



Revisiting Elliot's Modification of Moberg's Flap and Our Improvisation

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Abstract

Thumb tip injuries constitute one of the most common hand injuries. There are various reconstructive options for thumb tip injuries. We present our series of thumb tip injuries reconstructed using Elliot's modification of the Moberg flap, which provides like-for-like tissue. We also present our flap improvisation, which can be useful in the armamentarium of plastic surgeons.

Background Moberg described the advancement flap for thumb defects in 1964, which was modified by O'Brien in which the proximal part of the flap is incised and advanced. Although it is a popular flap, it has the disadvantage of interphalangeal (IP) joint flexion deformity. Among the various modifications of the Moberg flap, Elliot's flap provided more tissue with minimal donor site morbidity and no usage of skin grafts or first web skin.

Methods We retrospectively analyzed the patients who underwent reconstruction of thumb defects by Elliot's modified Moberg's flap. The size of the defect, etiology, and IP joint movement were analyzed. Two patients underwent our improvised flap where a daughter flap was elevated within Elliot's flap.

Results Between January 2021 and September 2023, 12 patients underwent reconstruction by Elliot's flap. All flaps settled well. There was no IP joint deformity. Two patients had scar hypertrophy that was managed conservatively.

Conclusion Elliot's modification of the Moberg flap is a very useful but underutilized flap for thumb tip injuries that provides like tissue with sensation and with little donor site morbidity. It can be used for *thumb tip defects of up to 3 cm*. It is possible to incorporate a second V-Y flap in patients for whom additional movement is required for tension-free closure.

Keywords

- Elliot's flap
- modified
- daughter flap

Introduction

Moberg described the advancement flap for thumb defects in 1964, which was modified by O'Brien (1968) in which the

proximal part of the flap is incised and advanced.¹ The original flap has the disadvantages of interphalangeal (IP) joint flexion deformity for which many modifications have been described.²⁻⁴ V-Y closure of the Moberg flap was contributed

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by Russell and Casas (1989), which avoided skin grafting or secondary intention healing of O'Brien's modification.¹ Among the various modifications of the Moberg flap, Elliot's flap has minimal donor site morbidity and no usage of skin grafts or first web skin.¹ We present a series of cases and our innovation/improvisation that can be used to avoid tight inset of the flap.

Material and Methods

Twelve patients were reconstructed using Elliot's modification of the Moberg flap between January 2021 and September 2023. All the patients were males. The etiology was traumatic in all patients. Patients who had associated tendon or bony injuries of the thumb were not considered for reconstruction using this flap. Two patients underwent double V-Y flap, that is, a daughter V-Y flap was done in the (mother) Elliot modified Moberg's flap.

The patient's age and other evaluations, namely, size of the defect, flap survival, sensation, time taken for healing, scar nature, and complications, were analyzed. Postoperatively patients were put on a plaster of paris (POP) slab for 10 days to decrease pain and edema. Suture removal was done on the 14th day. Any residual raw area at the tip was managed conservatively. Physical therapy was initiated at 2 weeks if the tip had healed completely.

All the patients were given silicone finger cap for better contour and for better scar. All the patients were advised scar massage, and were followed for 3 months.

Surgical Technique

All the patients were operated on under regional block and tourniquet control. Debridement of the defect was done and washed.

Flap markings: The incision lines are marked at the mid-lateral lines of the thumb. They are extended proximally to cut across a point in the line drawn from the radial border of the middle finger to the wrist (**►Figs. 1–4**).

The first incision is made along the radial aspect of the flap and raised superficial to the paratenon of the flexor pollicis longus. This ensures that the radial neurovascular bundle is

included in the flap. The dorsal branches at the level of the IP and metacarpophalangeal (MCP) joints are cauterized. The flap is elevated proximally superficial to the thenar musculature. Once the radial neurovascular bundle is visualized, it is traced proximally and safeguarded. The flap is elevated as a book to the ulnar side, *completely hinging along the ulnar side of the thumb*. The incision is made on the ulnar side of the flap. *Care is taken near the first web space where the ulnar neurovascular pedicle is close to the skin*. The flap is completely elevated, hanging only with the neurovascular bundles. The tourniquet is let down and flap bleeding is confirmed. Hemostasis is secured. The flap is advanced and inset given with the IP joint in extension. Sutures are taken such that each suture is advancing the flap. *The raw area at the thenar eminence is closed primarily in the V-Y fashion, which helps in advancement*. If the flap seems tight, a daughter V-Y flap can be made with its dimension not more than half the length of the mother flap. *The second flap is elevated as the Atasoy flap and it is not completely islanded (►Fig. 2)*. The proximal secondary raw area of the daughter flap is usually allowed to heal by secondary intention. *Sterile dressing and POP, with flexion of the thumb IP joint and MCP joints, are applied.*

