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Research Paper

FDMA FLAP: A VERSATILE TECHNIQUE TO RECONSTRUCT THE THUMB

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Background: The First Dorsal Metacarpal Artery (FDMA) Flap or Kite flap or Foucher's flap is an island pedicle flap proximally based on the first dorsal metacarpal artery and veins (William C Pederson, 2011). A branch of radial sensory nerve is incorporated in the flap to make it a sensate flap. The aim of our study was to evaluate the 8 FDMA flaps done over a period of 7 years for distal thumb soft tissue defects. The results in all the cases were good except for two cases; one of which had an unstable scar, which required revision procedure; and the other one had distal flap necrosis which healed without any surgical intervention. The FDMA flap is a versatile workhorse flap for distal thumb soft tissue coverage (Kodi K Azari and Andrew Lee, 2011). **Methods:** We present a series of 8 cases of distal thumb soft tissue defects, all of which were reconstructed with the FDMA flap. The period of study was from November 2004 to August 2012. **Results:** All donor sites were closed primarily over the first webspace and split thickness grafted over the index finger proximal phalanx dorsum. 7 flaps survived and one had flap tip necrosis. **Conclusion:** The FDMA flap is a versatile flap to cover the defects of the dorsal aspect and to a certain extent the volar aspect of the thumb. The flap is sensate, durable, provides adequate soft tissue coverage.

Keywords: FDMA flap, Kite flap, Foucher's Flap

INTRODUCTION

Thumb reconstruction in cases of distal soft tissue defects, i.e., in cases with acceptable length and poor soft tissue coverage requires sensibility and durability of skin coverage (Kodi K Azari and Andrew Lee, 2011). The choice of reconstructive procedure for thumb depends on the amount and type of tissue lost. The options vary from secondary intention healing, free skin grafts, lateral triangular advancement flaps, "V-Y" advancement flaps to palmar advancement flaps, FDMA flap, cross-finger flaps and neurovascular island or radial sensory-innervated cross-finger flaps (Kodi K Azari and Andrew Lee, 2011). Skin grafts cannot be used when bone or tendon is exposed. Amongst all these, the FDMA flap is a versatile flap for covering distal thumb defects on dorsal or volar aspects (Kodi K Azari

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and Andrew Lee, 2011). Also the flap can be made sensate by including a branch of the superficial radial nerve in the pedicle, hence closely meeting the sensitivity requirement of the thumb (William C Pederson, 2011). The FDMA flap is a versatile method with minimal donor site morbidity which provides sensation, length, stability, mobility as well as aesthetics.

MATERIALS AND METHODS

We present a series of 8 cases of distal thumb soft tissue defects, all of which were reconstructed with the FDMA flap. The period of study was from November 2004 to August 2012.

All cases underwent clinical and doppler examination for identifying the FDMA in the affected hand. The relevant anatomy and surgical technique has been described below.

Relevant anatomy: The FDMA flap was popularized as a pure island flap [kite flap] by Foucher in 1979 (Kodi K Azari and Andrew Lee, 2011 and Roger K Khouri and Alejandro Badia, 2006).

The skin of dorsum of the proximal phalanx, especially of the index and middle fingers receive axial flow from branches of the First Dorsal Metacarpal Artery (FDMA) and the second dorsal metacarpal arteries, both of which are present in 90% and 97% of hands, respectively (William C Pederson, 2011). The FDMA arises from the radial artery or its communications with the dorsal carpal arch, the posterior interosseous artery, the deep palmar arch and the ulnar digital artery of the thumb, around the base of the second metacarpal; the branches from the FDMA supply till the proximal interphalangeal joint. A subcutaneous vein drains the FDMA flap (William C Pederson, 2011).

Surgical Technique

A preoperative Doppler examination was performed to evaluate the radial artery and the FDMA; and their directions. Patient was taken under regional or general anaesthesia. Tourniquet was inflated and debridement done. Then a template matching the size of the defect was drawn on the proximal phalanx index finger.

