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Headband technique of reimplantation of a partially amputed finger: a first reported in literature

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ABSTRACT

Background: Reimplantation of a partially amputee finger is a challenging task especially in resource limited country like India. In most of the scenario it lands in total amputation either due to delay in arrival at operative set up or due to lack of plastic surgery facility.
Methods: We developed an innovative approach (1st reported in literature) of "headband technique "of reimplantation of such partially amputee fingers and toes. Partially amputee fingers and toes with viability were selected for the operative treatment and for the study. The study was conducted from January 2020 to 2021 with a follow up period for 6 months at our institution. The innovative suturing technique involved a single stitch at the tip of the pulp and rest on adjacent to nail bed securing the neurovascular structures. The patient was in age group of 9 months to 94 years, mostly traumatic injury, with 40 male and 15 female patients. Patients who reported with fully amputee fingers, black escharotic finger were excluded from the study.
Results: To our accomplishment out of 55 operated patients, more than 50 have fully recovered.
Conclusions: With this simple technique of reimplantation even doctor at PHC'S can save fingers from getting amputed. Our study is with small number of patients; hence we advocate a larger study for to have conclusive evidence for the same.

Keywords: Headband, Reimplantation, Amputee finger, Finger plastic surgery

INTRODUCTION

Although success of digital replantations has been reported by many authors, the very distal fingertip replantation remains technically demanding. The aim of this article is to review our experience with fingertip replantations at or distal to the nail base in patients and evaluate the clinical outcomes.[1] From January 2020 to January 2021, 55 fingertips amputated at or distal to the nail base were replanted at our institute. Only one artery was anastomosed for revascularization with or without nerve repair; vein drainage was provided by the controlled bleeding technique. Both the patients and their relatives were satisfied with the final results. In conclusion, fingertip replantation allows good functional and esthetical recovery and should be attempted if technically feasible.[2] Headband technique: clothing accessory worn in around forehead. Composition: loop of elastic material also called as: Alice band in UK, Bandeau in French, Hachimatu in Japan. First seen in literature in 4756 to 330 BC. Anatomy: common digital artery arises from superficial palmer arch. Divide in proper digital artery at web space. Gives dorsal branch distal to proximal phalanx.

Objectives

Objective of the study was to have good functional and final outcome after repair of a partially amputed finger.

METHODS

Study type, location and duration

Prospective observational study conducted at KCG medical college and hospital, Karnal, India from January 2020 to January 2021, with follow up period of 6 months.

Inclusion and exclusion criteria

Partially amputed finger who reported within 1 hour, viable fingers, mentally fit patient and who can have a good follow up were included. Patients who reported with fully amputee fingers, black escharotic finger were excluded from the study.

Procedure

The innovative suturing technique involved a single stitch at the tip of the pulp and rest on adjacent to nail bed securing the neurovascular structures. 55 cases of partial and near partial finger amputation were attended by the team of orthopedic & plastic surgeon at KCGMC and hospital. Upon arrival, after initial investigation, consent and explanation of procedure patient were taken for operative fixation of near amputee finger. Patients were kept under close observation with daily dressing, antibiotics and analgesics. Out of 55 patient 50 had fully functional recovery at complete 6 months follow up, however 5 of remaining fingers could not be salvaged.

Figure 1: Surgical process.

Headband technique

1 knot on either side of nail bed & 1 at pulp under local anesthesia. Follow up was done at 10th day, 1 month, 3 months and 6 months. 50 fingers reached to fully functional recovery.

Statistical analysis

For data storage, an Excel$^{(r)}$ spreadsheet for MAC was used. Subsequently, data were imported into SPSS 20.0 for MAC software for statistical analysis. Descriptive statistics was performed and measurements such as mean and standard deviation were used as a degree of central tendency and variability of the data. The Kolmogorov-Smirnov test was used to test the distribution of the data. For analysis of inferential statistics, logistic regression models were used with the stepwise method, so in every step of the procedure the most important variable, in statistical terms, was the one that produced the biggest change in log-likelihood in relation of the model that did not contain the variable. The value accepted as the type I error was $p \leq 0.05$.

