



# Study of Yang's Onion Flap Technique for Release of Scarred Eponychium and Nail Fold Reconstruction in Burn Patients

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## Abstract

**Background** Abnormalities of fingernail growth and appearance are among the most common deformities encountered after burn injury to the hand. Various techniques used for resurfacing defects include incision of the scarred eponychium and advancement of the distal segment, flap reconstruction-distally, and proximally based transposition/advancement flaps, composite graft techniques, microvascular transfer. In the present study, we used an onion flap to release scarred eponychium and nail fold reconstruction in a single stage without using soft tissue from another area.

**Materials and methods** Forty-four burnt fingers were operated using Yang's onion flap technique. Patients were assessed for flap necrosis, hematoma and infection in the early postoperative period and for donor site scar, nail appearance, and symptomatic relief in a follow-up for at least 4 months.

**Results** The flap was successfully performed on all fingers. Only two fingers had flap necrosis. There was no incidence of hematoma or infection. The donor site scar and nail plate appearance improved and was acceptable to most patients after surgery. There was also significant relief in daily activities in 19 out of 28 symptomatic patients.

**Conclusion** Yang's flap to correct nail deformities in burn patients is feasible in Indian scenario. It is associated with a low complication rate and improved nail appearance. There is also significant symptomatic relief in performing daily activities after surgery.

## Keywords

- ▶ onion flap
- ▶ post-burn nail deformity
- ▶ nail fold reconstruction

## Introduction

Abnormalities of fingernail growth and appearance are among the most common deformities encountered after burn injury to the hand. Abnormalities of the burnt nail apparatus can be divided into (a) intrinsic, resulting from

direct thermal damage to the regenerative nail matrices and (b) extrinsic, because of contracture of the soft tissues proximal to the eponychium.<sup>1</sup>

The severity of the nail deformity is usually proportional to the degree of the nailfold proximal dislocation and can be roughly determined by the extra amount of visible lunula.

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Regardless of the mechanism of nail deformity, the key to reconstruction depends upon the adequate release of retracted eponychium, followed by generous resurfacing of the resulting defect.

Various techniques used for resurfacing defects include incision of the scarred eponychium and advancement of the distal segment, flap reconstruction by either distally or proximally based transposition or advancement flaps, composite graft techniques, and microvascular transfer.<sup>1</sup> All these techniques demand a secondary donor site and its associated morbidity, except small advancement flaps where the donor site may be closed primarily. Small advancement flaps or rotation flaps cannot be used for moderate or severe types of nail fold contractures. Some procedures are associated with poor cosmetic appearance, pulp-to-pulp, and lateral-to-pulp (key) pinches that are uncomfortable.<sup>2</sup>

We aim to study Yang's onion flap to release scarred eponychium and nail fold reconstruction in a single stage. The flap is bipediced based on residual nailfold on both sides and advanced to normal position for nailfold reconstruction. Because the scar will be dorsally located instead of sides, lateral pinch and the light touch of the fingers are expected to be preserved much better.

## Materials and Methods

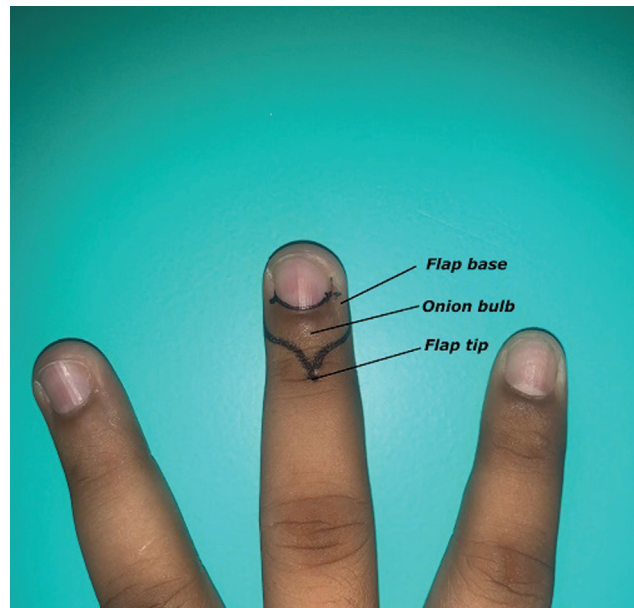
We conducted a prospective interventional study from September 2016 to March 2018 over a period of 18 months. Inclusion criteria were patients of burn nail deformity due to retracted eponychium at least 6 months after burns. Exclusion criteria were patients previously operated for burn nail deformities, nail deformity other than burn injury, less than 18 years of age, and those with infected nailbeds and local ulcers.

