



An algorithmic approach to posttraumatic nail deformities based on anatomical classification[☆]

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Summary *Background and aims:* Most of the clinical series on posttraumatic nail deformities (PTNDs) address an individual deformity and its correction. The aim of the study was to classify PTND on the basis of its anatomical defect, devise the reconstructive modality and propose an algorithmic approach to PTND. We have also analysed our results of surgical correction and compared the data with the published literature.

Method: A 5-year retrospective study of 45 patients with PTND was conducted. The deformities were classified into three groups: intact nail bed, partially amputated nail bed and completely amputated nail bed on the basis of the remnant nail bed.

Results: PTNDs with intact nail bed were present in 78%, with partially amputated nail bed in 16% and with completely amputated nail bed in 7% of the patients. Deformities in intact nail bed group were nonadherence (33%), ridged nail (31%), split nail (9%) and nail horn (4%). All patients with partially amputated nail bed presented with hooked nail deformity. A satisfactory result was seen in 87% of nonadherence, 71% of ridged nail, 50% of split nail and 57% of hooked nail. None of the patients with nail horn and absent nail showed a satisfactory result.

Conclusion: PTND with intact nail bed are consistently benefitted when the option is only split-thickness sterile matrix (STSM) grafting. Appreciable correction of hooked nail deformity can be achieved by the reconstruction of lost components. In our opinion, there is

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no role of split-thickness germinal matrix (STGM) and STSM graft transfer in total nail reconstruction.

Level of evidence: III.

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Nail is important for both aesthetic and functional capability of the finger. The nail unit consists of nail plate, proximal and lateral nail folds, nail bed consisting of sterile and germinal matrixes and hyponychium. The germinal matrix is the primary generative centre of the nail and forms the bulk of the nail plate. The sterile matrix is involved in shaping and adhering of the advancing nail. Lunula is white, semilunar-shaped area extending beyond the edge of the proximal nail fold. It marks the transition from germinal matrix to the sterile matrix and is an important surgical landmark for harvesting nail matrix graft. Nail grows at a rate of 0.1 mm day⁻¹ or 0.5 mm week⁻¹.¹ Finger nail grows faster than toe nail by a ratio of 4:1.²

The most common cause of nail bed deformity is trauma,³ and chronic nail deformities are difficult to treat. Nail bed matrixes (sterile and germinal) are specialised tissues and attempts to replace them with skin or dermal graft is rarely a success.^{4,5} Numerous techniques of nail matrix transfer have been described but each has its own drawbacks. Free nail grafting techniques are split thickness, full thickness and composite grafts.⁶ Vascularised nail transfer techniques include long- and short-pedicle free flaps.⁷

Method

A 5-year retrospective study from November 2007 to December 2012 of 45 patients operated for posttraumatic nail deformities (PTNDs) of fingers and toes was conducted. Patients with healed and closed wound with deformed nails were only included in the study. The deformities were classified into three groups according to the size of the existing nail bed: intact, partially amputated and completely amputated nail bed. The intact nail bed group included nail beds normal or near normal in size but scarred, leading to deformed nails. This included split nail, nonadherence (onycholysis), ridged nail and nail horn. The partial amputation group included nails in which germinal matrix with varying length of sterile matrix was intact, leading to hooked nail deformity. In the complete amputation group, whole of sterile and germinal matrix was absent and patient required total nail reconstruction. All sterile and germinal matrix grafts for nail bed reconstruction were harvested from the great toe. All grafts were split thickness, and no full thickness or composite grafts were used. Prior to surgery, an X-ray of the involved digit was performed to visualise the bony abnormality, and a dermatological opinion was taken to rule out fungal infection of the nails. Patients were also shown previous post-operative results to give them a realistic level of expectation from the surgery.

As the anatomic basis of PTND could be easily ascertained preoperatively and subsequent reconstruction

technique was based on the replacement of component losses, an algorithm was designed to guide the surgeon in a standardised manner (Figure 1).

Operative technique

The surgery was performed under digital blocks and tourniquet with loupe magnification as a day-care procedure. In the intact nail bed group, the scar tissue over exposed nail bed was delineated and excised, and the nail matrix graft harvested from the great toe was applied. When required, the nail fold flap was raised to define the proximal limit of the scar into germinal matrix. The donor toe nail was used to splint both the donor and recipient areas. Bony spurs, seen in X-ray in the cases of ridged nails, were filed to correct the bony curvature.

In the partially amputated group, the treatment involved sub-periosteal freeing of hooked nail bed, local flap (volar V-Y advancement flap, cross finger flap) to gain additional distal pulp and de-epithelialisation and split-thickness sterile matrix (STSM) grafting of the advancing edge of skin flap to lengthen the nail bed (Figure 2).

Total nail reconstruction was done in the patient with a completely amputated nail bed. The technique involved de-epithelialised skin 'turnover' flap with sterile matrix grafting for proximal nail fold reconstruction, de-epithelialisation with split-thickness germinal matrix (STGM) and STSM grafting for nail bed creation and full-thickness skin grafting of the turnover flap. In one case, unicortical bone graft from olecranon was used for distal phalanx reconstruction.

First-check dressing was done 10 days after surgery and nail splints were removed after 3 weeks. Serial photographic records were maintained and results were graded as satisfactory and unsatisfactory based on the shape of the nail, adhesion to the underlying bed and donor site morbidity.

Results

Gender and age group

Amongst 45 patients included in the study, 24 were female and 21 were male. The patient age group ranged from 13 to 57 years with a mean age of 28 years.

Causes of injuries

Crush injury was the commonest aetiological factor accounting for 84% of the total cases. This included crush injury in doors (33%), car doors (27%) and under heavy

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