A COMPARATIVE STUDY OF CROSS-FINGER FLAP VERSUS SPLIT-THICKNESS SKIN GRAFT FOR RESURFACING OF SOFT TISSUE LOSS IN FINGERTIP INJURY

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ABSTRACT

BACKGROUND

Different types of Fingertip injuries are found in human population and different modalities of treatment options are available. Results of the treatment vary according to the mode of treatment. In our institute, we prefer cross-finger flap coverage for composite tissue loss of fingertip defect.

The aim of the study is to find out long-term result of cross-finger flap in comparison with STSG.

MATERIALS AND METHODS

The study was conducted between November 2014 and October 2016 in Late Sri Lakhiram Agrawal Memorial Govt. Medical College Hospital. It was a time bound, prospective comparative study. It was non-randomised, as patients were segregated into Group A [cross-finger flap (CFF)] and Group B [Split thickness skin graft (STSG)] based on their choice.

RESULTS

Results were assessed in terms of duration of surgery, length of stay, durability, resistance to normal stress injury, finger stiffness and aesthetic acceptance of repaired area of finger and touch sensation.

CONCLUSION

Duration of surgery was assessed at the time of surgery between cross-finger flap and STSG groups. Length of hospital stay was assessed and noted postoperatively. Functional outcome was assessed after discharge and followup of patients. Operative time for CFF was more than for STSG. Duration of hospital stay in patients treated with CFF than STSG was same. Functional outcome at 12 months was better in CFF. Durability, resistance to injury in normal stress and aesthetic acceptance and sensory function was better in CFF as compared with STSG.

KEYWORDS

Cross-Finger Flap, Split-Thickness Skin Graft.

HOW TO CITE THIS ARTICLE: Panda R. A comparative study of cross-finger flap versus split-thickness skin graft for resurfacing of soft tissue loss in fingertip injury. J. Evolution Med. Dent. Sci. 2017;6(84):5904-5910, DOI: 10.14260/jemds/2017/1284

BACKGROUND

Hand is both an organ designed to obtain information and an organ of execution. Fingers are integral part of hand. Different functions help us to perform our normal activity, especially thumb contributes maximum than other fingers for functioning of hand. Fingertip helps to do fine things, to grasp tiny particles, helps for writing and fine tactile sensation.

Fingertip injury commonly occurs at home, usually in children during playing and accidentally during closure of door. Many interesting techniques have been devised to ensure coverage of exposed bone or soft tissue. There are no definite rules that serves as a satisfactory guide to the choice of each of the technique. Different methods adopted for treatment of fingertip injury are secondary healing,^[1] semi-occlusive dressing,^[2] split-thickness skin graft and local flap coverage.^[3] Local flap coverage like V-Y pasty,^[4,5] Volar

advancement flap^[6,7&8] and cross-finger flap^[9,10,11,12,13,14,15,16,17] and homodigital neurovascular flap.^[18]

In consultation with patient, every surgeon must choose the type of coverage that appears to be most appropriate for that individual's need.

Aim of the study was to find out long-term result of cross-finger flap in comparison with split-thickness skin graft.

MATERIALS AND METHODS

The study conducted was comparative, time bound and hospital based. It was non-randomised as patients were segregated into Group A [cross-finger flap (CFF)] and Group B [split-thickness skin graft (STSG)] based on their choice. This study was carried out in the Department of General Surgery at Late Sri Lakhiram Agrawal Memorial Government Medical College, which is a tertiary care referral teaching hospital. All patients above 10 years of age with fresh fingertip injury were included by the author irrespective of the cause of injury and type of injury between November 2014 and October 2016. During the study period, we were able to enrol 72 patients operated either by cross-finger flap or by split-thickness skin graft (36 subjects in each group).

Patients with active infection, concurrent serious medical illness, non-traumatic disorders and phalanx bone fracture were excluded from the study. All patients who came to the hospital were initially evaluated properly, a written consent was taken for surgery and then posted for surgery. Options

'Financial or Other Competing Interest': None.
Submission 21-09-2017, Peer Review 13-10-2017,
Acceptance 16-10-2017, Published 23-10-2017.

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DOI: 10.14260/jemds/2017/1284

for type of surgery were given to the patients and treatment

was done as per the patient's choice, either CFF or STSG.

