Modified cup flap for volar oblique fingertip amputations

Der modifizierte V-Y-Cup- oder „Schüssel“-Lappen für volare und schräge Fingerkuppenamputationen

Abstract

We describe a modified volar “V-Y cup” flap for volar fingertip defects that do not exceed more than half of the distal phalanx for better aesthetic and functional outcome. In seven cases out of eight, the flap was elevated with a subdermal pedicle, whereas in one case, the flap was elevated as an island on the bilateral neurovascular bundle. The fingertips have been evaluated for sensibility using standard tests, hook nail deformity and patient satisfaction. Seven flaps have survived completely. The flap with skeletonized bilateral digital neurovascular bundle has shown signs of venous insufficiency on the 5th postoperative day with consecutive necrosis. Suturing the distal edges of the flap in a “cupping” fashion provided a normal pulp contour. The modified flap can be used for defects as mentioned above. Subdermally dissected pedicle-based flap is safe and easy to elevate. The aesthetic and functional outcomes have been reported to be satisfactory.

Keywords: fingertip amputations, volar oblique fingertip amputations, volar V-Y cup flap, volar injuries, occlusive dressing

Zusammenfassung


Schlüsselwörter: Fingertipamputation, Fingerkuppedefekt, V-Y-Lappen, Okklusionsverband

Introduction

Fingertip amputations are common and challenging conditions as the defects vary widely. A stable, mobile and sensate fingertip is essential to the overall function of the hand [1]. Basically, fingertip amputations are classified as dorsal oblique, transverse, volar oblique and lateral oblique amputations. Conservative therapy is an established contemporary treatment option for fingertip injuries, being superior over other treatment options in fingertip injuries. Occlusive dressing bands are established treatment-of-choice in case of distal 1/3 or 1/2 of nail bed injuries, whereas flap options are used in larger injuries [2]. If bone tissue is set free after injury, a flap option is suggested to take into consideration as a treatment-of-choice,
since skin and bone contact may cause distinct problems on later stages of healing process [3]. In their study, Vogt et al. have concluded, that the following substances, which are also found in the occlusive bands, catalyse the healing process [4].

- epidermal growth factor
- basic fibroblast growth factor
- interleukin-1α
- transforming growth factor-β2
- transforming growth factor-β1
- Insulin-like growth factor-1
- Platelet derived growth factor-AB

Based on this fact, this method is nowadays being widely accepted as a treatment of choice in most of the European countries. Nevertheless, social factors may play a crucial role in choosing the treatment option.

In most Muslim countries patients are getting hard to accept long-term conservative treatment with an open wound. The peculiar foetor of a bandage and not changing the bandages daily, seem to be unacceptable for these patients. As washing hands 5 times during the course of a day for their religious service is a necessity, the patients prefer immediate surgical intervention to the open wounds with shorter healing time. Thus we favored flap options for the management of the wounds.

Flap options that can be used for reconstruction of volar oblique fingertip amputations are limited in contrast to the transverse and dorsal oblique fingertip amputations and they suffer from high morbidity of the donor site [5]. Atasoy’s volar triangular V-Y advancement flap is widely accepted as gold standard for dorsal oblique and some transverse fingertip amputations. Unfortunately, volar oblique injuries are more difficult to manage, because the precious volar skin and the pulp are missing [5]. Many of the flaps described for these types of injuries suffer from donor site morbidity [6]. There is no gold standard method for volar oblique fingertip amputations and therefore the surgeon must choose the most suitable method for the patient and must approach the injury in a digit-specific manner [5]. For example, for the most of the volar fingertip injuries of the thumb, the Moberg volar advancement flap is the first treatment option. However it is dangerous to use the Moberg flap in other digits, due to the risk of ischemia of the finger [5], [6]. The V-Y cup flap was described by Furlow in 1984. This flap combined the V-Y advancement principle with the “cupping technique” that was first described by Snow (1967) [6], [7]. It has been a bilateral digital arterial based flap, which was used in volar oblique fingertip amputations [6], [8]. This paper describes and reports the modified cup flap for volar oblique fingertip amputations with at least intact half of the volar skin of the distal phalanx, which has been achieved by modifying the Furlow flap. The main point of discrimination from the original flap has been the incision that has not crossed the distal digital crease.

