The finger-tip flap technique is a time-tested method of fingertip reconstruction that has been criticized due to possible finger flexion contractures and unsightly donor site scarring. Function was preserved in both affected finger and the same finger on the contralateral hand in all patients. The questionnaire measured subjective satisfaction in: sensibility, appearance, and function. Finger-tip sensation was preserved in both affected finger and donor site. The most persistent patient complained involved fingertip contour, were most patients rated it as “Fair” (43%) and “Good” (56%). After statistical analysis of the data we found no statistical difference in range of motion (ROM) between affected finger and the same finger on the contralateral hand on both PIP and MCP joints (p=0.08, 0.06 respectively). Conclusions: The “Shark Mouth” incision thenar flap is an effective strategy for fingertip reconstruction. The results demonstrate this technique has excellent functional and aesthetic results and is not associated with flexion contractures, excessive sensibility or pain in the pediatric population.

Index words: fingertip, reconstruction, shark, mouth, incision, thenar, flap, outcome

ABSTRACT

INTRODUCTION

The fingers serve a crucial role in the functioning of the hand. They are an organ of manipulation and sensation and are wrapped with countless sensory nerves endings, which account for sensation of pain and an extremely sharp two-point discrimination. The skin covering the pulp of the finger is very durable and has a thick epidermis with deep papillary ridges. It consists of a subcutaneous layer of subcutaneous fat and a fibrous septa extending from the dermis to the periosteum of the distal phalanges. Unfortunately, the most common injuries of the hand are finger injuries. These injuries are caused by a cut distal to the insertion of flexor and extensor tendons (1). These injuries could be as insignificant as a fingertip fracture with no significant displacement or soft tissue injury, at which point treatment is conservative, or could be as severe as fingertip amputation with loss of distal fragment. In the latter case, even though preservation of the nail, lining, and a good soft and durable skin with no fingertip pain. Considerable dysfunction can occur when a painful fingertip excludes the use of a digit, or even the hand from use. It is crucial to maintain sensation in fingers, not only does it help guide the finger along surfaces and aid in the overall functioning of the whole hand, but it serves as a defensive mechanism and protective sensation.

Treatment of fingertip injuries should be individualized according to specific wound characteristics. Various methods of treatment are possible, including allowing wound to heal by secondary intention, shortening of the bone and primary closure, skin grafting and coverage with a local and regional flap. It is important to know whether there is loss of skin and/or tissue and the size of the defect. Also knowing whether there is exposed bone, bone loss or fracture of the distal phalanx tip is important for choosing the appropriate treatment. Primary closure of injury usually suffices for injuries with no skin or tissue loss. For those injuries with loss of skin or pulp tissue with no exposure of bone, skin grafting and allowing the wound to heal by

ORIGINAL ARTICLES/ARTÍCULOS ORIGINALES

FINGERTIP FLAP RECONSTRUCTION WITH THE “SHARK MOUTH” INCISION: THENAR FLAP—Analysis of Outcomes in Pediatric Patients

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REFERENCES


Acknowledgement

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RESEARCH CONTENT

El objetivo de este estudio fue describir los patrones en citología cervical de una muestra de pacientes con enfermedad inflamatoria del intestino (EI) y los métodos de tratamiento. Se presentó el primer estudio de su tipo en el grupo de mujeres en esta población. DISEÑO: Mujeres entre 21 y 49 años de edad con enfermedad inflamatoria intestinal (EI) o enfermedades inflamatorias clínicas fueron identificadas en el periodo de junio del 2012 a abril del 2014. Se les ofreció un cuestionario a través del correo electrónico. Las frecuencias y por ciento de las edades entre 21 a 49 años. Treinta pacientes (58%) tenían diagnóstico de Crohn (EC). Veintisiete pacientes (52%) se encuen- traron en remisión. Los inmunomoduladores se utilizaron en 23% de pacientes con CU y 91% de pa- cientes con EC. Sesenta y seis por ciento (67%) de las participantes informaron hacerse tazamómetro para cáncer de cuello manualmente. Cuarenta y un por ciento de las pacientes con CU y 23% de pacientes con EC refirieron haber tenido una prueba anormal. Casi la mitad de las pacientes con EI reportaron ci- tos masculinos en las 25-30 días (43%) o 31-35 días (37%). Las pacientes de CU reportaron perio- dos menstruales más regulares que las pacientes de EI. Ochenta y seis por ciento de las participantes reportaron no haber utilizado un método anticoncepcional. CONCLUSION: Muestra de un grupo de pacientes con EI en una ciudad en describir condiciones ginecológicas carac- terísticas de pacientes puertorriqueñas con EI. Es importante que las mujeres con EI reporten su vida y su necesidad para así poder establecer guías de manejo que permitan un mejor tamizaje de condiciones ginecológicas.