Table 1: Factors evaluated to determine reimplantation survival and revascularization of thumb and/or fingers.

Patient related factors	Trauma related factors	Surgical procedure related factors
Age	Mechanism	Number of anastomosed arteries
Comorbidities	Cutting injuries	Number of anastomosed veins
Systemic hypertension	Crushing	Use of venous graft
Habits (smoking)	Avulsion	
	Ischemia time	
	Ischemia type: hot or cold	
	Injury zone (Verdan) Osteoarticular injury location	

RESULTS

During the study period, 55 reimplantation were performed in 55 patients. Thirty-five patients underwent reimplantation/revascularization of one finger, three of two fingers, five of three fingers, one of four fingers and one of five fingers. The mean age of patients was 36 years old (range 3-75) (2). Of these patients, two (4.4%) were women and 43 (95.6%) were men. Cutting injuries were the main mechanism of injury in 54 (83%) cases, three (4.6%) were avulsion injuries and eight (12.3%) were crush injuries. The majority (73.3%) of patients had lesions in the non-dominant hand. Of the 65 procedures performed, 28 (43%) involved the thumb, 11 (16.9%) the index finger, 12 (18.4%) the middle finger, nine (13.8%) the ring finger and five (7.6 %) the little finger. Workplace accidents corresponded to 55.6% of patients and the majority worked in civil construction (48.8%) or the industry (13.3%). The average ischemia time was 8.39 hours, 7.57 hours in the fingers that did not survive and nine hours in successful reimplantation/revascularization

(Figure 3). Nine (20%) patients were smokers and five (11.1%) patients had hypertension. No replantation or revascularization was performed in patients with a history of type II diabetes mellitus, alcoholism or psychiatric illness.

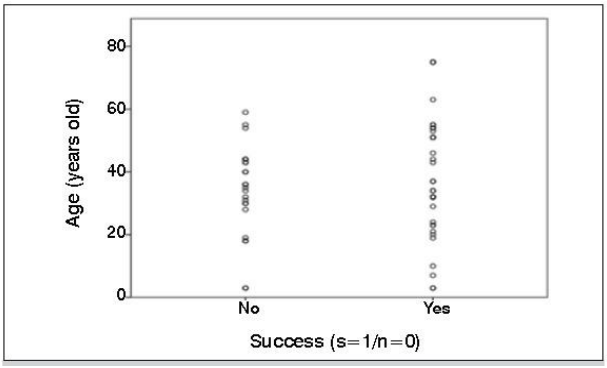

Figure 2: Mean age of patients.

Regarding the injured area of the fingers, 44 (67.7%) of the fingers were injured in Verdan zone 2, 14 (21.5%) in zone 1 and seven (10.8%) in zone 3. Twenty-eight presented simple fractures trait, 31 were comminuted and six pure dislocations without bone injury.

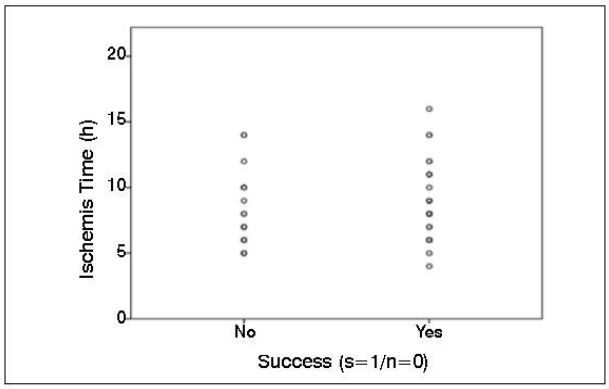

Figure 3: Mean ischemia times.

Eight amputations had metacarpal fractures, 29 in the proximal phalanx, 10 on medial phalanx and one on the distal phalanx. Ten had fracture-dislocation at the proximal inter-phalangeal level and six at the distal inter-phalangeal.

Table 2: Need to perform venous anastomosis and reimplantation success.

