TOE TO THUMB TRANSFER

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ABSTRACT: Introduction: Thumb is the most important part of human hand both functionally and cosmetically. The reconstruction of lost thumb is always challenging for the surgeons. **Objectives:** The aim of study is to evaluate the results of micro – vascular reconstruction of thumb by toe transfer. **Place and duration of study:** B. Victoria hospital Bahawalpur from January 1998 to December 2008. **Material and method:** Both male and female patients who presented to the orthopedic Department with traumatic amputation of thumb were included in the study. **Results:** All ten thumbs survived with minor complication as for as functionally and cosmetically are assessed. Dominant hand was involved in eight cases. **Conclusions:** Results of Microvascular reconstruction are much better as compared to conventional methods. This is single stage procedure and early rehabilitation of hand is possible. Cosmetically and functionally this is far superior to conventional methods.

Key words: Thumb, Trauma, Micro vascular reconstruction, Toe.

INTRODUCTION

Importance of hand is self evident. The dexterity of hand unlike other species allows the human being the ability to perform several unique functions[1,2]. The function of the hand is largely dependent on thumb as it accounts for 40 to 50% of the total hand function[2,3]. In the mutilated hand the thumb takes on an even greater role providing prehension to an otherwise fairly useless extremity[19]. In the human hand by virtue of strength and mobility of thumb, power and twist grip is possible[20].

Nail pinch, key pinch, pulp pinch, chuck pinch all requires coordinated mobility of thumb with one or more of the digits. Nail pinch requires maximum flexion at interphalangeal joint of the thumb. Sensibility is dependent upon the unique pulp padding with stable glabrous skin and nail plate. The stabilized pulp skin allows the nail pinch needed for fine manipulation of objects. Thumb is an important part of human hand, specially the dominant one. Forty percent loss of earning capacity in case of amputation of thumb at the carpometacarpal joint, 30% at metacorpophalangeal joint and 20% at interphalangeal joint[4]. In fact the thumb is the master finger of hand[21].

Restoration of the length was a great problem for the surgeons for decades in case of loss of thumb partially or completely. Many methods were used liked pollicization, distraction lengthening, central core of bone and pedicel skin flap. All the conventional methods have limitations and failed to fulfill the ideal of restoring a digit with good motor and sensory function along with reasonable external appearance. Microsurgical techniques have solved the problem of missing thumb components by transferring composite tissue from toes of the foot[5,6].

MATERIAL AND METHODS

A prospective study was conducted in the department of orthopedic and trauma unit Bahawal Victoria Hospital Bahawalpur from January 1998 to December 2008 for reconstruction of thumb in case of traumatic loss. During this period total 15 patients presented with traumatic loss of thumb. Out of these 10 patients agreed for reconstruction by toe transfer using micro surgical techniques. Antero-posterior and lateral radiographs were taken to document the level of amputation. Laboratory investigations including blood and urine analysis, blood sugar, ECG and X-rays chest were done. There were 8 males and 2 females showing more exposure of males to these types of injuries. Dominant hand was involved in 8 cases. Patients were classified according to modified Rieds Classification[7].

Group 1:	Amputation distal to MP joint which is further sub divided into A, B, C.
Group A:	Amputation distal to inter-phalangeal joint.
Group B:	Amputation through the interphalangeal

joint.

Group C: Amputation through the proximal phalanx.

Group 2: Amputation through the meta-corpophalangeal joint.

Group 3: Amputation through the metacarpal with preservation of intrinsic muscles.

Group 4: Amputation through the metacarpal with destruction of intrinsic muscles.

Groups	No. of patients
1 B	01
1 C	02
Group 2	03
Group 3	02
Group 4	02

Bone of great toe is stabilized to the remaining part of the bone of thumb with k-wires (Figure 1-C). End to end anastomosis of the dorsalis pedis artery with the radial artery is performed then vein is anastomosed and tourniquet is released to check the circulation. Nerves and tendons are repaired at the end. After all the structures have been repaired, wound is closed loosely and raw area left is covered with skin grafting. Hand is placed in loose bulky dressing and a thumb spica cast is applied leaving the tip of transferred toe exposed to check the circulation. Donor site is closed while the toe is being transferred and back splint is applied (Figure -2). Hand and foot are elevated to prevent edema. 1st dressing is changed on 3rd day. Stitches are removed after 2 weeks and thumbs spica cast is reapplied. After 2 months cast is removed and gentle movements are started. K-wire removed when union is confirmed radiologically at about 10 weeks and progressive strengthening and range of motion exercises are continued.

In wrap round technique partial great toe transfer, the thumb nail along with dorsal skin and any bony piece if required is transferred when there is exposed bone of the thumb. (Figure 3) The level of amputation and crushing of the skin leads to exposed tendons and interphalangeal joint. This transfer really matches the normal thumb and there is no pulp sensory deficit. This technique requires expertise and dexterity of the operating surgeon for micro vascular anastomosis.

