Abstract

Introduction: Fingertip injuries are the most common injuries in pediatric hand trauma. The goal in fingertip amputation reconstruction is to cover the defect, establish maximum tactile gnosis, and protect the joint function and none the less to obtain a satisfactory cosmetic appearance. The plane of the amputation and the condition of the tissue at the injury site help to determine the best repair technique.

Materials and Methods: Thirty pediatric patients underwent fingertip reconstruction using the V-Y advancement flap and cross finger flap techniques at the Department of Pediatric Surgery in Târgu-Mureş between January 2015 and December 2016. The used technique was chosen according to the nature of the injury, the size and condition of the defect, the affected fingertip, the plane and the zone of the traumatism. During the follow up visit the two point discrimination test was determined. The parents compared the cosmetic results with the contralateral fingertip and they rated it on a 1-10 scale.

Results: Cross finger flap was used in 14 cases and V-Y advancement flap in 16 cases. We corrected with cross finger flap technique 14 volar and 1 dorsal fingertip injuries. The operation average time was 83.21 minutes. The cosmetic outcome in this group was 8.28. Mostly dorsal (n=9) and transverse (n=7) injuries were corrected by V-Y advancement flap. The surgery to cover the deficiency took 36.56 minutes. A better cosmetic result was found in this group, the average rate was 9.37. There was a significant correlation between the plane of the traumatism and the cosmetic outcome of the operation. The best outcomes were found in transverse injuries. The quicker hospital presentation showed the better cosmetic outcomes at the 0.01 significance level.

Conclusion: The V-Y advancement flap can be used with a high liability in dorsal and transverse injuries. Cross finger flap is used more often in volar traumatism. We cannot apply an algorithm for the elective approach.

Keywords: V-Y advancement flap, cross finger flap, hand trauma
the dorsal finger and normal sensation [2]. It can be a volar or lateral lesion, a shortening of the bone, the chief competitor with the V-Y technique is the cross-fingerpulp flap in fingertip loss. The cross finger flap can be used primarily to replace an avulsed finger pad or to replace an inadequate skin graft [3]. The aim of this study is to compare the results of these two reconstructive techniques in pediatric population.

Materials and methods
Thirty pediatric patients underwent fingertip reconstruction using the V-Y advancement flap and cross finger flap techniques at the Department of Pediatric Surgery in Târgu Mureș between January 2015 and December 2016. The used technique was chosen according to the nature of the injury, the size and condition of the defect, the affected fingertip, the plane and the zone of the traumatism. An injury classified as zone I occurred distal to the bony structures of the digit and the distal phalanx was preserved. Most of the nail bed and the integrity of the matrix were intact. Zone II injuries were located distally to the lunula of the nail bed and were commonly implicated by the bony exposure of the distal phalanx. Injuries of zone III involved the nail matrix and result in loss of the entire nail bed; usually they were not candidates for elaborate reconstruction (Fig. 1). According to the plane of the amputation injuries were also classified as dorsal, transverse or volar (Fig. 2). The crossed finger flap (Fig. 3) was designed on the opposite pulp area of the adjacent finger. The V-Y advancement flap (Fig. 4) used a triangular flap which was designed with the base at the edge of the amputation and the full thickness skin flap was advanced over the exposed bone. Regardless of which treatment option was chosen, the wound debridement was the first step for wound healing and infection prevention. Two-point discrimination measures the individual’s ability to perceive two points of stimuli presented simultaneously. Before surgical treatment two-point discrimination test was completed. The operations were performed under general anesthesia. During

![Figure 1](image1.png)

**Figure 1.** Zonal classification of amputation: Zone I is distal to the phalanx; Zone II distal to the lunula and Zone III proximal to the lunula

![Figure 2](image2.png)

**Figure 2.** Injuries classified by the plane of the injury: dorsal oblique, transverse and volar oblique

![Figure 3](image3.png)

**Figure 3.** Cross finger flap: The skin was elevated like a page of the book with the base on the controlateral side of the donor finger and it covered the exposed bone.
the follow up visit the two point discrimination test was determined again. The parents compared the cosmetic results with the controlateral fingertip and they rated it on a 1-10 scale.

Results
The mean age of the patients is 7.23 with a minimum of one year and a half and a maximum of seventeen years. Out of the 30 patients 56.66% (n=17) are boys. The most frequent type of injury is due to crush mechanism 46.7% (n=14) followed by sharp injury in 30% (n=9) and avulsion in 23.3% (n=7) of the cases. A volar traumatism plane is observed in 12 patients, dorsal in 11 and transverse in 7. After statistical analyses we observed that there is a correlation between the plane of the traumatism and the time until hospitalization. In case of volar damage the time between the traumatism and surgical consult shortens. There is also a significant correlation between the plane of the traumatism and the cosmetic outcome of the operation. The best outcomes are found in transverse injuries. The mean cosmetic result is 8.87 (Fig. 5) however it depends on variable factors. The quicker hospital presentation shows the better cosmetic outcomes at the 0.01 significance level. The size of the wound correlates negatively with the cosmetic outcome (p<0.01). The mean size of the defect is 2.47 square centimeters. The biggest discontinuity is found in avulsion trauma with an average of 2.78 sqcm wound. There is a negative correlation between age and wound size at 0.05 level. The middle finger is injured in 8 traumas; the index along with the ring finger is damaged in 7 (23.35%) patients.