Study Procedure

Study Outcomes and Measurement

Duration of surgery was assessed at the time of surgery between cross-finger flap and split thickness skin graft groups. Length of hospital stay was assessed and noted postoperatively. Sensation, pinching, stiffness of finger, durability and contour and aesthetic acceptance of patients was assessed at regular followup intervals of 1 month up to 6 months and every 3 months up to 12 months of post-operative period respectively.

Chi-square test was used to assess final outcome of patients between the two groups.

Study Analysis Plan

Descriptive statistics with demographic details of study patients was generated by using software SPSS statistics version 1.0 with respect to age, gender, duration of surgery, side of hand, finger involved and length of hospital stay for the two procedures was compared.

Data at regular followup intervals postoperative 1 month, 2 months, 3 months, 4 months, 5 months, 6 months, 9 months and 12 months were collected to assess the functional outcome. They were compared using appropriate statistical

tests.

Chi-square test was used to ascertain the statistical significance in the differences of the categorical variables and independent test was used for continuous variables. P value is considered significant if it was < 0.05.

Procedure for Cross-Finger Flap Surgery

Surgery was performed under regional block (brachial plexus block) or under general anaesthesia as per patient's choice of anaesthesia and fitness of patient. Wound of fingertip (Fig. 1 and 1a) was debrided and prepared for coverage of flap from the dorsal surface of middle phalanx of adjacent finger. Injured fingertip area impression was taken by a gauze and put on dorsum of adjacent finger of middle phalanx and marking was done by methylene blue ink (Fig. 2). Normal saline was injected subcutaneously to the marking area for easy plane of dissection and to prevent damage to tendon sheath. From dorsal surface of middle phalanx of finger, flap was elevated just like open book just above the plane of tendon sheath (Fig. 3). Split thickness skin graft (STSG) was taken from prepared area of dorsal surface of arm and

applied over the raw area of dorsum of middle phalanx of finger, STSG fixed with 5 - 0 cutting silk suture and tied over bolus dressing done. Elevated flap was applied on injured fingertip and sutured by 5 - 0 silk surrounding the margin of wound (Fig. 4). Both fingers were closely kept and bolus sterile dressing was done and hand was covered with sterile dressing. Patient was discharged on next day of surgery and called for followup on 7th day and 14th day of post-surgery. Operated area was inspected on 7th day and dressing changed. On 14th day of post-surgery (Fig. 5 and 6), flap detachment and refastening was done under local digital block. Grafted area was inspected and all skin stitches removed and kept open. Bandage of donor area of skin graft comes out automatically with healthy operated area.

After 21 days of surgery, all areas of surgery were healed completely and without any defect. All patients were called for followup (Fig. 7) regularly every month up to 6 months and every 3 months till 1 year during the study period. During followup period, history was taken about injury to operated area with normal stress, observation and clinical examination like sensation of operated fingertip, pinching action of fingers, contour of tip of finger and stiffness of fingers of operated hand. Patient's aesthetic acceptance data was collected by asking question to patient whether satisfied or not.

Procedure for Split-Thickness Skin Graft (STSG) and Followup

As per choice of patient, surgery was done under regional block. Wound of injured fingertip (Fig.) was debrided and STSG was taken from forearm and applied over raw area of finger. Graft was fixed by stitching with margin of wound and tie over bolus dressing done, operated finger was immobilised by plaster of Paris posterior slab for 12 days. Patient was discharged on next day of surgery with advice and called for followup on 12th post-operative day. On 12th post-operative day, dressing was removed and found healthy and kept open. Patient was followed up regularly every month during the study period.

RESULTS

Demographic Data

In this study, the minimum age of the patient was 10 years and maximum was 51 years. Out of 72 patients, 52 were male, 20 were female patients, which accounts for 72.22% and 27.77% respectively. Mean age is 27.111 years and standard deviation was 10.22501 [Table 1].

Number of Patients	Mean Age in Year	Standard Deviation
72	27.1111	10.22501

Table 1. Showing No. of Patients, Mean and STD Deviation in Study Groups

Age group distribution is 10 - 20 year, 22 (30.56%), 21 - 30 years of age 26 (36.11%), 31 - 40 years 14 (19.44%), 41 - 50 years 8 (11.11%) and 51 - 60 years of age is 2 (2.78%) [Table 2].