Material and methods

From June 2010 to September 2011, the modified cup flap has been applied in eight patients (six of which were male). The ages at surgery ranged between 21 and 56. Three of the defects were on the index finger, two on the middle finger, two on the ring finger and one was on the little finger.

The flap has not been applied on the thumb. Six of the patients had acute volar oblique tip amputation (Figure 1), one patient had pulp defect due to tumoral lesion excision and one patient had pulp and nail deformity due to a previous injury. Six of the eight patients were actively working in their daily life, whereas one was a housewife and the other one was retired at the time of surgical intervention.

As the related hospital has not required IRB approval, informed consents have been obtained from all of the patients.

Surgical technique

The operations have been performed under digital block using a finger tourniquet. The flap incision has been planned to start at a 2 mm distance from and parallel to the lateral sides of the nail, and then to extend it from the proximal to the medial, making a concave V line, ending at the distal digital crease (Figure 2, Figure 3). The 4 incision depths parallel to the nail included full skin thickness, whereas the V-shaped incision on the volar side did not include the subcutaneous tissue. The flap has been totally freed from the underlying flexor tendon sheath, advancing from the distal to the proximal; then, the dissection of the subdermal pedicle, that holds the bilateral digital neurovascular bundle, has been made (Figure 4). The subcutaneous tissue and the neuromuscular bundle have been dissected to free them from the overlying dermis, extending from the "V" incision proximally and parallel to the neuromuscular bundle, up to the middle of the midphalanx. Then, the subdermal pedicle
Figure 2: Case 1. Operative technique: The steps in the surgical procedure are outlined; A: Volar oblique amputation of middle fingertip and flap incision, B: Flap elevated from the flexor tendon sheath, C: Flap adaptation with cupping the distal end of flap; anterior view, with lateral view in D.

Figure 3: Schematic representation of operative technique: A volar oblique fingertip amputation. A: The modified cup flap is marked out parallel to nail laterally and distally, medializing proximally up to distal digital crease, B: Digital neurovascular bundle was dissected up to the mid-point of mid-phalanx as a sub-dermal pedicle, C: The flap is advanced and sutured over the defect, the donor site is closed in a V-Y fashion. (Illustrated by corresponding author)
Figure 4: Case 2. A: volar oblique fingertip amputation and nail avulsion of index finger after debridement, dorsal view, B: volar view, C: Flap is elevated from the underlying flexor tendon sheath, white sheet is placed between flap and flexor tendon sheath, sub-dermal pedicle of the flap is signified clearly, D: The medial edges of the flap is cupped and flap is advanced distally and sutured to the nail bed.

has been accessed through dissection from the flap base in the same direction and separating the subcutaneous tissue and the neuromuscular bundle from the underlying flexor tendon sheath. The digital neurovascular bundle has not been skeletonized in order to sustain the venous circulation in the flap. For flap adaptation, the lateral sides have been pulled towards the volar surface and sutured to the nail, or in case of nail absence, to the nail bed. The medial sides of the flap in the distal have been sutured to each other in order to obtain “cupping”. The donor site has been closed-up in the classic V-Y form. The flap dissection has been performed as described above in seven patients. The defect of one of the patients with acute fingertip amputation included half of the distal phalanx volar and extended to the dorsum of the fingertip, exposing the bone in the dorsal aspect. In this patient, as further advancement of the flap was required, the subdermal pedicle dissection has been found to be insufficient and the bilateral digital neurovascular bundle was skeletonized.

Postoperative treatment

Postoperative dressing with Oxytetracyclin ophthalmic pomade has been performed and an extension static splint has been placed to achieve digit immobility for edema control in all of the patients. The hand has been placed above the heart level. The patients have been examined on the 1st postoperative day, after the first examination, the flaps have been followed-up at 48-hour intervals in the 1st postoperative week. The splint has been removed on the 3rd postoperative day. After the 1st postoperative week, the patients have been examined once a week. Wound healing has been obtained within a mean time of 12 days. The patient follow-up lasted from 2 to 20 months (mean 6 months). The finger pulps have been evaluated for sensibility using the static 2-point discrimination test, cold intolerance, percussion tenderness, hook nail deformity and patient satisfaction.