RESUMEN


Original Articles/Artículos Originales

BOLETÍN Médico Científico de la Asociación Médica de Puerto Rico

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secondary intention are appropriate treatments. Several authors have reported few complications and high patient satisfaction with the latter method (2,3), specifically for wounds no larger than 1 cm2. Larger wounds, however, when treated non-operatively heal with a thin layer of epithelium that is relatively fragile and could be over-sensitive to the point of being irritating and disabling to patients. Also, injuries that involve exposed bone and tissue loss almost never have enough tissue to close primarily, and treatment by secondary intention after shortening exposed bone below exposed tissue is associated with an unacceptable incidence of nail plate deformities (1). In these cases the application of full thickness skin graft should be considered. Full thickness skin grafts tend to contract less than split-thickness grafts, are more durable and less tender, and achieve better sensibility than split grafts (4).

One possible option for obtaining full coverage of a fingertip injury is implementation of a thanar flap. Thalar flaps are very advantageous in fingertip injuries with extensive tissue loss since they can provide a three-dimensional reconstruction that contains similar skin to the original skin of the finger, has extensive sensory endings, and is functional, durable, and aesthetically pleasing. The cavities of flap design are described by Beasley and Melone (5–7) and state that the flap should be placed high on the thenar eminence, based laterally, and adjacent to the metacarpophalangeal joint crease. Placing the incision too close to the mid-palm has been associated with debilitating donor-site tenderness (7). The thanar flap can be used for fingers two to five, although problems may arise in thickness if hands were the 4th and 5th digit flaps could have difficulty comfortably reaching the thenar eminence. Rinker described that in a study with 15 patients who underwent thanar flap reconstructions of fingertip injuries, 75% reported good or excellent results in terms of sensibility, function and appearance (8). Delon (9) reported a small case series of five patients with thanar flaps who had excellent sensory recovery, Barbato et al (10), also reported a case series of 20 patients, who also underwent thanar flap reconstruction, and also resulted with excellent sensory recovery.

All the studies previously mentioned show that the thanar flap is effective for sensory recovery of affected digit; however, functional outcome data is scarce in medical literature. The technique has been criticized due possible flexion contractures of the proximal interphalangeal joint and the mandatory digit flexion.

Barbato (10) reported in his thanar flap case series a 25% rate of PIP flexion contracture requiring extension splinting after flap division, but Rinker reports no significant flexion contractions observed in his case series. He did however notice a measured decrease in DIP joint motion of 13° compared to the contralateral side that was statistically significant (8). Recently, in the University of Puerto Rico School of Medicine, pediatric orthopedic surgeons have been implementing a modification to the thanar flap technique described, specifically the shape of the incision and flap. This new technique, termed “Shark Mouth” incision thanar flap, has given excellent function and aesthetic results in this institution. In this retrospective chart review we acquired information from 16 medical records of patients ages 0-17 years old, who underwent “Shark Mouth” incision thanar flap reconstruction by two different surgeons after traumatic amputation at the level of the proximal phalanx. The reameter after removal of bone from 2005-2011. The purpose of this study was to review the experience of two pediatric surgeons with the “shark mouth incision” thanar flap for composite fingertip reconstruction. An objective assessment of sensory recovery and range of motion was performed to confirm the approach in pediatric fingertip injuries in the future. The main focus is to provide the best care, in the adoption of the thanar flap technique, and its application.

MATERIAL & METHODS

Institutional Review
The present study was categorized as expedite and received approval of the participating institution’s Institutional Review Board for research involving human subjects. This approval was given prior to beginning data collection.

Study Design
This is a retrospective study examining the medical records of pediatric patients ages 0-17, who underwent thanar flap fingertip reconstruction with “shark mouth” incision of the 2nd, 3rd and 4th digits after fingertip injuries. Patients underwent surgical treatment by two separate pediatric orthopedic surgeons at the University Pediatric Casartel with follow-up at the Puer- rico Trauma Center. A data sheet was created to organize information extraction. This information included demographic data, mechanism of injury, type of surgery, timeline which included time to flap division, complications that may have developed, and physiologic findings, range of motion of PIP, DIP and MP joints, and grip strength.