The proximal and the distal limits were the Metacarpophalangeal (MP) and the Proximal interphalangeal (PIP) joints respectively to prevent scar contracture (Kodi K Azari and Andrew Lee, 2011 and Roger K Khouri and Alejandro Badia, 2006)

The extended FDMA flap was used in one case to include the skin from the dorsum of the middle phalanx index finger (Gebhard and Meissl, 1995).

The FDMA was mapped with hand held Doppler from the radial aspect of the index metacarpophalangeal joint to the junction of base of first and second metacarpals. Under tourniquet, the flap was raised in the loose areolar plane above the extensor tendon paratenon; generally from ulnar to radial and distal to proximal side (Kodi K Azari and Andrew Lee, 2011 and Roger K Khouri and Alejandro Badia, 2006).

The tip of the first web space can be palpated between the bases of the first and the second metacarpal bone, which denotes the proximal most point of pedicle dissection and hence the pivot point (Muyldermans and Hierner, 2009).

A lazy s-shaped incision or a rat-tail incision is made over the proximal phalanx index finger dorsum to the dorsum of the first web space as per the defect size, the skin is elevated in the plane superficial to adipose tissue (Kodi K Azari and Andrew Lee, 2011 and Roger K Khouri and

Alejandro Badia, 2006). A key point in dissection is the radial aspect of the extensor hood of the MCP joint. The ulnar branch is tiny and courses deep in the musculo-osseous grrove, hence no attempt is made to visualise the artery, which is not to skelotonise the artery. The trick is to carry dissection including the radial shaft periosteum of the second metacarpal bone, continued by ulnar head fascia of the first dorsal interosseous muscle (Muyldermans and Hierner, 2009).

The flap was elevated with the pedicle dissected enbloc; with the fascia of the first dorsal interosseous muscle, one or two subcutaneous veins, a rich band of connective tissue and if planned then a branch of the superficial radial nerve. The dorsal veins and the sensory nerve enter the flap over the ulnar border of the MP joint. The pedicle was then dissected to the pivot point at the junction of the first and the second metacarpals (Kodi K Azari and Andrew Lee, 2011 and Roger K Khouri and Alejandro Badia, 2006).

The tourniquet was released and the flap vascularity assessed. The flap was then passed through a subcutaneous tunnel to the defect area and sutured. The distal tip of the flap over the

Figure 1: Thumb Defect with Elevated FDMA Flap

Figure 2: FDMA Flap Tunnelled and Placed over the Defect

Figure 3: FDMA Flap Inset Done

Figure 4: Three Months Postoperative Regain of Function

thumb defect was left open for monitoring. The donor site was grafted over the dorsum of the proximal phalanx index finger and the rat tail defect over the dorsum of the second metacarpal was closed primarily.

Figure 5: 30 Years Male Patient With A. Thumb Defect, B. FDMA Marking Done, C. FDMA Flap Elevated, D. 3 Months Postoperative Result

Figure 5 (Cont.)

Representative Cases

Case 1: In a 18 years female patient with distal thumb defect involving the soft tissue and the distal phalanx, FDMA flap was done with K-wire fixation of the distal phalanx. Around three months later, the patient had normal hand function (Figures 1 to 4).

Case 2: In a 30 years male patient with distal thumb soft tissue defect, FDMA flap was done (Figure 5).

Figure 6: Hypertrophic Scar at the Donor Site in a 25 Years Female Patient

Figure 7: Distal Tip Necrosis in a 30 years Male Patient

RESULTS

Flaps based on the FDMA was done for distal thumb defects in 8 cases, three female and five male. All defects were post-traumatic. The average age was 30 years. All donor sites were closed primarily over the first webspace and grafted over the index finger proximal phalanx dorsum. 7 flaps survived and one had flap tip necrosis. Only two cases had donor site complication, one of which had an unstable scar, which required excision, grafting and pressure garment; and the other one had distal flap necrosis which healed without any surgical intervention (Figures 6 and 7). All patients returned back to normal activities with no impairment of hand function. The average time to return back to normal activities was around 6 weeks.