The time between the injury and surgical consult is 1.43 hours. A statistically significant correlation is found between the age and the time until the hospitalization (p<0.01).

Cross finger flap is used in 14 cases and V-Y advancement flap in 16 cases. The chosen technique is cross finger flap in 6 avulsion, 3 crush and 5 sharp injuries. The ring finger is affected the most. We corrected with this technique 14 volar and 1 dorsal fingertip injuries. The mean defect size is 2.51 sqcm. Parents arrive to the hospital after 1.5 hour (range of 30 minutes and 2 hours) after the accident. The patients wait in average 2.53 hours until the surgical treatment from the moment of the injury. The operation average time is 83.21 minutes. Before operation the two-point discrimination test is 5.45 and during the follow up consultation 4.94. The follow up control takes place averagely 4.71 months after surgery. The cosmetic outcome in this group is 8.28. The best outcome is in crush injuries with an average of 8.33.
Seven transverse and 9 dorsal injuries are corrected with V-Y advancement flap. The average defect size is 2.42 square centimeters (sqcm). The most frequent injured fingertip in this group is the middle one. This treatment was chosen in 1 avulsion, 11 crush and 4 sharp cases. Mostly the dorsal (n=9) and transverse (n=7) zone I injuries are corrected by this method. The surgery time to cover the deficiency takes 36.56 minutes. The time between the injury and surgical consult is 1.37 hours; 2.28 hours until the operation. Before the operation the two-point discrimination test is 5.79 and during the follow up is 4.83. A better cosmetic result is found in this group, the average rate is 9.37. The best cosmetic result is given in the crush mechanism trauma (9.45).

**Discussion**

Fingertip injuries are the most common injuries in pediatric hand trauma. The major causes in children are due to traumatic-crush avulsion, such as when the affected digit is caught in the closing door or beneath heavy objects. In older children, we can see hand injuries from sport related activities [4]. The fingertip being the end organ for touch, preserving maximal function is the utmost importance. When there is adequate skin and soft tissue available, primary wound closure should be attempted. A small uncovered distal phalangeal bone (<1sqcm) will allow healing by secondary intention. The dressing is changed by the doctor; but once they confirm that there is no infection parents need to be instructed to change the dressings until healing. This strategy takes time and can be challenging in young patients. A bigger wound where the amputated fragment is not available, the optimal reconstruction has to pre-

The V-Y advancement flap and cross finger flap techniques are commonly used reconstructive techniques in pediatrics because they are simple solutions for wound covering and they can be used even in distress, nonverbal child in whom multiple procedures and anesthetics are to be avoided. The recovery is faster and better than in other techniques. However they are not at the top of the reconstructive ladder elaborated by Levin[6], they have good tactile gnosis and cosmetic outcomes. The two point discrimination test shows healing in both of the cases, but in the cross finger flap group the difference was lower. When dorsal skin was used for volar correction the sensory function decreased because of different tissue. To improve sensory recovery, maximal amounts of subcutaneous tissue must be included in the neurovascular island dissection [7].

The V-Y advancement flap has better cosmetic results. The advantage of this method is that it preserves the finger length with tactile gnosis and nail growth. It is a one stage surgery that uses similar colored and textured adjacent tissues. The child can move the injured finger after the operation; physical therapy isn’t usually needed for stiffness. The disadvantage can be the created tension in larger defects.

The other frequently used technique in pediatric population is the cross-finger flap which has acceptable cosmetic results. An advantage of this technique is that the abundant circulation in the skin of the finger offers a good blood supply; a pedicle vascular insufficiency is rare. This flap can easily cover dorsal digital defects if the adjacent finger is sufficiently long. The disadvantage is that there may be some residual scarring and stiffness in the donor finger. It needs skin grafting for donor site and a second surgery for flap separation. Another disadvantage is the uncomfortable positioning in case of terminal digital defects [8]. Children don’t support well to have stuck fingers for 2-3 weeks. Non innervated cross finger pulp flap has the weakness of poor sensory recovery [7]. Despite of the disadvantages this technique is a good option if other local flaps are not available.

**Study Limitations**

Our study is based on the outcome of 30 fingertip injuries, which may be small to conclude which reconstructive technique has better esthetic results.

**Conclusion**

Through this review we demonstrated that V-Y advancement flap can be used with a high liability in dorsal and transverse injuries. Cross finger flap is used more often in volar traumatism. We cannot apply an algorithm for the elective approach. The surgeon has to choose the reconstruction technique which gives a viable digital tip and if possible preserve the digital length.
REFERENCES