Participants
Inclusion Criteria
• Male and female Patients
• 0 to 17 yo
• Suffered traumatic amputation at the level proximal to the middle portion of the nail bed, with loss of the terminal phalanx.
• Patients older than 17 years old
• Multiple digit amputation

• Patients who underwent other flap reconstruction or completion of amputation

Procedure/Operative Technique
The incision is accomplished by taking the tip of the injured finger and placing it against the thenar eminence. Two parallel lines are traced along the lateral and medial borders of the affected finger. The incision is then raised and the two lines are joined distally by a curved line (concave towards fingers and convex proximally) creating an angle greater than 60° between straight and curved lines. The wound is incised following the sketched lines. The tip of the wound incised is elevated and is sutured to the respective dorsal and volar fingertips and to each other along the lateral margins (see Figure 2). This method effectively advances the edges of the donor defects to one another. The hand is immobilized with the thumb in palmar abduction and flexion. The affected finger is flexed to minimize flexion at the PIP joint. Plaster is added to the hand to keep it in position over the dressing to complete immobilization. The digit is left attached to the donor site for approximately three weeks, and the flap is then divided. This can be accomplished by injec- ting local anesthesia. Skin flap is approximated in the finger with 3-4 sutures and the dorsal site is closed (see Figure 3). An active range of motion program is initiated for both the affected finger and thumb. Cautious wound hygiene is maintained along with dressing changes to decrease risk of wound infection and graft failure. Patients and parents are instructed on proper care including hand care and dressings; especially on bathing techniques utilizing plastic bags to cover the cast and prevent ideal conditions for infection. After 15 after graft division, sutures are removed. Pa- tients were followed up for at least 6 months (Figure 4) to assess function and any possible complication.

Sensory Assessment
Objective sensory assessment was made by the surgeon following clinical performance pinprick and light touch to verify adequate sensory nerve regeneration. Average follow up time was 14 months post flap division. Semmes Weinstein Monofilament test and two-point discrimination were not performed. Patients were subsequently given a questionnaire that surveyed their opinions in terms of sensibility, color, pain, appearance, and hygiene. Patients were instructed to rate each category as fair, good, or excellent, depending on how they perceived each outcome.

Data Analysis
Data gathered was analyzed utilizing descriptive statistics and a Wilcoxon Signed Rank Test to compare between affected digit ROM and corresponding fin- ger on contralateral hand.

Continued in page 14...
secondary intention are appropriate treatments. Several authors have reported few complications and high patient satisfaction with the latter method (2,3), specifically for wounds no larger than 1 cm2. Larger wounds, however, when treated non-operatively heal with a thin layer of epithelium that is relatively fragile and could be over-sensitive to the point of being irritating and disabling to patients. Also, injuries that involve exposed bone and tissue loss almost never have enough tissue to close primarily, and treatment by secondary intention after shortening exposed bone below exposed tissue is associated with an unacceptable incidence of nail plate deformities (1). In these cases the application of full thickness skin graft should be considered. Full thickness skin grafts tend to contract less than split-thickness grafts, are more durable and less tender, and achieve better sensibility than split grafts (4).

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**Material & Methods**

**Institutional Review**

The present study was categorized as expedite and received ethical approval of the participating institution’s Institutional Review Board for research involving human subjects. This approval was given prior to beginning data collection.

**Study Design**

This is a retrospective study reviewing the medical records of pediatric patients ages 0-17, who underwent thenar flap fingertip reconstruction with “shark mouth” incision technique. This study included 3rd and 4th digital fingertip injuries. Patients underwent surgical treatment by two separate pediatric orthopedic surgeons at the University Pediatriccasual with follow-up at the Puerto Rico Trauma Center. A data sheet was created to organize information extraction. This information included demographic data, mechanism of injury, type of injury, timeline which included time to flap division, complications which may have developed, and physical examination findings, time of motion of PIP, DIP and MP joints, and grip strength.

