deep palmar arch by proximal perforating arteries and, near their bifurcation, with dorsal perforating branches from the palmar metacarpal arteries which pass between the metacarpal necks. They also anastomose distally at the level of the web spaces with dorsal perforating branches from the palmar digital arteries. The third and fourth dorsal metacarpal arteries are much smaller than the first and second.

Cutaneous branches from the dorsal metacarpal arteries supply the dorsal skin as far distally as the proximal interphalangeal joint. At the level of the neck of the second, third and fourth metacarpals, direct cutaneous branch are given off which passes proximally and supplies an area of skin between the two adjacent metacarpals.

These anatomical arrangements permit the surgical elevation of flaps of dorsal skin to be based either proximally on the dorsal metacarpal arteries proper, or distally on the direct cutaneous branch. These flaps may be used for reconstructing areas of missing tissue elsewhere in the hand [32].

The first and second arteries are anatomically constant, making them very safe as a source of pedicle flaps. In the other hand, the third and fourth DMAs are not constant. Therefore, it would be wiser to confirm their presence with Doppler prior to surgery [22].

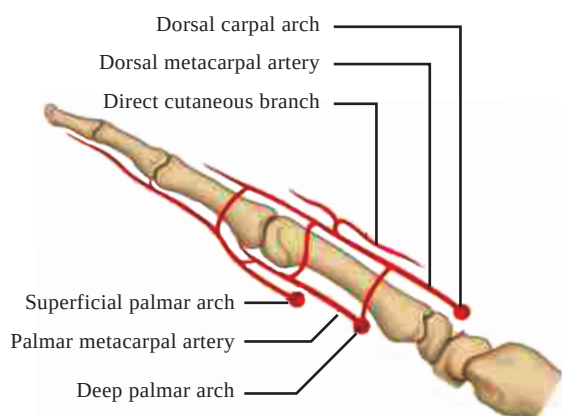


Fig. (1): Dorsal metacarpal artery anatomy (23).

MATERIAL AND METHODS

A total number of twelve cases of various types of dorsal metacarpal artery flaps were done in Shebin El-Kom Teaching Hospital from March 2013 to March 2015 with age ranges from 2 years till 65 years with mean age was 30.3y. Ten cases were males and two cases were females. Seven cases were second dorsal metacarpal artery flap. Two cases were double pivot for thumb reconstruction after trauma and first web space reconstruction and three cases were classic type for dorsal hand reconstruction. Other two cases of extended second dorsal metacarpal artery flap for reconstruction of the fingers. Three cases of the third dorsal metacarpal artery were done. One case of Boomerang flap from the dorsum of the fourth finger dorsum to reconstruct the third finger tip. Another two cases of classic third dorsal metacarpal artery flaps for reconstruction of the dorsum of the hand were done. Two cases of fourth dorsal metacarpal artery flap for reconstruction of the dorsum of the hand and little finger. All flaps survived completely with adequate postoperative results. Follow for at least 3 months.

RESULTS

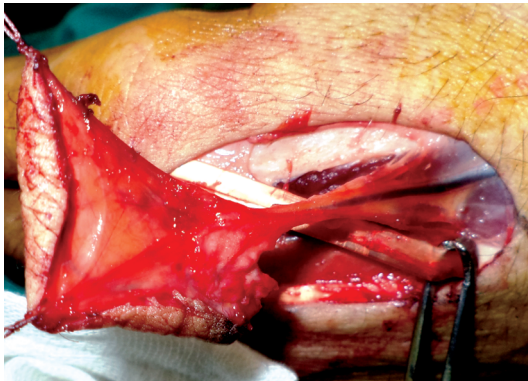
All flaps survived with good functional results and acceptable cosmetic appearance. Donor site of all dorsal metacarpal flaps were closed directly except one case which was grafted. Functional and cosmetic results were acceptable.



(2-A): Preoperative.



(2-B): Design.



(2-C): Intraoperative.



(2-D): Postoperative.

Fig. (2): Second dorsal metacarpal artery flap Double pivot (Case 1).



(3-A): Preoperative.



(3-B): Postoperative.

Fig. (3): Third dorsal metacarpal artery flap (Case 2).



(4-A): Preoperative.



(4-B): Postoperative.

Fig. (4): Fourth dorsal metacarpal artery flap (Case 3).



(5-A): Preoperative.



(5-B): Postoperative.