Results

All the patients were males with age ranging from 5 to 58 years.

All the flaps survived completely. There was no infective complication. There was no IP joint flexion deformity (**►Fig. 5**) and were able to extend beyond neutral. Scar hypertrophy was noted in two patients (**►Fig. 6**). There was no scar contracture or first web shortening/narrowing. The secondary raw area in the patients, who underwent double V-Y flap, healed completely.

The maximum advancement obtained in our series was 3 cm in patients who underwent double V-Y flap. The two-point discrimination (static) was on average 5.5 mm. It could not be assessed in one pediatric patient (patient 1). There was no IP joint flexion deformity in any of our patients (**►Figs. 5–8**). *Deformed nail growth was noted in patients*

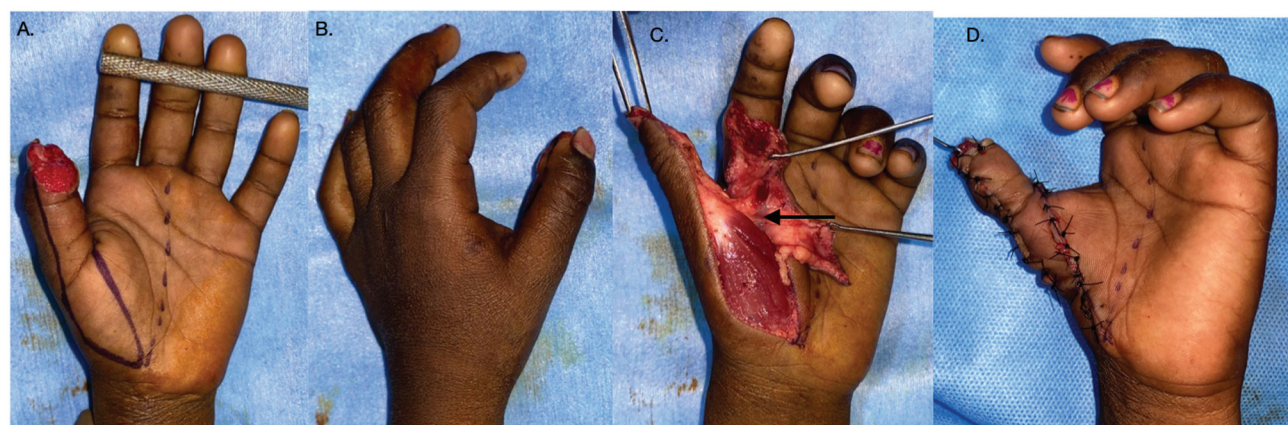


Fig. 1 (A) A 2.5-cm volar soft-tissue defect from the volar skin edge. Flap marking as mentioned. (B) Dorsal view. (C) Flap elevated as a book page with the ulnar and radial (arrow) neurovascular bundle included in the flap. (D) Flap inset.



Fig. 2 (A) A 3-cm volar soft-tissue defect the volar skin edge. F, Elliot's modified Moberg's flap; f, Atasoy flap marked within the flap "F." (B) Flap elevation. (C,D) Flap inset. Secondary raw area of the daughter flap allowed to heal by secondary intention. The F flap had a movement of 2.5 cm and f advanced 5 mm.



Fig. 3 A patient with a 2.5-cm thumb defect covered using Elliot's modification of the Moberg flap.



Fig. 4 A patient with right thumb tip crush injury defect covered using Elliot's modification of the Moberg flap.