Results

Seven of the eight flaps have completely survived. In the case where the digital neurovascular bundle was skeletonized, neither arterial nor venous problems have been observed until the 5th postoperative day. On the 5th postoperative day, however, signs of venous insufficiency have been detected. This flap, from a previous smoker, later underwent total necrosis. After debridement, the fingertip defect of the patient has been reconstructed with a cross-finger flap. The final static 2-point discrimination ranged from 3 to 6 mm on both sides of the fingers (Normal values
3–6 mm). None of the patients have complained of tenderness with percussion of the fingertip. Five patients have stated mild cold intolerance in the affected finger in comparison to other fingers. Two patients have not experienced cold intolerance, and the patient who underwent reconstruction with cross finger flap, has described moderate cold intolerance. None of the patients has had hook nail deformity. All the patients were satisfied with the appearance of the fingertips. Observation revealed that suturing the distal flap as “cupping” has facilitated the formation of a normal pulp contour in the late postoperative period (Figure 5). The mean healing time was 14 days.

Discussion

There are two treatment alternatives used in fingertip injuries: conservative vs. surgical. Results obtained with occlusive dressing have made them as a standard treatment of choice [3], [4]. According to results obtained from the study of conservative treatment with occlusive dressing of Dereskeiwitz et al. the mean healing time and 2-point test has been 24.6 days and 5.8 mm, respectively [3]. The patients’ satisfaction was reported to be high. After this conservative treatment almost no nail growth deformity could be observed. Despite of these features of conservative treatment, flap method based on social factors mentioned by the patients has been decided upon. Social factors play a major role while establishing indications for the treatment of fingertip amputations. Taking these factors into consideration, the refusal of getting conservative therapy for a long time period has been the major factor in preferring the surgical approach in group of patients with fingertip injury. As an alternative, patients have been offered an occlusive dressing therapy. However, the patients have reported that long-lasting therapy with occlusive dressing bandage, that may cause smell discomfort, would probably restrict their daily life. For this reason a surgical approach for oblique volar fingertip amputations has been decided upon. There is no standard surgical procedure for fingertip amputations; therefore treatment is patient and digit specific. The standard “cup” flap is directly supplied by the bilateral digital neurovascular bundle [8]. Suggested flap is freed together with its surrounding tissue without full digital arterial dissection. The aim in preserving the surrounding tissue has been avoiding possible venous congestion in the flap. In conclusion, facilitating a bipedicular blood supply and arcadial supply as in the random flap, suggested flap has been thought to be more durable. In comparison with the standard “cup” flap, the main advantages of the cup flap described in this study are: the incision has not crossed the distal crease of the finger, leading to less donor site scar, and by being limited to the distal interphalangeal joint, it has minimized the flexion contracture risk to none.

Incorporating the digital arteries totally into the flap as a subdermal pedicle renders easier dissection of the modified flap in comparison with original flap, consecutively leading to a shorter duration of operation, which is another advantage of the modified flap. The need for only one operational session, achieving better pulp contours and preserving the fingertip sensation has made modified cup flap superior to cross finger and thenar flaps that have been frequently used in volar defects. The superiority to the homodigital neurovascular island flap, another optional technique for reconstruction of volar defects, is that the chosen flap has had a smaller dissection site, rendering it safer and having a smaller donor site scar. Since it has not needed any magnification, it can be safely performed in the emergency room setting. The disadvantage of the modified flap has been its application area that has been limited to defects that involve half or less of the distal phalanx. In cases of volar defects without exposed bone injury, instead of leaving
it for secondary healing or using the skin grafting process, the application of the modified cup flap has been strongly advised. The prolonged healing time and the loss of pulp contours have proven to be the main disadvantages of these two techniques [1], [2]. Cold intolerance, hook-nail deformity, hypo- or hyper-aesthesia, and postoperative tenderness have been particularly more frequently observed in skin grafting method than in other techniques [2]. In comparison with the secondary healing method and the skin grafting technique, the healing time has been shorter, and the pulp contour and sensation have been more favorable in the proposed technique. This kind of modification of the volar V-Y cup flap has not been previously described. This flap can be used safely, not only in the volar oblique tip amputations, but also in the following groups of patients: cases with insufficient tissue on the fingertip due to previous injuries, patients with hook nail deformity, or patients with pulp defect due to any kind of excision due to various reasons.

Limitations of the study
The main limitation of our study was a small number of patients. Due to this factor we did not do any statistical analysis.

Notes

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Competing interests
The authors declare that they have no competing interests.

Ethical standards and informed consent
The study protocol was approved in advance by the institutional ethical committee and letter of „informed consent“ was obtained from every patient prior to surgery.

References

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