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ORIGINAL ARTICLE

Evaluation of versatility of use of island first dorsal metacarpal artery flap in reconstruction of dorsal hand defects

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Summary *Background:* Posttraumatic dorsal hand defects with exposed tendons and/or bones represent a challenge to reconstructive surgeons. Many options are suggested ranging from local, regional, distant up to free flaps. First dorsal metacarpal artery island flap was commonly prescribed for reconstructing the thumb or first web space defects.
Methods: During a 30 month's period, 23 patients, 15 males aged between 17 and 48 years and 8 females aged between 18 and 36 years presented by posttraumatic dorsal hand defects. Of them 18 had both exposed tendons and bones while 5 had exposed tendons only. The defects dimensions ranged between 3 × 4 cm and 4.5 × 6 cm. All defects were reconstructed by using a single stage first dorsal metacarpal artery island flaps.
Results: All flaps survived completely without complication during the mean follow up period of 2 years. All patients were very satisfied both functionally and aesthetically by the procedure.
Conclusion: Island first dorsal metacarpal artery flap is a good option for reconstructing mild to moderate dorsal hand defects with acceptable functional and cosmetic results.

1. Introduction

Dorsal hand has a unique structure with thin skin and less subcutaneous tissue which allows extensor tendons to glide freely under it. The best reconstructive option in hand defects is to replace the lost tissue with like tissue.[1]

Many options are available for soft tissue reconstruction of dorsal hand defects, of them; local flaps which are lacking, regional, distant and free flaps.[2–7]

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One of the commonly used flaps in hand reconstruction that described for thumb in almost all series is the first dorsal metacarpal artery flap (FDMAF).[8–10]

In current study we present another new use for the FDMAF utilizing its island form which may considered a novel use.

2. Methods

Over a two and half year's period (May 2015 to October 2017) 23 cases presented to Plastic Surgery Unit, General Surgery Department, Zagazig university Hospital, Egypt with post traumatic soft tissue defects at the dorsum of their hands. Of them 18 had exposed extensor tendons and metacarpal bones while five had exposed tendons only. All exposed tendons were devoid of their epitenons.

The defects were ranged from 3 cm × 4 cm to 4.5 cm × 6 cm. Of the 23 patients, 15 were males and their age ranging between 17 and 48 years and 8 were females aged between 18 and 36 years. All patients were formally consented after acceptance of the procedure from the university ethical committee. All defects were reconstructed by island first dorsal metacarpal artery flap (FDMAF) with 18 of them acutely while five as a delayed procedure.

2.1. Operative technique

Flap marking was firstly done (with its size 20% larger than template of the defect for delayed procedures due to fibrosis that limits skin mobility). Considering the distal limit of the flap to be the midpoint of proximal interphalangeal (PIP) joint and the proximal limit is the level of metacarpophalangeal joint (MPJ) while the radial and ulnar limits are just dorsal to the volar neurovascular bundles of the index (Fig. 1). The operations were performed under general anesthesia with the use of magnifying loupes 4× and pneumatic tourniquets. The use of magnifying loupe was helping to achieve a maximum flap dimensions without any bundle exposure.

The flap dissection was started from distal to proximal and from medial to lateral. Great care was taken to preserve the epitenon to insure later skin graft take. Once reached the MPJ after cauterizing its nutrient branch a sub dermal dissection was continued proximally along its radial side till identification of the flap pedicle. Then the dissection of the pedicle was continued till its origin from the radial artery in the anatomical snuffbox just ulnar to the extensor pollicis longus tendon (Fig. 2). A strip of 1st dorsal interosseous muscle fascia was included with the flap pedicle. There was no need to include the periosteum of second metacarpal bone. After complete dissection of the pedicle the tourniquet was deflated, the flap viability confirmed and heamostasis was secured (Fig. 3). A wide tunnel was then made and the flap was transferred to the

Figure 1 A preoperative picture shows defect, skin paddle design and S shaped incision for pedicle dissection.