Sensibility Criteria: (Two point Discrimination)

Interpretation of score guide lines set by American society of hand surgery.

Normal: Less than 6 mm.

Fair: 6 to 10 mm.

Poor: 10 to 15 mm

Protective: Perceived as 1 Point

Anesthetic: No Perception.

Leung Criteria for Motor function

Grasp and pinch function of reconstructed thumb, writing and turning the cards were observed and compared with

Fig-1. A. donor site is market anterior view B, Medical view after marking of donor site. C, great toe is transferred at recipient site.

Fig-2. Second toe to thumb transfer
A. Preoperative view B. Second Toe harvested C. Implanted at recipient site.

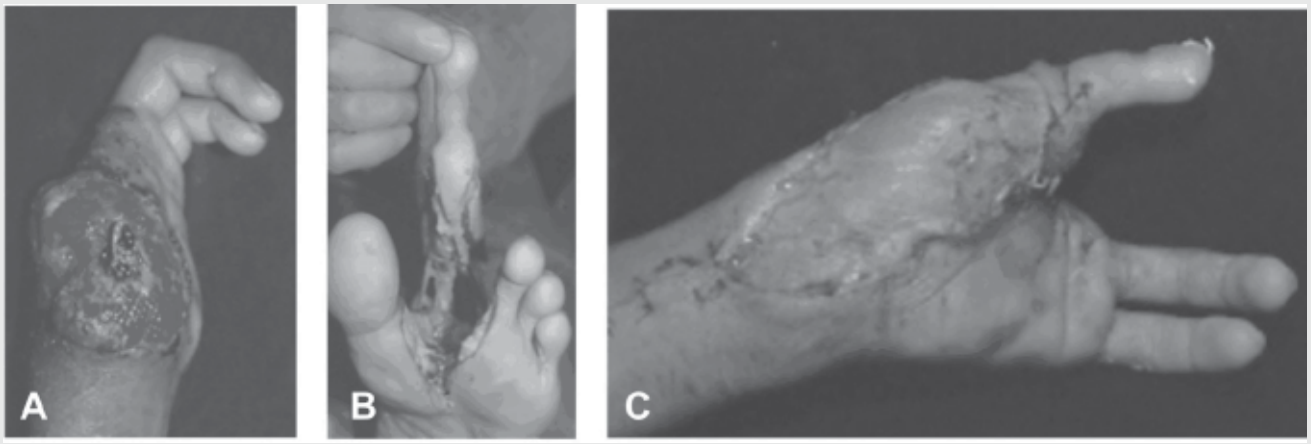

Fig-3. A donor site for wrap round technique is market. B. Transferred to the thumb. C. Showing good punch function of thumb.

the normal hand. Each function is graded as:

Excellent: As efficient as that of normal.

Fair: Performance that is obviously clumsy and weak.

Good: Performance between excellent and fair.

We proposed our own criteria for Cosmetic Results that is as follows

Consider general appearance at rest and on activity, consider the scar, stiffness, residual joints imbalance, rotational deformities and cosmetics results are graded as...

Good

General appearance of thumb at rest and on activity is satisfactory.

There is minimal scaring, no stiffness of joint and rotational deformities.

Fair

General appearance of thumb at rest and on activity is satisfactory.

There is mild to moderate scaring, joint stiffness and rotational deformities.

Poor

General appearance is compromised at rest and on activity.

There is maximum scaring, joint stiffness and rotational deformities.

RESULTS

The patients were followed at 1 month, 3 months, 6 months, and 9 months, then yearly. We have evaluated our results on the bases of function and cosmoses. Some very basic and common functions were assessed like sensibility, motor function and cosmoses.

1. SEX DISTRIBUTION

Eighty percent of the patients were male and twenty percent were female.

2. DISTRIBUTION ACCORDING TO OCCUPATION

Twenty percent of the patients were farmer and students each, forty percent were military men and ten percent were carpenter and house hold each.

3. AREA WISE DISTRIBUTION

Sixty percent of patient belongs to rural area and forty percent were residents of urban area.

4. HAND INVOLVED

In eighty percent of the patients right (dominant) hand was involved and in twenty percent left hand was injured.

5. DIVISION OF PATIENTS ACCORDING TO TECHNIQUE

In five (50 %) patients second toe was used as donor, in two (20 %) patients total great toe was used as donor and in three (30%) patients partial great toe was used as donor.

6. DIVISION OF PATIENTS ACCORDING TO LEVEL OF AMPUTATION

Three (30 %) patients presented with amputation at interphalangeal joint level, three (30 %) patients presented with amputation through the metacarpal phalangeal joint and four (40%) patient presented with amputation through the metacarpal.

7. DIVISION OF PATIENTS ACCORDING TO AGE

Most of the patients belong to age between 21- 40 years (90%).