Majority of the injuries (53) involved the right side (73.61%) of hand than left side hand 19 (26.39%).

Age Group in Year	No. of Patients	Percentage of Patient
10-20	22	30.56%
21-30	26	36.11%
31-40	14	19.44%
41-50	08	11.11%
51-60	02	2.78%

Table 2. Showing Distribution of Age Group in Fingertip Injury

Digits involved about 58.33% (42 no. of patients) middle finger, index finger 20 (27.78%), ring finger 8 (11.11%) and little finger is 2 (2.78%) [Table no. 3].

Finger Involved	No. of Patients	Percentage of Patients
Middle finger	42	58.33%
Index finger	20	27.78%
Ring finger	08	11.11%
Little Finger	02	02.78%

Table 3. Shows Distribution of different Finger Involved in Fingertip Injury

Study Outcomes and Analysis

Duration of Surgery: The minimum duration of surgery in our study was 45 minutes and the maximum was 120 minutes. The mean duration of surgery for cross-finger flap was 80.88 mins and for STSG was 54.05 mins. Standard deviation is 18.395 for Group A and 8.024 for Group B. [Table 4]. In cross-finger flap group, there were two surgeries- first at flap insertion and second was on 14 days of post-operative period for flap detachment. For second surgery in Group A, the minimum time was 15 minutes and maximum time was 25 minutes.

P value was 0.097, which suggests that the operating time for cross-finger flap was more than split thickness skin graft procedure.

Criteria	Group A	Group B
Number of Patients	36	36
Mean	80.8889	54.0556
Standard Deviation	18.39531	8.02476

Table 4. Statistical Data Shows Comparison of Duration of Surgery in Minutes in Both Groups

Length of hospital stay: Majority of the patients got discharged just after 24 hours of surgery in both groups. Average time for hospital stay in CFF is 25.16 hours and STSG is 24.91 hours. Std. value in Group A is 2117 and in Group B is 2.442 [Table 5].

Criteria	Group A	Group B
Number of Patients	36	36
Mean	25.1667	24.9167
Standard Deviation	2.11795	2.44219

Table 5. Statistical Data Shows Comparison of Length of Hospital Stay (In Hours) in Both Groups

Touch sensation- In Group A 72.22% (26) and in Group B 61.11% (22) touch sensation returned in operated fingertip between 6 months - 12 months of followup period.

Impaired touch sensation was 10 (27.77%) in Group A and 14 (38.88%) in Group B [Table 11 and 12]. According to mean 72.222 for Group A and 61.111 for Group B, patients

were having proper touch sensation [Table 6]. P value is 0.0041. It signifies that touch sensation is better in CFF as compared to STSG.

Criteria	Group A	Group B
No. of Patients (N)	36	36
Mean	72.222	61.111
Std. Deviation	45.4256	49.441

Table 6. Statistical Data Shows Comparison of Touch Sensation in Both Groups

Pinching was assessed between 6 months and 12 months of followup period after repair. Patient was asked to pinch by repaired finger and thumb on skin of dorsum of own hand. Ability to pinch properly was 28 (78.77%) and poor pinch was 22.22% in Group A and ability to pinch properly was 12 (33.33%) and poor pinch 24 (66.67%) in Group B [Table 11 and 12]. Standard deviation is 42.163 for Group A and 47.809 for Group B [Table 7]. P value is 0.0051, showing that the functional outcome of pinch is more in CFF as compared to STSG.

Criteria	Group A	Group B
No. of Patients (N)	36	36
Mean	77.7778	33.3333
STD Deviation	42.16370	47.80914

Table 7. Statistical Data Shows Comparison of Pinching Function of Finger in Both Groups

Stiffness of finger was assessed by restriction of movement of finger at interphalangeal joint and at metacarpophalangeal joint level of injured finger. Stiffness was absent in 72.22% (26) and stiffness of finger was noted in 27.77% (10) in Group A patients and stiffness present in 52.77% (19) of patients, absence of stiffness of finger 47.22% (17) in Group B [Table 11 and 12]. According to mean 22.222 for Group A and 72.2222 for Group B, patients were suffering from finger stiffness [Table 8]. P value is 0.00069. It signifies that stiffness is more in Group B as compared to Group A.

