Original Article

Local or Distal Flap in the Management of Digital Trauma in Children

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Abstract

Objectives: We aim to describe the management of fingertip injuries treated by flaps in the paediatric surgery emergency ward and evaluate the long-term results. **Patients and Methods:** Through a 2-year prospective study, we analysed all fingertip injuries treated by flaps in the paediatric emergency ward. We collected patients' data and the clinical and imaging characteristics of the lesions. The type of flap was chosen on a case-by-case basis. We evaluated aesthetic and functional results. **Results:** Forty-two fingertip injuries required the use of flaps. The average age was 7 years, and boys were more affected. The smashed fingertip was the most common mechanism; pulp lesions and amputation were located mainly in zone I or II. We performed Atasoy flaps, palm flap, free skin grafts, McGregor flap and the cross finger flap. Our results were good to excellent in 66.67%. **Conclusions:** The best management of fingertip injuries in children remains prevention.

Keywords: Children, distal flaps, fingertip trauma, local flaps

Introduction

Trauma to the digital extremities and the nail apparatus is one of the first causes of consultation in paediatric trauma emergencies. Slamming a finger in a door is the usual aetiology, producing the classic 'crushed fingertip'.[1] The presence of growth cartilage at the base of the phalanx, its close relationship with the nail and the sheathing of the flexor tendons give it particular gravity.[2] Surgical approaches for fingertip amputations and loss of skin tissue with exposed tendons and/or phalanx that cannot attend to primary closure include stump plasty, local or distant flaps, microsurgical replanting, composite grafts or skin transplants.[3]

We aim to describe the management of fingertip treated with flaps in paediatric emergency departments and evaluate the long-term results.

Patients and Methods

Through a prospective study running from January 2017 to December 2019, we analysed all the fingertip traumas received at the paediatric emergencies. We excluded all benign traumas whose management does not require the use of a flap. Data concern the traumatised person and the trauma, the management and the outcome. X-ray was performed of all affected hands.

We used the Rosenthal's[4] classification to locate the pulp lesions and the Dautel and Barbary's[5] classification for distal amputation. Duration of antibiotics depends on the presence or absence of an open fracture. The type of flap was made on a case-by-case basis according to the lesion assessment. All patients were treated under anaesthesia.

We performed nail fixation when the native nail was intact and nail plasty using flexible propylene glycol when it was completely destroyed. The wound of the matrix was sutured by an interrupted stitches by 5-0 or 6-0 cat gut. We performed pinning by an 18 Gauge pin for displaced phalanx

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body fractures and orthopaedic treatment for epiphyseal detachments and stable body fractures. The pin was removed after 3 weeks.

The final result was evaluated at the end of follow-up by the criteria below:

- The nail: its appearance, the degree of coverage of the nail bed, its shiness.
- The finger's participation to the grasping function,
- The distal sensitivity of the finger,
- The aesthetics aspect (residual length of the finger and its appearance),
- The parental satisfaction;

Scored from 0 to 2. rated excellent [9-10 points], Good [6-8 points], Fair [3-5] and Poor [0-2 points].

Ethical aspects

The parents' consent was obtained and the research protocol was validated by the ethics committee.

Results

Ninety-six patients were admitted for fingertip trauma and 42 had severe trauma and received a flap. The average age was 7 years (1–15 years). Boys were more affected (57.14%). The average consultation time was 9 h (1–36 h). The aetiologies encountered were the door 69.05%, the ring 14.28%, other domestic accidents 7.14%, fall of stone 7.14% and work accidents 2.39%. The third and fourth fingers were the most affected 33.33% and 26.19%, respectively. Smashed fingertip was the most frequent mechanism in 29 cases.

The right hand was affected in 71.43%, and there was no bilateral involvement. In 88%, the trauma occurs at the dominant side. The amputation is more located at zones I and II. Nail avulsion was more encountered. The bone lesion mainly involved the phalanx tuft. The average time to care was 8 h (4–24) [Table 1].

We performed 22 palmar flaps [Figure 1a-f], 14 Atasoy pulp advancements, 4 free skin grafts, 1 McGregor flap and 1 cross finger. Amongst the palm flaps, 2 were in the hypothenar zone, 12 at the thenar level and 8 in either the Verdan's zone II or III[6] depending on the finger's comfort. All patients received antibiotics (clavulanic acid combined with amoxicillin) from 2 days to 1 week. The hospital stay was 6–24 h. The outcome was marked by one case of infection and three cases of necrosis during the 1st week. We regularised cases of necrosis. For the case of infection, we recommended local care twice a day and 1 week of antibiotics. The mean time to weaning the flap was 29 days. Patients were followed for an average of 7.12 months (4 months, 36 months), and the result was excellent in 28.57%, good 38.10%, average 23.81% and fair 9.52%.