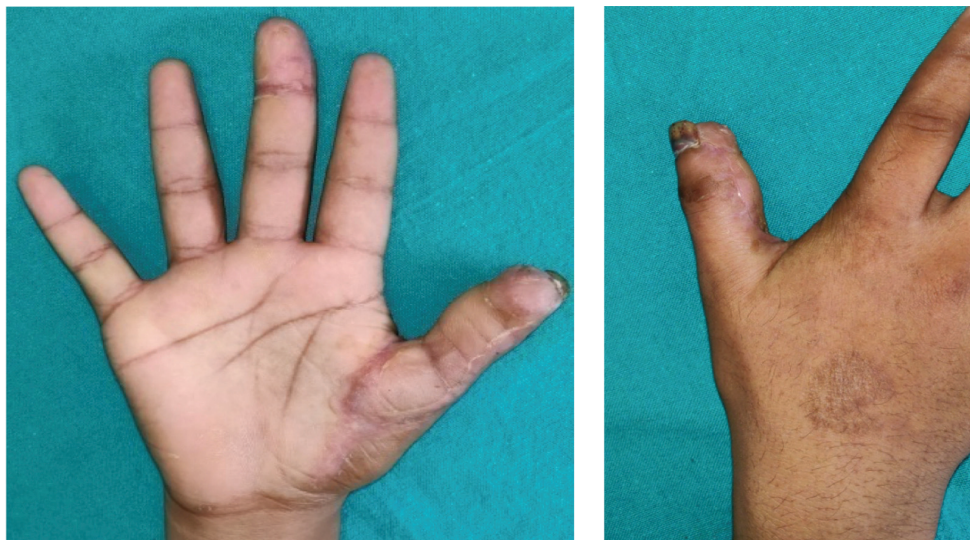


Fig. 5 Late post-op picture of the patient in Fig. 3 showing well-settled flap and no deformity at the interphalangeal joint.



Fig. 6 Late post-op picture of the patient showing well-settled flap and interphalangeal joint in full extension.

who were associated with nail bed injury and patients in whom the flap was sutured to the nail bed.

Six patients had partial palmar oblique defects, four had transverse defects, and two patients had dorsal oblique defects (► **Fig. 3**; ► **Table 1**).

Representative case 1 (patient 1): A 5-year-old boy presented to the emergency department with a left thumb tip door crush injury. On examination, the patient had volar soft tissue with exposed distal phalanx. Under anesthesia and tourniquet control, debridement of the defect was done. The flap was marked, elevated, and advanced. The flap settled well (► **Figs. 1 and 7**).

Case 2 (patient 9): A 39-year-old male patient presented with a left thumb crush injury at the workplace. The patient had a distal phalanx fracture. The patient was operated on

under tourniquet control. The distal phalanx fracture was stabilized with a K-wire and conventional Elliott's flap with a daughter flap was marked as the defect measured 3 cm. Both flaps were raised and inset was given. Both flaps survived well. The patient developed scar hypertrophy, which was managed conservatively with scar massage and silicone sheet application (► **Figs. 2 and 8**).

Discussion

The thumb constitutes approximately 40 to 50% of the hand function.⁵ Thumb tip injuries are one of the most common hand injuries.⁶

The vascularity of the thumb is from the princeps pollicis artery and the first palmar metacarpal artery. These arteries give rise to palmar and dorsal digital arteries. The thumb, unlike the other digits, has both dorsal and ulnar blood supply. This dual blood supply of the thumb makes complete elevation of the volar skin feasible without jeopardizing the blood supply to the dorsum of the thumb.^{7,8}

Reconstruction of the thumb tip injury has various options.^{6,9,10} Whenever possible and feasible, reimplantation of the amputated part is the option for reconstruction. Other options include free pulp transfer, free toe transfer, neurovascular islanded pedicled flap, Moberg's flap, Brunelli's flap, cross-finger flap, etc.^{11,12} The thumb, being functionally very important, reconstructive options that restore the contour and sensation should be preferred. Like-for-like tissue is one of the preferred principles/options of reconstruction whenever possible. Hence, it is preferable to use the volar tissue of the thumb in suitable patients.