**Participants**

**Inclusion Criteria**

- Male and female Patients
- 0 to 17 y/o
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- Patients older than 17 years old
- Multiple digit amputation

- Patients who underwent other flap reconstruction or completion of amputation

**Procedure/Operative Technique**

(see Figure 1) The tip of the affected finger is identified by examining the injured finger and placing it against the non-injured finger. The finger is then raised and the two lines are joined distally by a curve (concave towards fingers and convex proximally) creating an angle greater than 60° between straight and curved lines. The wound is incised following the sketched lines. The tip of the wound is elevated and is sutured to the respective dorsal and volar flaps and to each other along the lateral margins (see Figure 2). This method effectively advances the edges of the donor defects to one another. The hand is immobilized with the thumb in palm abduction and the index finger. The affected finger is flexed to minimize flexion at the PIP joint. Plaster is added to the thenar flap and the hand is splinted over the dressing to complete immobilization. The digit is left at 0° to 10° flexion and covered with a cast and prevent ideal conditions for infection. After 15 days after graft division, sutures are removed. Patients were followed up for at least 6 months (Figure 4) to assess function and any possible complication.

**Sensory Assessment**

Objective sensory assessment was made by the surgeon following clinical performing pinprick and light touch to verify adequate sensory nerve regeneration. Average follow up time was 14 months post flap division. Semmes Weinstein Monofilament test and two-point discrimination were not performed. Patients were subsequently given a questionnaire that surveyed their opinions in terms of sensibility, color, pain and appearance. Patients were asked to rate each category as poor, fair, good or excellent, depending on how they perceived each outcome.

**Data Analysis**

Data gathered was analyzed utilizing descriptive statistics and a Wilcoxon Signed Rank Test to compare between affected digit ROM and corresponding finger on contralateral hand.

Continued in page 14...
RESULTS

We identified 150 records with distal fingertip injuries. Of these, 37 were excluded by age and 86 did not undergo thenar flap graft. Of all records reviewed, we found 27 fingertip injuries that had thenar flap technique with "shark mouth" incision performed. Of these, 2 patients denied participation, and 9 were unable to be contacted, leaving a final population sample of sixteen patients who fit the inclusion criteria for this study. There were 14 males (87.5%) and 2 females (12.5%), ranging in age from 0-17 years old with a median age of 9.8 years. Three fingers were affected, with 9 cases involving the index finger (56%), 3 involving the long finger (19%), and 4 involving the ring finger (25%). The mechanisms were mostly restricted to some kind of door crushing the fingertip, being interior door the most common observed mechanism of injury (56%), followed by exterior door (18%) (see Table 1).

Time from injury to reconstruction ranged from 12-48 hours. Time to division ranged from 12 to 30 days with a mean of 19.6 days. No infections were recorded and length of finger was successfully preserved in all cases. Both fine and gross sensation, as well as temperature and pain were preserved in affected finger and donor site in all cases, as recorded in follow-up clinics after subsequent division of flaps. Re- vision was not necessary in any of the sixteen cases reviewed and there were no reported complications.

Range of motion (ROM) was measured in degrees in PIP, DIP, and MP joints in both affected finger and corresponding finger on the contralateral hand. MP joint mean ROM was 100.3° in flexion with a standard deviation of 2.2°. PIP recorded at a mean of 89° with a standard deviation of 4.6°, and DIP had a mean of 39.7° with a standard deviation of 7.9° (see Table 2). ROM of corresponding finger on non-affected extremity was a mean of 102 ± 5.8° at MP joint, 100 ± 5.5° on PIP joint, and 55 ± 5° for DIP joint. A Wilcoxon Signed Rank Test revealed no significant differences in ROM between PIP (p=0.08) and MP joints when compared to mean ROM of the corresponding digits PIP and MP joints of contralateral hand (Table 3). DIP ROM, however, showed to be significantly less (p = <0.001) than corresponding joint on contralateral hand. On follow-up, there were no functionally significant flexion contractures or thumb adduction contractures.

All 16 patients answered the questionnaire. All 16 patients reported resulting sensibility, pain and general motion in affected finger and donor site as good or excellent. Two patients (12%) reported fair results in color of skin on donor site and graft, and 14 (88%) reported good or excellent results in this category. Six patients (43%) reported fair results in fingertip contour, while 10 patients (57%) reported contour to be good or excellent. No patients reported poor results in any category (see Table 4).