## Methodology

Patients attending the outpatient department as well as inpatients were screened for nail deformities. A total of 44 nail deformities were operated upon. All cases were done under general or local anesthesia, and the onion flap procedure as described by Yang et al<sup>2</sup> was followed to reconstruct the burn nail deformity.

## Surgical Technique

All fingers were operated under tourniquet control for ease of dissection. Flap markings were designed by marking the existing eponychial edge and then the projected eponychial edge. This gap was restored by advancing the onion flap raised on residual eponychium superficial to underlying tendons. The bipediced advancement flap was planned with lateral bases of at least 5 mm in width. The onion flap tip was usually planned 1 mm more than the desired advancement and was kept narrow to allow primary closure (► **Figs. 1** and **2**). An anchoring suture was taken from the distal end of the flap to the nail pulp. Yang did not initially describe this suture, but we found it to be a worthwhile modification.

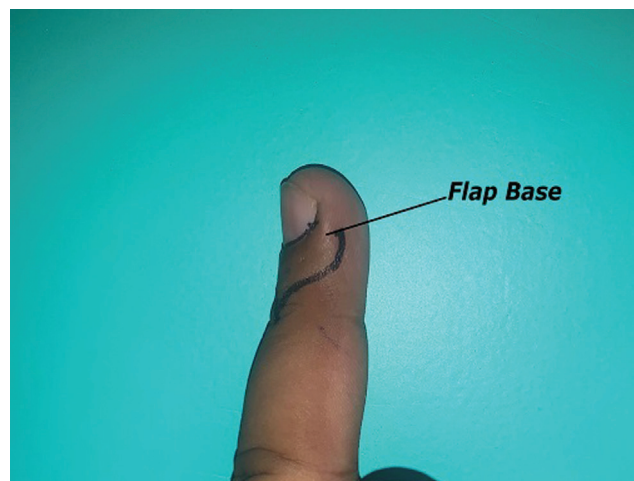


**Fig. 1** Onion flap dorsal view.

Viability of flap, hematoma, and infection were recorded in the early postoperative period. The parameters assessed and recorded till 4 months of follow-up were final donor site scar appearance, assessed by visual analog scale (VAS) (0: unacceptable scar to 10: natural appearance),<sup>3</sup> and nail plate appearance, such as the direction of nail growth and the smoothness of the nail plate, assessed using clinical examination and photographs.

## Statistical Analysis

All data were subsequently analyzed with the help of computer software (SPSS statistical software, version 25.0, for Microsoft Windows, SPSS Inc. Chicago, IL). All values were expressed as mean and percentages. Qualitative data correlation was done by Chi-square test. The quantitative data correlation was done by *t*-test.



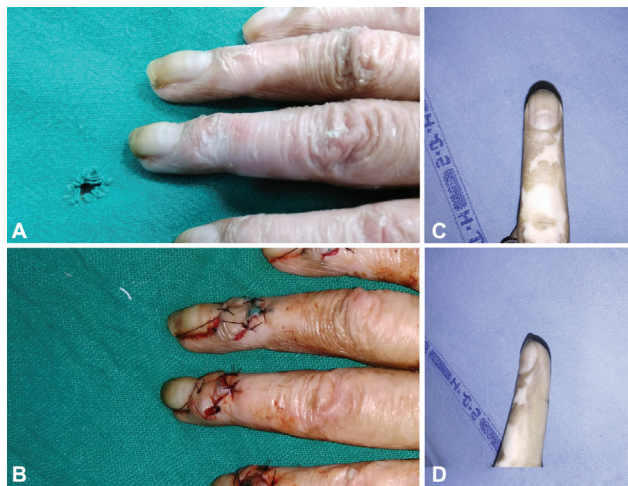
**Fig. 2** Onion flap lateral view.