Discussion

Digital trauma is common in children. The incidence is 3.5% of domestic accidents involving children: 1.7% of all



Figure 1: Palm flap: Clinical, imaging, per-operative and final result images after 3.5 months of follow-up. (a and b) Pulp amputation of the third finger with bare bone and nail detachment and respect for the matrix. (c) X-ray front plan of the right hand: no bone fracture, annulation is located at the zone II. (d) Postoperative mage palmar flap was performed. (e and f) Clinical control image at 3½ months, good healing normal appearance of the pulp and complete regrowth of the nail

Table 1: characteristics of the 42 lesions treated by local or distal flap

Characteristics	Effectif	Pourcentage (%)
Level of the lesion		
Zone I	14	33,33
Zone II	11	26,19
Zone III	9	21,43
After the zone III	8	19,05
Level of amputation		
Zone 1	14	33,33
Zone 2	11	26,19
Zone 3	9	21,43
Zone 4	8	19,05
Nail detachement	13	30,95
Nail avulsion	22	52,38
Smashed nail	6	1428
Nail bed involvement	29	69,05
Matrix involvement	25	59,52
Pedicule involvement	14	33,33
Fracture	18	42,86
Phalanx tuft	9	
Body of the phalanx	7	
Epiphysal detachment type 2 (Salter)	2	
Phalanx exposed	26	66,90
Tendinous section	3	7,14

paediatric emergencies and 8% of all hand emergencies.[2,6-8] The average age of our patients was 7-years, while it varies between 2 and 6 years in most studies on fingertip trauma in children.[2,9-11] Epidemiological data agree on the predominance of boys, and doors are the causative agent in more than half of cases.[1,9,12] There is no absolute predominance on the left or right side.[1,6,12,13] The most important is to determine the dominant side of the child. That is difficult in this young paediatric population where neither the child nor the parents are yet able to identify the dominant side.

The dominant hand is more exposed to fingertip trauma.[14,15] The third and 2nd fingers are more frequently affected probably because of their length what exposes them to more trauma than other fingers.[1,2,16] Several classifications are proposed to locate the pulp lesions. They are all close to each other. We used the Rosenthal's[4] and Dautel and Barbary's[5] classification for their simplicity and the use that we considered more practical in an emergency. The frequency of nail bed sores varies between 20% and 30%, most of which are transverse wounds, and nail avulsion is more common.[10,13,16,17] When the matrix is affected, the sequelae are always greater because it is the organ that produces the tablet.[9] We observed 60.98% of matrix involvement. Lesions associated with trauma to the nail apparatus are dominated by pulp lesions, of which those located in zone I (35%) or II (25%) were more frequent. They can result in the 'unwinding' of the end of the finger, with exposure of the bone, 63.41% in our series. Amputations in zone I or II are more common.[1,2,18] The association with a fracture of the distal phalanx is around 20%–50% with a clear predominance of those located at the level of the phalanx tuft.[6,10,13,19]

Fingertip trauma is a real emergency, the consultation and management of which take place in the first 24 h.[10,13,19] There are three main factors that influence the choice of the appropriate flap for covering tissue loss: her size, its location (proximal dorsal or ventral fingertip) and the functional requirements of the patient.[20]

The Atasoy/V-Y flap is sufficient for amputations located in zone I or II. The palm flap is used for when the amputation is located at the zone III, sometimes for the zone II amputations when the Atasoy flap is not sufficient. The cross finger and the McGregor have been indicated for more proximal amputations. The free skin graft was reserved for the loss of major substances. Our surgical indications respect those described in the literature.[20,21] Pearce and Colville[8] observed in their series 50% of associated fractures for which they did not make any treatment which did not affect the final result. In our protocol, we respect only the phalanx tuft fracture.

The data are contradictory about the place of antibiotic prophylactic or therapy. For Fitoussi and Penneçot[22] and Masquelet and Gilbert,[6] prophylactic antibiotic should be systematic. Stevenson[6] in his double-blind randomised study found no interest in antibiotic prophylaxis in open fractures of the last phalanges. We received fingertip trauma in a high risk of infection (delay of consultation without primary care, application of traditional drug, etc.) that justifies a systematic use of antibiotics. Usually, we programme these patients after 21 days for weaning under anaesthesia. Non-respect of programme or anaesthesia requirements made our mean weaning time long as that found in the literature.[10]

The nail growth rate is approximately 0.1 mm/day or 0.5 mm/week and 1.9–4.4 mm per month.[19] Of the 22 nail plasties, we observed 17 re-growths, 6 of which were complete and 11 reaching at least half of the nail bed. All fixed nails either held or allowed complete regrowth of the nail. Crushing and loosening lesions seem to have a poor prognosis. The quality of final sensitivity is inversely proportional to the patient's age at the time of the accident.[6,8,15,16] Our overall score was good to excellent at 66.67%.

Conclusions

The use of local or distal flaps is frequent in the management of fingertip injury in children. A precise imaging and clinical lesion assessment under anaesthesia makes it possible to identify the type of the flap indicated to restore the functional anatomy of the traumatised finger. Although the results are satisfactory, the best treatment remains prevention.

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Conflicts of interest

There are no conflicts of interest.

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