The distal phalanx of the thumb is broad when compared with other digits or the great toe. The thumb also has its specialized pulp over the widened distal phalanx, which cannot be easily substituted by any tissue from other digits or toes.⁵

Moberg's flap satisfies all these needs in thumb reconstruction but with the disadvantage of IP joint flexion deformity. To overcome its original disadvantage, various

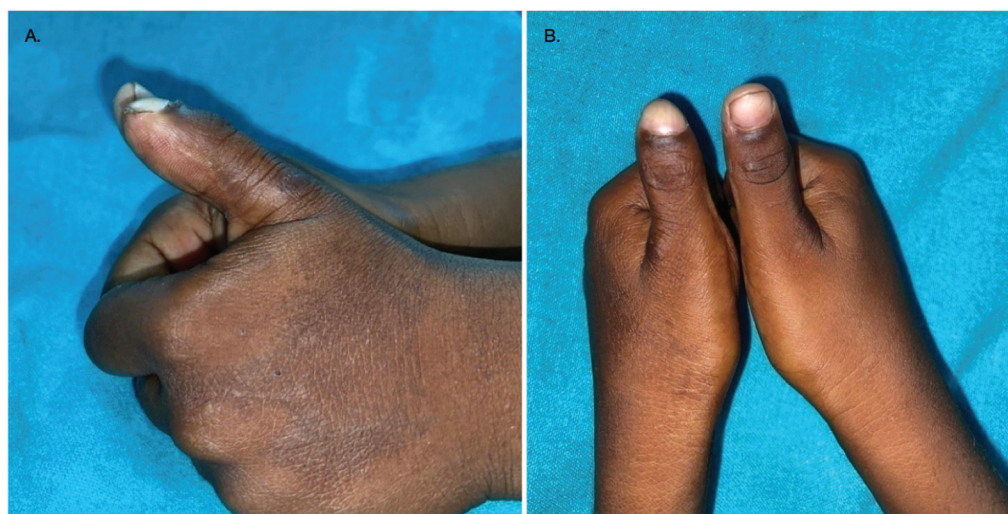


Fig. 7 Late post-op (A) lateral and (B) dorsal views.



Fig. 8 Post-op picture of the patient in Fig. 2 showing well-settled flaps and interphalangeal joint in neutral. The patient had a hypertrophic scar and was treated with silicon finger cap compression and scar massage.

modifications were proposed, which are using the first web skin, allowing the donor raw area to heal secondarily, split skin grafting (SSG) at the proximal incision site, and extended palmar modification.¹⁻⁴ Elliot's modification of the Moberg flap overcomes the IP joint deformity by extending

the flap to the thenar eminence and including more tissue, making the donor site closure possible. The extended segment when advanced comes over the MCP joint where primary closure is normally not possible. It also avoids IP joint flexion contracture.

Table 1 Details of the patients

Sl. no.	Age (y)	Side	Flap	Flap advancement	Complications	Two-point discrimination
1	5	Left	Elliot's modification of the Moberg flap	2.5 cm	Nil	–
2	18	Left	Elliot's modification of the Moberg flap	2.5 cm	Nil	5 mm
3	28	Right	Elliot's modification of the Moberg flap	2.5 cm	Nil	5 mm
4	15	Right	Elliot's Moberg with daughter V-Y	3 cm	Nil	5.5 mm
5	25	Right	Elliot's modification of the Moberg flap	2.5	Scar hypertrophy	5 mm
6	19	Right	Elliot's modification of the Moberg flap	2.5 cm	Nil	6 mm
7	29	Left	Elliot's modification of the Moberg flap	2 cm	Nil	5 mm
8	34	Left	Elliot's modification of the Moberg flap	2 cm	Nil	5 mm
9	39	Left	Elliot's Moberg with daughter V-Y	3 cm	Scar hypertrophy	6 mm
10	23	Left	Elliot's modification of the Moberg flap	2	Nil	6 mm
11	30	Left	Elliot's modification of the Moberg flap	2	Nil	5.5 mm
12	58	Right	Elliot's modification of the Moberg flap	2.5	Nil	6 mm

Although it is a well-known flap, it is very underutilized. In our series of patients, defects of up to 2.5 to 3 cm were covered with Elliot's modification of the Moberg flap. In two patients, we had included a second V-Y flap as a single flap appeared too tight a closure. The donor area of the daughter V-Y was allowed to heal secondarily. Both flaps survived and there was no IP joint flexion deformity.