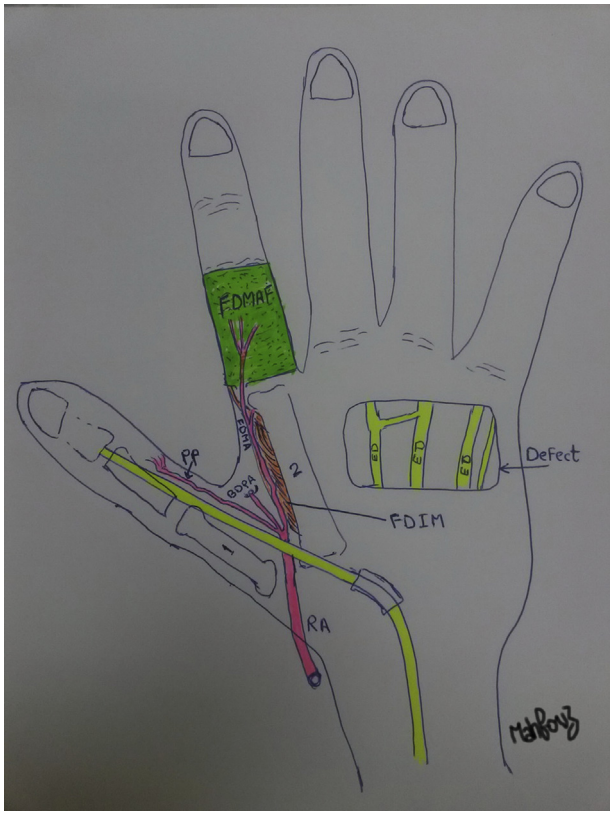

Figure 2 A handout diagram illustrates the anatomy of the first dorsal metacarpal artery flap and its relation to first dorsal interosseous muscle and second metacarpal bone. FDMAF; First dorsal metacarpal artery flap, FDMA; First dorsal metacarpal artery, FDIM; First dorsal interosseous muscle, BDPA; Branch to deep palmar arch, PP; Princeps pollicis, RA; Radial artery, ED; Extensor digitorum, 1; First metacarpal bone, 2; Second metacarpal bone.

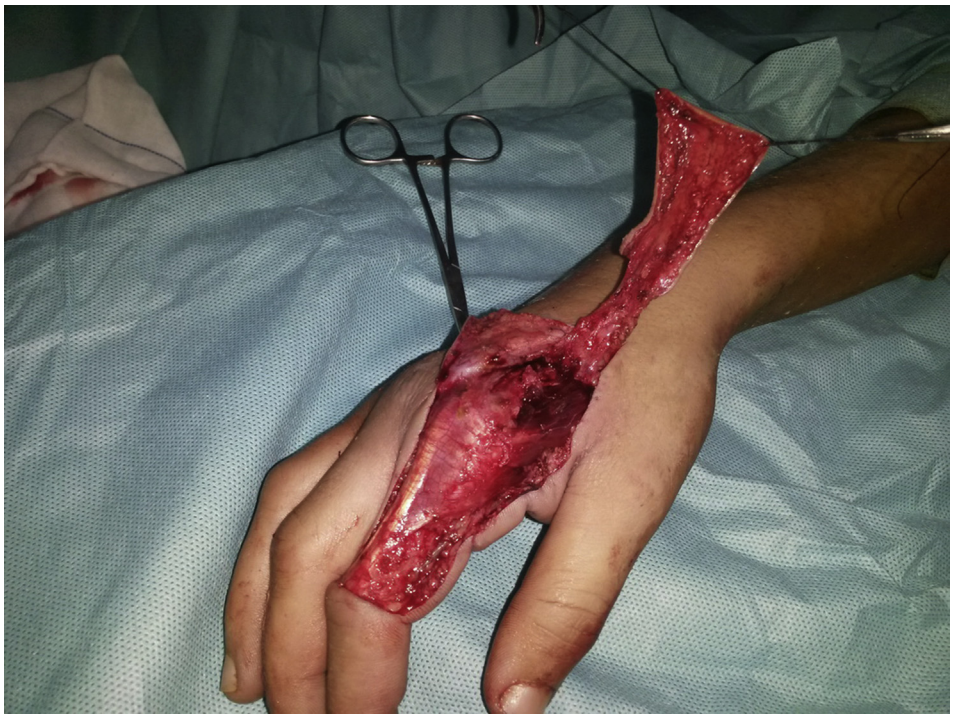

Figure 3 Intra operative picture shows dissected island first dorsal metacarpal artery flap until its origin from radial artery.

defect with very good reach distance (Fig. 4). The donor was then grafted using a full thickness skin graft from medial arm.

Then the hand was held in extension with help of volar splint as most patients had repaired extensor tendons.

First dressing was performed on day 6th, after which the mobilization started. The follow up visits were arranged at one month, 6th months, one year and two years when sensation and patient's satisfaction assessment were performed. Patient's satisfaction was assessed using modified

Figure 4 The flap covering the whole dorsal hand defect and its reach is indicated by the metallic ruler and also the donor site defect is shown with intact epitenon.

Figure 5 a, b — Six and four months post operative pictures showing neat healing of donor sites without any extension lag, normal first web space and defects are completely covered by the flaps.

Elder et al, 2005 scoring system.[11] For determination of the degree of the patient's satisfaction, patients were given a postoperative questionnaire including the five following questions;

1. Knowing what i know today, i would definitely choose to have this type of reconstruction.
2. Overall, i am satisfied with my reconstructed hand with my index finger could be freely flexed and extended.
3. I would recommend this reconstructive procedure to a friend.
4. The size and shape of my reconstructed hand and normal one are the same.
5. My reconstructed hand feels soft to touch

Item response were scored using five point scale (strong agree = 4, agree = 3, not sure = 2, not agree = 1, strong not agree = 0).The summation of the points (ranged from 20 points which mean very satisfied to zero which mean not satisfied) dichotomize the result into three groups we consider 20 response very satisfied, 15—19 response satisfied and any response else is not satisfied.

3. Results

All flaps survived completely also grafted donor sites are taken well (Fig. 5 a, b). There were no complications recorded during a mean follow up period of two years.