## Results

A total of 44 fingers (15 patients) were operated on. The mean age of patients was 31.6 years. The mean time interval since burn injury to surgery was 17.8 months, with a range of 6 to 48 months. All 15 patients had received conservative management for the primary burn injuries with regular dressings. Of the 44 fingers included in the study, 35 fingers had flame burns, while 9 had scald injuries. Because the number of patients of both types of burns was not comparable, the difference in outcome was not assessed. Out of 44 patients, 11 (25%) were operated on for other contractures under general anesthesia, and Yang's flap was done simultaneously, while 33 patients (75%) were operated under local anesthesia under digital or wrist block. The procedure was successfully done on all fingers. It was done as a single staged procedure in all patients, and the donor site was closed primarily. Yang's flap was also successfully done in fingers with scarring on dorsal aspect till distal interphalangeal joint (DIP) with wider flaps even reaching the middle phalanx (►Figs. 3 and 4).

Flaps were monitored clinically for 48 hours, after which the primary dressing was done. Wounds were then dressed on alternate days, and sutures were removed on day 7 and the anchoring suture on day 10. The following findings were noted:

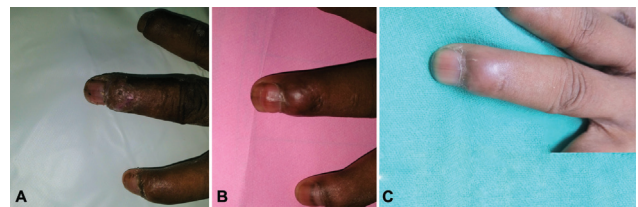
1. Two out of 44 flaps developed partial necrosis of the onion flap; these fingers were managed conservatively with dressings only. Wounds healed in the two patients in 10 and 12 days, respectively. No further procedures/flaps were required for both of these patients. The overall complication rate in the early postoperative period was 4.54%.
2. The bulb of the onion flap settled down with time and was less prominently seen at the end of follow-up in all fingers. The average VAS score was 6.8, indicating good acceptability (►Fig. 5).



**Fig. 3** (A) Middle finger with nail plate deformity. (B) Operative photograph. (C) Well-settled flap with improved nail growth at 6 months' follow-up, dorsal view. (D) Lateral view.



**Fig. 4** (A) Post-burn nail deformity middle and ring fingers. (B) Intraoperative photograph of onion flap for middle finger, dorsal view. (C) Lateral view. (D) Improved nail growth seen in the middle finger as compared with ring finger.



**Fig. 5** (A) Onion flap at postoperative day 7. (B) Flap at 2 month's follow-up. (C) Well-settled Onion bulb at 6 month's follow-up.

3. Improvement in nail plate appearance was observed in 26 (59.1%) out of 44 fingers. There was no improvement in appearance in 18 fingers (40.9%). Improvement was considered when a crooked, uneven nail was replaced by a smooth and shiny one. These changes were noted by both the patient and observer during clinical examination and in photographs (►Fig. 3–5). The follow-up period in most patients was 4 months. A longer follow-up is needed to document an improvement in nail plate appearance as the pace of nail growth is slow and may not be documented well in 4 months. In a few patients not showing an improvement in nail appearance, a later release and skin grafting was planned. However, this intervention was not a part of this study.
4. Preoperatively, patients had reported that deformed nails caused problems other than aesthetic concerns. Of the 44 fingers, there were complaints of the hindrance of daily activity with the deformed nails in 28 fingers. The main problems were the entanglement of nails in clothes, pockets, and the frequent break in nail plates. Of these 28 fingers with symptoms, 22 fingers (78.57%) reported a symptomatic relief postoperatively, while six fingers reported no symptomatic relief after the operation. There was a positive correlation of the reduction in functional



problems with restoration of the horizontal anatomy of the deformed nail plates (19 out of 20 patients reported less entanglement  $p$ -value: 0.01). Only one patient reported that he still suffered nail entanglement even after a more horizontal nail plate was achieved, in the coronal plane.

## Discussion

A normal healthy nail has a dorsal nail matrix with the eponychium that covers and protects it. The first case report for the attempt to release scarred tissue and correct the nailfold was by Barford in 1974 as a four-stage procedure.<sup>4</sup> Though he attempted to correct the contracture of the DIP joint, an improved nail appearance was also seen.