Fig. (5): Second dorsal metacarpal artery flap (Case 4).



(6-A): Preoperative.



(6-B): Intra-operative.



(6-C): Immediate post-operative.



(6-D): Late Post-operative.

Fig. (6): Extended second dorsal metacarpal artery flap (Case 5).



(7-A): Preoperative.



(7-B): Intra-operative.



(7-C): Intra-operative.



(7-D): Postoperative.

Fig. (7): Boomerang third dorsal metacarpal artery flap (Case 6).

Table (1): Summary of cases.

No.	Age	Sex	Etiology	Site & size	Procedure	Follow-up	Result
1	44	M	Trauma	Dorsum of the hand & 2 nd finger skin 5x4 cm	Classic 2 nd	5M	Good
2	19	M	Trauma	3 rd fingertip injury	Boomerang flap 3 rd metacarpal	5M	Good
3	42	M	Trauma	Web space 5x3	2 nd metacarpal Quaba flap	7M	Good
4	55	M	Trauma	Dorsum of the hand 4x3	Classic 3 rd metacarpal	3M	Good
5	2	F	Trauma	Degloved left little finger	Classic 4 th metacarpal	3M	Small raw area healed conservatively
6	12	F	Trauma	Dorsum of the hand 5x4	Classic 2 nd metacarpal	4M	Good
7	65	M	Tumor excision	Dorsum of the 3 rd finger 4x3	Classic 3 rd metacarpal	4M	Partial necrosis healed conservatively
8	40	M	Trauma	Dorsum of the hand 5x4 cm	Classic 4 th metacarpal	3M	Good
9	30	M	Trauma	Dorsum of the hand 5x5 cm	Classic 2 nd metacarpal	6M	Good
10	19	M	Trauma	Dorsum of the hand & index finger 5x2	Extended 2 nd metacarpal	4M	Good
11	39	M	Trauma	Dorsum of the hand & 2 nd finger skin 10x4 cm	Extended 2 nd metacarpal+STSG	6M	Small raw area healed conservatively
12	48	M	Trauma	Dorsum of the hand 4x5	Classic 2 nd metacarpal	3M	Good

DISCUSSION

The dorsal metacarpal artery perforator flap is a versatile solution for resurfacing soft-tissue defects of fingers, web spaces, thumb and the dorsum of the hand. The cause of these defects may be trauma with, contracture release or tumor excision.

Many modalities are used for covering and reconstruction of these areas including skin grafting [24,25], local random flaps e.g. rotation flap, z plasty 5 flap, MV flap and VY flap [26,27,29,30], local pedicled flap from the hand eg dorsal metacarpal flaps [31,32,34-39], moberg flap [40,41], island flap [42], cross finger flap, dorsal turnover flap [43,44,45], regional pedicled flaps from the forearm, abdominal wall and groin flaps [46,47,48] and free flaps [49].

Skin grafting is an easy technique but it is only limited to small defects without exposed bone or tendons. Applying full thickness graft to the injured finger can be done successfully when there are small gaps in the tendon sheath, but not after more extensive flexor tendon exposure. Full thickness graft reconstruction will cover intact nerves, arteries and the flexor tendon sheath well [25].

Local random flaps are good option in small defects and contractures in the presence of supple nonscarred skin but not suitable in the presence of scar tissue and in tissue loss.

Moberg flap is a good sensate flap in volar thumb defects but has no rule in dorsal hand or web space reconstruction.

Cross finger flap needs another operation for flap separation and island flap needs extensive dissection.

Turnover flap is adequate only for dorsal finger defects.

Forearm flaps, and free flap need leaning curve and has many complications. Groin flap and abdominal flaps need another operation for flap separation.

First dorsal metacarpal artery flap is a good sensate flap for reconstruction of dorsum of the hand, 1st web space and thumb in one stage operation. Donor site graft is acceptable.

Second, third and fourth dorsal metacarpal artery flaps has wide range of resurfacing for soft-tissue defects of fingers, web spaces, thumb and distal portion of the dorsum of the hand technique of harvesting is easy and donor site is closed directly in most of cases. The only disadvantage is that it is nonsensate.

Conclusion:

The dorsal metacarpal artery flaps are good alternative for reconstruction of soft-tissue defects of the fingers, thumb, dorsum of the hand and web

space. Its advantages are simple technique, thin tissue, minimal donor site morbidity, and a good appearance without bulk.

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