There have been various modifications of the Moberg flap to decrease the IP joint flexion, namely, using the first web space tissue (which covers defects up to 2 cm), the extended palmar modification, etc..^{1-3,11}

Free pulp transfer or trimmed great toe flap provides like tissue with sensation for thumb defects. It needs microsurgical expertise and not every patient accepts for any toe transfer in our population.¹¹

Although Littler's flap provides neurovascular tissue of considerable dimensions, it needs cortical relearning for sensation. It has considerable donor site morbidity.

The first dorsal metacarpal artery (FDMA) flap is another well-described flap for thumb reconstruction. Although it has been said to reach thumb volar tip defects, it is widely used for dorsal thumb defects. It also provides sensate skin. For thumb volar defects, the FDMA flap provides sensate, unlike tissue, which needs cortical relearning.

The dorsoulnar and dorsoradial thumb flaps are other flaps for the thumb tip that do not provide sensate and like-for-like tissues.^{13,14}

The cross-finger flap from the index is another option that can be raised as sensate or insensate and provides dissimilar tissue and is a staged reconstruction.¹⁵

Conclusion

Elliot's modification of the Moberg flap is a very useful but underutilized flap for thumb tip injuries which provides like tissue with sensation and with little donor site morbidity. *It can be used for thumb tip defects of up to 3 cm.* It is possible to incorporate a second V-Y flap in patients for whom additional movement is required for tension-free closure.

Conflict of Interest

None declared.

References

- 1 Elliot D, Wilson Y. V-Y advancement of the entire volar soft tissue of the thumb in distal reconstruction. *J Hand Surg [Br]* 1993;18(03):399-402
- 2 Dellon AL. The extended palmar advancement flap. *J Hand Surg Am* 1983;8(02):190-194
- 3 O'Brien B. Neurovascular island pedicle flaps for terminal amputations and digital scars. *Br J Plast Surg* 1968;21(03):258-261
- 4 Thibaudeau S, Tremblay DM, Tardif M, Chollet A. Moberg modification using the first web space: thumb reconstruction following distal amputation. *Hand (N Y)* 2012;7(02):210-213
- 5 Taghinia AH, Littler JW, Upton J. Refinements in pollicization: a 30-year experience. *Plast Reconstr Surg* 2012;130(03):423e-433e
- 6 Germann G, Sauerbier M, Rudolf KD, Hrabowski M. Management of thumb tip injuries. *J Hand Surg Am* 2015;40(03):614-622, quiz 623
- 7 Sharma D, Bhardwaj P. Vascular anatomy of the thumb and its clinical implications. 2018
- 8 Ramírez AR, Gonzalez SM. Arteries of the thumb: description of anatomical variations and review of the literature. *Plast Reconstr Surg* 2012;129(03):468e-476e
- 9 Zhou X, Wang L, Mi J, et al. Thumb fingertip reconstruction with palmar V-Y flaps combined with bone and nail bed grafts following amputation. *Arch Orthop Trauma Surg* 2015;135(04):589-594
- 10 Wang J, Zhou X, Qiang L, Xue M. Thumb fingertip injuries reconstruction using a dorsoulnar flap of the thumb combined with relay V-Y flaps for donor site repair. *J Orthop Surg (Hong Kong)* 2022;30(02):23094990211025089
- 11 Tang JB, Elliot D, Adani R, Saint-Cyr M, Stang F. Repair and reconstruction of thumb and finger tip injuries: a global view. *Clin Plast Surg* 2014;41(03):325-359
- 12 Moschella F, Cordova A. Reverse homodigital dorsal radial flap of the thumb. *Plast Reconstr Surg* 2006;117(03):920-926
- 13 Chang SC, Chen SL, Chen TM, Chuang CJ, Cheng TY, Wang HJ. Sensate first dorsal metacarpal artery flap for resurfacing extensive pulp defects of the thumb. *Ann Plast Surg* 2004;53(05):449-454
- 14 Gebhard B, Meissl G. An extended first dorsal metacarpal artery neurovascular island flap. *J Hand Surg [Br]* 1995;20(04):529-531
- 15 Walker MA, Hurley CB, May JW Jr. Radial nerve cross-finger flap differential nerve contribution in thumb reconstruction. *J Hand Surg Am* 1986;11(06):881-887