Achauer et al used a primarily closed donor site, but the procedure could only be applied to mildly deformed nails. The author later favored proximally based flaps for nail deformities and nail fold creation.<sup>5</sup> Distally based flaps have a risk of precarious blood supply if they are raised very distally, and the digital nerve and vessels can be damaged while raising the flap leading to a decreased sensation and flap loss.<sup>1,6</sup> The proximally-based flaps can have a digital artery or branch included in the flap, but the flap still has the chance of digital nerve injury. This risk is because earlier flaps included skin from the finger's lateral side, which often encroached on the volar aspect. When raised, both proximal and distally based flaps should preserve the pulp-to-pulp pinch area (the flap is raised on the nondominant ulnar border of the fingers and the radial border of the thumb). However, it may not always be possible due to scarring of the skin in the involved finger.<sup>6</sup>

Donelan has described a bipedicled proximally based flap in over 100 cases over 20 years reliably with good results; this technique uses a skin graft to cover donor site defects.<sup>7</sup>

Yang described the technique for release of scarred eponychium and nailfold reconstruction in 2012 in 32 fingers with a 100% flap success rate. The technique further modified the reverse V-Y advancement flap described by the author earlier with primary closure of the defect.<sup>2</sup> We found the flap to be feasible as a single-stage procedure in 44 fingers.

## Early Postoperative Complications

We noted partial flap necrosis in two of our operated fingers. The reason for partial necrosis seen in two patients in our study could be excessive undermining at the pedicles, jeopardizing the vascularity of the flap. The bipedicled nature of this flap gives a good blood supply, leading to a high success rate of the flap noted by us.<sup>8</sup> Donelan et al in 2005 also described their experience with bipedicled flaps to release scarred eponychium. They described over 100 flaps over 20 years with no instance of flap loss. Their technique required the closure of the resultant donor site defect with skin graft like previous other techniques.<sup>7</sup> Flap necrosis is a known complication noted by Alsbjorn in one patient and Yang in two patients (epidermolysis of the tip).<sup>2,5</sup>

The procedure for nailfold reconstruction is a clean case by definition with no contamination. Meticulous technique and adequate hemostasis before closure prevent the incidence of hematoma post-surgery.<sup>9</sup>

## Scarring

The bulb of the onion flap settles with time. The same was reported by Yang et al in their study.<sup>2</sup> Donelan et al performed release of scarred tissue and closure of the resultant defect by a skin graft, the flap used by them for nailfold reconstruction also settled with time as seen in the postoperative photographs by the patients.<sup>7</sup> Achauer also reported flattening of dorsal flaps over time.<sup>10</sup> This previously documented flattening out of the flap was also seen in our study. Because the donor site was closed primarily in our study, we did not notice a different color of the donor site as seen in the report of Donolen et al.<sup>7</sup>

## Nail Plate Appearance

We found an improvement in the appearance of the nail plate in 26 (59.1%) out of 44 fingers (mean follow-up: 4.63 months). Yang et al reported improved nail plate appearance in all fingers (mean follow-up: 7.8 months).<sup>2</sup> Donelan et al, Alsbjorn et al, Achauer et al have mentioned an improved nail appearance, but the number of fingers is not mentioned.<sup>5,7,10</sup>

The nail bed and germinal matrix are not surgically altered directly by our procedure. The improvement in nail plate appearance is attributed to a more anatomically placed nail fold. However, when the association of a normal nail fold appearance with a normal nail plate appearance was tested, it was marginally statistically insignificant ( $p = 0.081$ ). Further, because the follow-up period in most fingers in our study was around 4 months and nails grew at around 0.5 cm per week, a longer follow-up would probably have more patients reporting a normal nail plate appearance. Most of our patients had flame burns (80%), and 66% of them had other associated contractures, indicating a more severe burn injury. Many of these patients could have fingers with direct thermal damage to the nail germinal matrices, in which case the normalization of nail fold would not affect the nail plate appearance in the respective fingers. Such patients could be planned for a nail bed transfer.

## Symptomatic Relief

Of 28 fingers with symptoms, 22 fingers (78.57%) reported a symptomatic relief, while six fingers reported no symptomatic relief at the end of follow-up period. Spauwen also reported symptomatic improvement in all patients operated. Though the effects of surgery reversed at the end of 1 year in their study, patients still reported symptomatic relief at the end of 1 year.<sup>11</sup>

## Conclusion

Yang's flap is a good option for the correction of nail deformity in burn patients. It was associated with a low complication rate and improved nail appearance in 60% of

patients. There is also significant symptomatic relief in performing daily activities after surgery.

#### Conflict of Interest

None declared.

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