DISCUSSION

The FDMA flap is a pedicled flap harvested from the dorsal aspect of the index finger including the FDMA, a concomitant vein and a branch of the superficial radial nerve. The flap was originally described by Hilgenfeldt, then modified by Holevich and remodified by Foucher and Braun. The FDMA flap comes into play in thumb reconstructions as there is deficiency of locally available tissue and tendon or bone is exposed. The main goal of thumb reconstruction is preservation of length and sensibility. Hence, FDMA flap is indicated in proximal and distal phalanx zone 4 defects (Muyldermans and Hierner, 2009).

The choice of reconstructive procedure for thumb depends on the amount and type of tissue lost; and it includes secondary intention healing, free skin grafts, lateral triangular advancement flaps, "V-Y" advancement flaps, palmar advancement flaps, FDMA flap, cross-finger flaps and neurovascular island or radial sensory-innervated cross-finger flaps. Skin graft is not possible when there is loss of periosteum and the paratenon (Foucher and Braun, 1979).

Indications for Hilgenfeldt technique are palmar or dorsal defects of the proximal and distal phalanx; and the indications for Holevich and Foucher techniques are palmar or dorsal zone 4 defects of the distal phalanx (Muyldermans and Hierner, 2009).

Contraindications of FDMA flap include circular defects at the proximal or distal phalanx and previous injury at the second metacarpal level (Muyldermans and Hierner, 2009).

An islanded sensory FDMA flap has a pedicle length of around 7 cm, thus it allows for wide arc of rotation and resurfacing of pulp defects of the thumb. The FDMA gives three branches; a radial branch, an ulnar branch and an intermediate branch. A cutaneous branch is also seen which may arise from the radial artery or the FDMA. The FDMA supplies the dorsal hand skin from the first metacarpal to the third metacarpal; and also the skin over the dorsal surfaces of the thumb and index to the proximal interphalangeal joint finger (Sherif, 1994).

There may be some variations in the FDMA, but the ulnar branch is usually tiny and fragile; this branch sticks to the fascia within the musculo-osseous groove and hence the fascia over the groove is included in order to prevent raising the flap on a nondominant arterial branch. The sensate FDMA flap was described by Shun-Cheng Chang *et al*. (2004)

The FDMA flap can extend proximally to the MP joint and distally to the PIP joint. There is no artery traversing the dorsal skin of the proximal phalanx and hence flap in the proximal phalanx region is random flap. If the flap is extended beyond the PIP joint, then its distal part is doubtful (Shun-Cheng Chang *et al*., 2004).

The modified FDMA flap including both dorsal branches of the proper digital nerves is useful to restore the thumb sensation and maintain adequate length of the thumb (Chao Chen *et al.,* 2010). The FDMA adipofascial flap has been used for combined soft tissue cover and as a venous conduit in a near avulsed thumb (Chaitanya Dodakundi *et al.,* 2012). Compared to heterodigital island flap for resurfacing thumb pulp loss defects the FDMA flap has negligible donor site morbidity, complete cortical reorientation and better overall hand function (Delikonstantinou I *et al*., 2011). Combination of digital neurovascular island flap and FDMA flap can restore the fine sensation of recipient palmar flap better and is applicable for those patients suffering from digital nerve defects from the proximal phalanx and with high demand for the recovery of thumb sensations (Qi *et al*., 2009).

CONCLUSION

The FDMA flap is a versatile flap to cover the defects of the dorsal aspect and to a certain extent the volar aspect of the thumb. The flap is sensate, durable, provides adequate soft tissue coverage. Also the flap can be extended to include the skin from the dorsum of middle phalanx index finger to cover extensive defects.

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