Table-I. Distribution of the patient according to sex

Sex	No. of patients	%age
Male	08	80%
Female	02	20%

Table-II. Division of patients according to occupation

Occupation	No. of patients	%age
Farmer	02	20%
House Hold	01	10%
Carpenter	01	10%
Military Men	04	40%
Students	02	20%

Table-III. Area wise distribution of patients

Are (Rural of Urban)	No. of patients	%age
Rural	06	60%
Urban	04	40%

Table-IV. Division of patients depending on the involvement of hand

Hand involved	No. of patients	%age
Right (dominant) Hand	08	80%
Left Hand	02	20%

Table-V. Division of patients according to technique of reconstruction

Technique	No. of patients	%age
Total great tow transfer	02	20%
Second toe transfer	05	50%
Wrap around partial great toe transfer	03	30%

DISCUSSION

Thumb has always been recognized as an important part of human hand. Absence of thumb represents a major functional loss. It can involve soft tissue only or all the

Table-VI. Division of patients according to the level of amputation

Type	No. of patients	%age
I	03	30%
II	03	30%
III	02	20%
IV	02	20%

structural elements. Loss may be total or subtotal. The function of hand is largely dependent on thumb as it accounts for 40% of total hand function[5,6]. Hand function is maintained by integrity of components mainly the thumb and finger. Adequate length is essential for the proper performance. If any of these components are lost completely or partially, serious impairment of hand function results. Trying to restore missing length of thumb has been great challenge to the surgeons for decades.

Many methods have been used such as: pollicization, lengthening, reconstruction by using, central core of bone and pedicel skin flap. All these conventional methods have limitations and failed to fulfill the ideal of restoring a digit, not only with good motor and sensory function but also with reasonable external appearance.

Table-VIII. Age-wise Distribution of Patients

Age range	No. of patients	%age
10 - 20 Y	01	10%
21 - 30 Y	06	60%
31 - 40 Y	03	30%

With the advent of micro surgical technique missing components may be restored by transferring composite tissue from the foot. The reconstructed digits posses not only desired length but also sensitive pulp and nail with appearance almost similar to the thumb[7].

Factors which must be considered while reconstructing a thumb are the length of remaining thumb, age of the patient, occupation, and cosmetic aspects[8,9]. Second line of treatment must be considered in mind before embarking on microsurgical procedure. Ideal level for toe to thumb transfer is an amputation through the proximal phalanx[10,11].

In this series two cases of total great toe to thumb transfer were done. In term of appearance and function total great toe transfer provides excellent results[12,13]. In second toe transfer donor site morbidity is less as compared to total

Table-VII. Functional and cosmetic results of the reconstructed thumb by toe transfer

Two point discrimination	Manual dexterity	Writing	Turning cards	Placking objects	Grip strength	Pinch strength	Range of motion	Daily activities	Cosmetic results
6-8 mm	Good	Good	Good	Good	Good	Good	Fair	Active	Good
8-10 mm	Good	Illiterate	Good	Good	Good	Good	Fair	Active	Good
10 mm	Good	Illiterate	Fair	Fair	Good	Fair	Fair	Deficient	Fair
8-10 mm	Good	Good	Fair	Good	Good	Good	Fair	Active	Good
6-8 mm	Good	Good	Fair	Good	Good	Good	Good	Active	Good
>15 mm	Fair	Illiterate	Fair	Good	Fair	Fair	Fair	Active	Fair
7-8 mm	Good	Fair	Good	Good	Good	Good	Good	Active	Fair
10 mm	Good	Good	Good	Good	Good	Fair	Good	Active	Fair
12 mm	Fair	Fair	Good	Good	Fair	Fair	Fair	Active	Fair
12 mm	Good	Good	Good	Good	Good	Fair	Good	Active	Fair

great toe transfer but appearance is not as good as that of total great toe transfer. In wrap around partial great toe transfer, thumb really matches with the normal thumb[14,15,16.] Cosmetic results of this technique are better than total great toe or second toe transfer. Principle disadvantage is absence of interphalangeal joint[17,18].

This is our initial experience of thumb reconstruction using micro-vascular technique. Our study sample is small and some hard and fast comparative analysis of results of different techniques is difficult. However results of micro vascular technique are superior to conventional methods.

In 2011 a systemic review was conducted by Pau-Yuan Lin et al [22] in 101 second toe transfer, 196 great toe transfer and 122 wrap round technique. The authors concluded 96.4% survival rate. This survival rate is almost similar to this study. Although the present study is conducted on small number of patients.

CONCLUSIONS

Results of micro-vascular reconstruction are much better as compared to conventional methods. It is single stage procedure and early rehabilitation of hand is possible. Cosmetically and functionally it is far superior to conventional methods.

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"Don't take any decision when you are angry and don't take promises when you are happy."

Unknown