Criteria	Group A	Group B
No. of patients (N)	36	36
Mean	22.2222	72.2222
Standard Deviation	42.16370	45.42568

Table 8. Statistical Data shows about Comparison of Stiffness of Finger in Both Groups

Further injury to repaired fingertip in normal wear and tear (stress injury) was assessed on followup period between 6 months and 1 year. It was found that minor small pin head size patchy ulcer or abrasion on tip of finger of Group A was 22.22% (08), absent of minor injury 20 (77.77%) and in Group B injury on fingertip in normal activity is 61.11% (22) and absent of any injury found about 14 (38.88%) [Table 11 and 12]. Durability of fingertip was excellent in Group A as compared to Group B. According to mean, patient 19.444 for Group A and 61.111 for Group B were suffering from further finger injury in normal wear and tear [Table 9]. In this functional outcome, P value was 0.0270. It signifies that further injury in normal wear and tear was found more in Group A as compared to Group B.

Criteria	Group A	Group B
No. of patients (N)	36	36
Mean	19.4444	61.1111
Standard Deviation	40.13865	49.44132

Table 9. Shows Comparison of Further Injury of Fingertip on Normal Wear and Tear in Both Groups

Aesthetic acceptance of patients of both procedures found that in Group A it is 32 (88.88%) and 08 (22.22%) in Group B [Table 11 and 12]. According to mean 88.888 for Group A and 22.222 for Group B, patients had excellent aesthetic acceptance [Table 10]. P value is 0.1785, showing that aesthetic acceptance is more in CFF as compared to STSG group.

Criteria	Group A	Group B
No. of patients (N)	36	36
Mean	88.8889	22.2222
Standard deviation	31.87276	42.16370

Table 10. Shows Comparison of Aesthetic Acceptation of Repaired Fingertip in Both Groups

Functional Outcomes	No. of Patients	Percentage of Patients
Presence of touch sensation of repaired fingertip.	26	72.22%
Further injury to repaired fingertip in normal wear and tear.	08	22.22%
Absence of Finger stiffness	26	72.22%
Aesthetic acceptance	30	83.33%
Good Pinching	28	78.77%

Table 11. Showing different Functional Outcome in Cross-Finger Flap (Group A)

Functional Outcomes	No. of Patient	Percentage of Patients
Presence of touch sensation of repaired fingertip.	22	61.11%
Further injury of repaired fingertip in normal wear and tear.	22	61.11%
Absence of finger stiffness	17	47.22%
Aesthetic acceptance	10	27.22%
Good pinching	12	33.33%

Table 12. Showing different Functional Outcomes in Split-Thickness skin Graft (Group B)

Figure 1. Showing Fingertip Injury of Index Finger Left Hand

Figure 1a. Fingertip Injury, Index Finger

Figure 1b. Little Fingertip Injury of an Adult Female Patient with Tattoo Mark

Figure 2. Marking by Methylene Blue Ink on Dorsum of Middle Phalanx for Elevation of Flap to Cover Injured Fingertip

Figure 3. Flap Elevated at the Level of Extensor Tendon Sheath on Dorsum of Finger. Sheath of Tendon is Preserved

Figure 4. Flap is Inserted to Injured Index Fingertip and Split-Thickness Skin Graft Applied on Dorsum of Raw Area of Middle Finger

Figure 5. On Post-Operative Day 14, Patient came for Flap Detachment

Figure 6. Post-Operative 14th Day, Vascularised, Inserted Cross-Finger Flap for Detachment

Figure 7. Result of Operated Index Fingertip Injury with Cross-Finger Flap at 6 Months Follow-Up Period

Figure 8. Fingertip Injury for Wound Debridement and STSG

Figure 9. Final Result of Skin Grafted Area of Fingertip Injury

DISCUSSION

Fingertip is defined as that part of the terminal phalanx distal to the insertion of the extensor aponeurosis on the dorsal surface and deep flexor digitorum tendon on the volar aspect of the finger. About 10% of all accidents in emergency department are hand injury and fingertip injury are common among them. In recent years, opting the treatment of these injuries has become controversial. Many interesting techniques have been devised to ensure coverage of exposed bone or soft tissue. No definite rule to dictate the choice of treatment modality.