DISCUSSION

Fingertip injuries can produce composite loss of fingertip pulp and tactile skin. The skin on the palmar aspect of the finger is specialized in that it has many more nerve endings that in other parts of the body and allows fine sensation. Extensive loss of palmar fingertip skin must be replaced with a flap of similar composition that allows restoration of fine sensation as well as maintain original fingerprint function. Aesthetic appearance is secondary to the previous goals but is nonetheless important to maintain patient satisfaction and self-esteem. The results of this study show that the thenar flap done with the "Shark Mouth" incision is effective for treating these types of injuries. This is reflected in the questionnaire results were 100% of patients reported good or excellent results in sensibility of affected finger and donor site, pain, and general motion. Overall, patients reported satisfactory results in terms of fingertip appearance after reconstruction. 88% of patients believed that the flap color match with original fingertip color was good or excellent. Contour, however, was the category that received the worst results, reflected by 6 patients (43%) who reported fair results in this aspect; nonetheless, the majority of patients (57%) believed that the shape of the reconstructed fingertip was good or excellent. The fact that no patients reported poor results in any category speaks favorably about this technique. Barbato (10) reported in his thenar flap case series a 25% rate of PIP flexion contracture requiring extension splinting after flap division. The results of this study show no clinically significant contractures of the
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Table 1: Demographic Patient Data

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age [years]</th>
<th>Finger</th>
<th>Mechanism of Injury</th>
<th>Days to Division</th>
<th>Follow up Months</th>
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ABSTRACT
Obesity is a major risk factor in the development of Diabetes Mellitus (DM). Body Mass Index (BMI), an estimation based on the persons weight and height, helps identify patients at risk to develop DM. We report the relationship between DM and BMI using data from a primary care facility in Puerto Rico. Method: Patients were chosen randomly with the only required criterion to be included in this study was age over 50. A population of 200 patients was obtained and each participant was categorized by gender, weight, height, BMI and their status as a known diabetic or not. Results: In respect to the diabetic population identified, which totaled 67 patients, 1 out of 67 (1%) were underweight, 14 out of 67 (20%) were normal, 28 out of 67 (42%) were overweight, and 24 out of 67 (36%) were obese. Conclusion: 78% of the diabetic population fell in the categories of either overweight or obese. BMI increases the incidence of Diabetes Mellitus in patients older than 50 years of age.

INDEX words: relationship, type 2, diabetess, mellitus, body, mass, index

INTRODUCTION
Diabetes Mellitus is a chronic condition in which glucose levels are high due to decreased production of insulin in the pancreas, fat and liver. The body does not yield sufficient insulin to meet its needs. Normally, glucose in the bloodstream would stimulate the production of insulin in order to convert glucose to energy or to be stored as glycogen. In Type 1 Diabetes Mellitus, the pancreatic β-cell is destroyed by the immune system, presumably in response to possibly a viral infection, recurring pancreatitis, or any disorder that damages the pancreas prior to age 30. The cause of this condition is essentially unknown. These patients produce little to no insulin and are therefore known as insulin-dependent requiring daily injections of the hormone.

In Type 2 Diabetes Mellitus, although the pancreatic β-cell produces insulin, there is insulin resistance. This means that muscle, fat and liver cells do not adequately respond to insulin and therefore are impaired in their ability to use the insulin released from the circulation. The immediate consequence of this is the need of higher levels of insulin to help glucose enter cells. These consequences are: β-cell of the pancreas, which may eventually fail to keep up with the bodies increased need for insulin (1). This type of Diabetes Mellitus is also known as adult-onset Diabetes Mellitus. The Diagnosis of Diabetes Mellitus is made by yielding a HbA1C > 6.5%. Fasting blood sugar test ≥126mg/dL on two separate occasions, Oral glucose tolerance test (75g) ≥200mg/dL after 2 hours and a random blood glucose test ≥200mg/dL (2).

According to the Merck Manual (2013), “About 27% of people older than 65 have type 2 diabetes”. There are modifiable risk factors such as being overweight or obese, physical inactivity, smoking, high blood glucose in pre-diabetes, and abnormal lipid metabolism (3). A good indicator to take into consideration is the individual Body Mass Index (BMI), which is estimation based on the persons weight and height. Individuals that yield a BMI of 25 to 29.9 are considered overweight and individuals with a BMI of 30 or higher are considered obese (4). These two categories of BMI have the highest risk of developing Diabetes Mellitus. According to Merck Manual (2013), “Obesity is the chief cause for abnormal glucose tolerance, and type 2 diabetes, and 80 to 90% of people with this disorder are overweight or obese. Because obesity causes insulin resistance, on the average people need very large amounts of insulin to maintain normal blood glucose level” (3). An example of obesity as a major risk factor in the