The sensation regained after a period ranged between three to eight months with acceptable two point discrimination (average of 12.3 mm). The average operation time was 46 min (ranged between 40 and 60 min). The average flap reach was 8.2 cm (ranged from 7 to 10 cm) (Table 1).

All patients were very satisfied both aesthetically and functionally with the procedure and they recommend it to others. A video is attached showing good flexion and extension of all index finger joints.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.asjsur.2018.03.004.

4. Discussion

Reconstruction of dorsal hand defects with exposed extensor tendons with or without exposed bones is representing a challenge to the reconstructive surgeons. It necessitates a good flap coverage helping tendon gliding.[12,13] The currently available reconstructive methods are local, regional, distant and free flaps.[2—7] The local flaps in this area are lacking due to scarcity of local tissues.[5] Of the regional flaps are the dorsal and the reversed ulnar artery perforator flaps but they have the disadvantages of their short pedicles and resulted in donor site numbness.[14,15] The posterior interosseous artery flap is another option but its tedious dissection, its anatomic variability and poor venous drainage limiting its use.[1] Instead of long pedicle and wide surface area of the reverse radial forearm flap but it has disadvantages of sacrificing a major vessel in addition to donor site morbidity.[3]

The use of distant flaps like groin, intercostals and abdominal flaps although it give amble of tissues, it has disadvantages of two staged procedures and requirement of multiple stages of flap de bulking.[16—19] Free flaps like lateral arm or anterolateral thigh flaps are good options for covering extensive defects but also lengthy operations and required expertise microsurgeon.[19]

The first dorsal metacarpal artery is reported to have a constant anatomy making it a very safe as a source of pedicle flaps. It arises as a 3rd division from the radial artery at the anatomical snuff box which are the princeps pollicis, FDMA and a branch to deep palmar arch.[20—22] The course of the FDMA was fascial in 61.5%, subfascial in 7.7% and duplicated in 30.8%. Accordingly a strip of 1st dorsal interosseous muscle fascia was suggested to be included with the flap pedicle by other series which was also done in our technique.[23,24]

Table 1 Patient's demographics, defects dimensions, flaps sizes, operative time, flap reach and 2PD.

Num	Sex/Age	Defect dimensions (cm)	Flap sizes (cm)	Operative time (min)	Flap reach (cm)	2PD (mm)
1	M/18	3 × 3.5	3 × 3.5	40	8	10
2	M/20	3 × 4	3 × 4	45	7	11
3	F/33	4 × 5	4 × 5	40	10	13
4	M/22	3.5 × 4	4.2 × 4.8	40	8	11
5	M/38	3 × 4.5	3 × 4.5	50	7	10
6	F/19	4 × 5	4 × 5	45	8	14
7	M/17	3.5 × 5	3.5 × 5	40	7.5	10
8	M/32	3.5 × 4	3.5 × 4	60	8	12
9	F/22	4.5 × 6	4.5 × 6	60	8.2	15
10	F/18	4 × 5.5	4 × 5.5	55	8.5	14
11	M/48	4.5 × 6	4.5 × 6	55	9	15
12	M/42	4.5 × 5	4.5 × 5	45	10	16
13	F/36	4 × 5.5	4 × 5.5	40	7	16
14	M/25	3 × 4	3 × 4	45	7.5	10
15	F/27	4 × 5	4 × 5	45	8	11
16	M/19	4 × 4	4 × 4	40	9	13
17	M/23	3 × 5	3.6 × 6	42	9.5	14
18	F/28	3.5 × 4	4.2 × 4.8	40	10	10
19	M/18	3 × 4	3.6 × 4.8	45	8	10
20	F/30	3 × 5.5	3 × 5.5	45	7.5	13
21	M/36	3.5 × 5	4.2 × 6	50	9	12
22	M/24	4 × 6	4 × 6	60	8	14
23	M/40	3 × 3.5	3 × 3.5	40	7.5	10
Mean/SD	37 ± 9	3.6 ± .6 × 4.7 ± .8	3.8 ± .5 × 4.9 ± .8	46 ± 7	8.2 ± 1	12.3 ± 2

N.B: Flap reach is measured from pedicle origin to distal end of flap.

FDMAF was first described in 1979 by Foucher and Braun.[25] The flap is a neurovascular one with its pedicle originated from the radial artery and passes just superficial and adherent to first dorsal interosseous muscle fascia till level of MPJ where it gives a nutrient vessel then branched into very small branches to dorsum of index.[23,26]

The flap almost always described for coverage of defects in the thumb.[9,27–31]

In this article we described the island FDMAF for coverage of mild to moderate dorsal hand defects. It has a constant anatomical course. It is easy to be dissected and to transfer with a good reach and it offers same skin texture which has excellent ability to withstand wear and tear. It provides sensory skin coverage as all patients in the study has good two point discriminations with no donor site morbidities.

5. Conclusion

Island FDMAF for coverage of mild to moderate dorsal hand defects is a good versatile, reliable option with many advantages. It does not involve sacrifice of any major vessel. It provides acceptable functional and cosmetic outcomes regarding skin match, elasticity, durability and sensibility. So It may be considered a novel use.

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Conflict of interest

None declared.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.asjsur.2018.03.004.

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