In consultation with patient, every surgeon must choose the type of coverage that appears to be most appropriate for that individual's need.

Function of Hand

Function of the hand are multiple, though the most important are the sensory function of touch and the function of prehension.

Sensory

Sensory function are deep and superficial sensation. Superficial sensation is either fine or discriminative (epicritic) or gross (protopathic). It has an essential role in

information and discrimination of intensities or qualities and particularly of local specification [Head 1992]. It has a protective role and thus bring about a regional response of defence, the most immediate and least controlled of which is the withdrawal reflex. Deep sensation of hand provides information regarding the position of the skeleton and muscles.

Grip and Prehension

In the animal world, a variety of organs are adapted for prehension. According to Rabischong,^[19] they may be divided into four types: organ that pinch, encircle, push and adhere. Usually animals can utilise only one of these forms of prehension. Man, owing to the multiple possibilities and malleability of his hand, can reproduce all type of pinch from the simple hook to digitopalmar grip.

Classification of Fingertip Injury

Fingertip injury classify as per Allen as follows,

Allen classification of fingertip injury-

Allen Type 1- Soft tissue injury distal to terminal phalanx.

Allen Type 2- An injury at the level of terminal phalanx.

Allen Type 3- An injury at the level of the distal phalanx shaft.

Allen Type 4- An injury just distal to the distal interphalangeal joint.

In this study, all types of fingertip injuries were taken and treatment options (CFF or STSG) were given to the patient.

The aim of our study was to compare two different methods of surgery, the cross-finger flap and STSG in the treatment of fingertip injury. The primary objective of the study is to assess the functional outcome of patients treated with either of the two procedures.

All the cases were classified according to the Allen Classification, which is the most accepted classification all over the world. All patients were operated and followed up for an average period of 6 - 12 months.

In this Study, it is Noticed that-

1. Maximum number of fingertip injuries occur in male.
2. In majority of Right hand (73.61%) is involved as compared to left hand (26.39%).
3. Duration of surgery is more in Group A as compared to Group B.
4. Average length of stay in hospital in both groups is approximately the same.
5. Sensation of fingertip after both procedures was observed up to 6 months of post-operative period. Touch sensation usually returned early in CFF at 6 months followup period. About 55.55% of patients percept touch sensation at 6 months of followup period. Two point discrimination was 80.66% in Group A as compared to Group B.
6. Stiffness of finger during post-operative followup period, finger stiffness was assessed on movement of finger at metatarsophalangeal joint and at interphalangeal joint. Stiffness of operated fingers is more in Group B as compared to Group A patient. But stiffness gradually subsided after physiotherapy of finger in all study groups.
7. After long followup period it was found that minor ulceration and any wound on fingertip on both study groups during normal wear and tear (normal work),

maximum number and percentage of patients 61.11% (22) had injury in Group B patients as compared to Group A 22.22% (8). This injury was more in skin grafted fingertip, may be due to thinning of area and unable to resist the minor trauma during normal work. In CFF group, contour of fingertip was excellent and it provided bulk of tissue to fingertip to resist minor trauma for further injury.

8. Aesthetic appearance of repaired fingertip in cross-finger flap group was better as compared to STSG group. Maximum number of Group A patients were satisfied as compared to Group B.

CONCLUSION

In this study, following conclusion was drawn

1. Majority of patients were male.
2. Maximum number of patients were in age group of 21 - 30 years of age (36.11%).
3. Right hand was more involved in fingertip injury as compared to left hand.
4. Middle fingertip injury was maximum 58.33% as compared to other fingers.
5. Aesthetic acceptance of patient observed in both procedures was excellent in Group A.
6. Durability of repair of injured fingertip in Group A was better as compared to Group B patient.
7. About functional outcome like sensation, pinch, stiffness of finger, resistance to injury on normal wear and tear of patients treated in different groups, good functional outcome was seen in Group A as compared to Group B.

Overall, it can be concluded that cross-finger flap coverage is an ideal option for treatment of fingertip injury.

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