Need of venorrhaphy	Reconstructed fingers (N)	Success (N)	Success (%)	Statistical Test	P value
Revascularizations	15	14	93.3	Fisher's Exact Test	0.006
Reimplantation	50	27	54		0.004

Among the 55 reimplantation performed, only 20 had a reconstructed vein and on 30 cases there were two or more venorrhaphies. In all cases, only one arterial anastomosis was performed. Sixteen replantation required vascular graft for arterial anastomosis and no finger submitted to revascularization required venous graft. Of the data analyzed, the only one that showed a statistically significant difference was the need for venous anastomosis. Of the 55 reimplantations performed 27 (54%) fingers survived. Of the 15 revascularization performed, only one did not survive, which represents a 93.3% survival rate (Table 2).

DISCUSSION

Given an amputation case, many factors are determinant to make the decision whether to reimplant it or not. We must consider what are the real chances of success of the procedure in terms of survival and functional recovery for actually indicate reimplantation. Therefore, there is a need to define objective parameters that can signal to the prognostic factors of this procedure (Table 3).

There exist reports on patients who underwent successful replantation of amputated fingers, but few cases of multisegment amputation have been reported.[5] Belsky et al have reported successful treatment of a patient with a double level amputation through the palm and forearm.[3] Cai et al have described successful replantation of a multiple digit and circular palm amputation. Pei et al classified a multi-segment hand amputation into five groups. The complexity of the multi-segment amputation made the reattachment technically challenging.[8,9] However, as in microsurgery, technical advancements have allowed replantation surgery to become a routine procedure.[3,8,9] A satisfactory functional recovery depends on several conditions: the surgeon's expertise, short ischemic time, sufficient functional rehabilitation, and secondary lysis of tendon adhesion.[10] During the replantation of a multi-segment amputation, surgeons should consider some factors potentially affecting the results. The procedure should be determined based upon the condition of the amputated surface. For a satisfactory result, the surgeon should connect as many blood vessels as possible for sufficient blood flow. The blood flow of repaired vessels can decrease depending on the level of obstruction.[10]

In replantation of a multi-segment amputation, most vessels have more than one anastomotic stoma. The blockage of any anastomotic stoma can cause the necrosis of the distal end of fingers. Special attention should be paid to ensure nontraumatic suturing and operation.[9] The reduction of one anastomotic stoma may help prevent the

circulation crisis and shorten the operation time; adequate debridement is the key to survival of the digits and prevention of infection.[8,9] In this case, we constructed vessel anastomoses with minimal dissection due to the short length of the intermediate vessels.

Table 3: Surgical technique employed and success of procedure.

Surgical Technique	Number of reconstructions (N)	Number of successful reconstructions (N)	Successful reconstructions (%)	Statistical test	P value
Number of reconstructed veins					
One	20	8	40	Pearson Chi-square=2.630	0.105
Two or more	30	19	63.3		
Graft for arteriorrhaphy					
Yes	16	9	56.25	Fisher's Exact Test	0.560
No	49	32	65.3		

The first finger showed blood circulation through three anastomotic stomas, but the other fingers did not because severe crushing injury at the interphalangeal joint damaged vessel walls, which led to necrosis. Most commonly bone fixation is perform to reduce ischemic time.[4] We performed bone fixation using K-wires. Stable bone fixation is important for early rehabilitation, but early correction and continuous functional exercise of the fingers is especially important for functional recovery.[8,9] Replantation should be performed for multi-segment amputation of the hands. Vascular anastomoses should be constructed without causing vascular damage, especially for multi-segment amputations. Therefore, vascular anastomoses should be made with little separation to ensure minimal blood vessel movement and prevent vessel collapse. The replantation should be performed starting from proximal one. In our study we did simple repair of the amputed finger with sutures one at the tip of finger and the other two at ends protecting the neurovascular structures.

Limitations

Limitations of the study were; this study is on only 55 patients in remote parts of India. A larger multicentric trial in a tertiary care hospital is recommended.

CONCLUSION

We advocate the usage of this methodology of treatment of partially amputee fingers as a resort to prevent disability. As the technique is simple and needs no special equipment, even non-surgical trained personnel can save the fingers in remote parts of the country and world. However, this study is small to make a conclusive mark and a larger study is suggested upon the topic to outline a new treatment methodology as India finger saviour method.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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