Functional Outcome in Digital Replantations – A Study Over A Period of 5 Years

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ABSTRACT

Introduction: Replantation should be the prime indications for treatment of amputated fingers, due to functional and aesthetic advantages. Study aimed to evaluate not study the functional outcome of digital replantation over a period of 5 years.

Material and methods: Seventy four digital replantations were carried out since June 2013 till May 2018. Mechanism of injury was sharp in 36 digits, crush in 18 digits, avulsion in 14 digits and blast injury accounted for 6 digits. The distribution of replanted digits was 38 thumbs, 22 index fingers, 9 middle fingers and 5 ring fingers. In 18 patients multiple digits were replanted. Eleven digits required reexploration and two digits were reexplored thrice.

Results: We had 62 successful replantations with 12 failures. 18 digits had good functional recovery, 30 satisfactory recovery and 14 poor function. The subjective satisfaction score was calculated by the DASH score.

Conclusion: Replantation surgery have become the method of choice in treating the digit amputations with the development of microscope. The viability of the replanted part is guaranteed by a successful vessel anastomosis, while the quality of the bone, tendon, nerve, and skin repair will determine the overall functional success of the replanted parts. Repair of all structures at the time of the primary procedure should be attempted, as secondary surgery is technically difficult.

Keywords: Digital, Replantation, Amputation

INTRODUCTION

Accidents of different nature are not uncommon in day-to-day life. Many result in digital amputations. Assaults, accidental injuries, vehicular accidents and blast injuries may result in loss of single or multiple digits. These accidents may take place in far off places necessitating proper preservation of the parts. The warm ishaemia of digits, which is 12-14 hours, thus can be prolonged to 20-22hours. With the development of microsurgery, replantation surgery have become the method of choice in treating the digit amputations.[1]

Halsted, Hopfner, and Carrel in the late nineteenth and early twentieth centuries supplied the basic principles of the new field of vascular surgery. With further technical advancements in suture material and surgical instruments, primarily the operating room microscope, replantation became a standard laboratory procedure. Kleinert et al. performed the first digital arteries anastomosis in the revascularization of a partially amputated thumb in 1963.[2] The first replantation of a complete digit amputation using microvascular anastomosis was performed by Komatsu and Tamai in 1965.[3] The ultimate goal and real benefit from replantation is determined by functional recovery and is related not only to the success of the microvascular anastomosis, but also to the adequacy of bone, tendon, skin, and nerve repairs.[4]

In a traumatized patient, priority must be given to life-threatening injuries that demand immediate attention. Replantation is only considered in a stable patient. Every effort should be made to minimize the time interval between amputation and replantation, and hypothermic preservation of the amputated part is the standard of care and should be established to avoid irreversible degeneration of tissue cells.[5,6,7,8,9,10]

Indications for digital replantation include (1) amputated thumbs, (2) multiple digits, (3) single digit distal to the flexor digitorum superficialis tendon, and (4) all digital amputations in children. The decision to replant a proximal amputation in a single digit is debatable among authors and a special circumstance is required, such as left ring finger in a female, occupational requirements, or religious and ethnic preference. Contraindications for digital replantation include severe crushing injury, multiple level injuries in the same digit, massive contamination, frozen parts, prolonged normothermic ischemia time, and parts preserved in non-physiologic solutions. Severe comminuted intra-articular fractures might be considered a contraindication for replantation given its presumed poor functional outcome. Complete ring avulsion injuries can be a contraindication for replantation, although some authors believe it still can be attempted with judicious use of venous grafts, unless the PIP joint is damaged or the proximal phalanx is fractured.[6,7,10,11,12,13,14,15,16,17] Predictive signs of severe damage to the neurovascular bundle and unsuccessful replantation include the "red line" and "ribbon" signs, which suggest a wide zone of intimal injury.[18]

MATERIAL AND METHODS

Seventy four replantations were carried out since June 2013 till May 2018. Mechanism of injury was sharp in 36 digits, crush in 18 digits, avulsion in 14 digits and blast injury

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accounted for 6 digits. The distribution of replanted digits was 38 thumbs, 22 index fingers, 9 middle fingers and 5 ring fingers (figure 1,3,4).

Preoperative management

The preservation of the amputated part is key to successful replantation. General consensus in the literature regarding reliable ischemia times for a successful replantation are 12 h of warm and 24 h of cold ischemia for digits and 6 h of warm and 12 h of cold ischemia for major upper extremity replantation. The amputated part should be immersed in saline solution or wrapped in a saline-moistened gauze immediately, placed in a sealed plastic bag, and submerged in ice saline solution (approximately at 4°C).[19,20] At arrival in the replantation center, X-rays and pictures of the stump and amputated parts were obtained. Prophylactic antibiotics and tetanus toxoid was given in addition to general resuscitative measures. Hemostasis of the amputated stump was achieved with external compression and clamping vessels was avoided to prevent additional vessel damage. The amputated part was examined under an operating microscope and important structures were dissected, isolated, and tagged.[11] Amputated parts unsuitable for replantation was not discarded, but instead evaluated for its use as a spare part in case of multiple digital amputations as a source for nerve graft, skin graft, arterial graft, or bone graft.[6]

Surgery

After the decision to undertake replantation was taken the amputated digits were dissected with mid lateral incisions when the patient was being prepared for surgery to conserve time. After completion of dissection skeletal shortening was done depending on the nature of injury. Skeletal fixation was done with axial, cross or parallel K wires followed by repair of extensor and flexor tendons. This was followed by anastomosis of digital artery and vein with 10.0 monofilament sutures followed by cooptation of nerves. All avulsion injuries and most of the crush injuries required interposition vein grafts taken from distal forearm.

Post-op care

All the patients were put on low molecular weight dextran post operatively for 3 days followed by Asprin for two more weeks. Post operatively when the digit developed vascular compromise, measures like change of dressings, removal of tight sutures if any, bolus heparin IV and brachial blockade were tried before re exploration. Only four patients responded to above measures but eleven digits required re exploration and two digits were re explored thrice. Out of these thirteen re explorations only two digits had sharp injuries while the remaining were crush, avulsion and blast injuries. Physiotherapy of the digits were started only after removal of K wire.

RESULTS

In 18 patients multiple digits were replanted. Eleven digits required reexploration and two digits were reexplored thrice. We had 62 successful replantations with 12 failures. 18 digits had good functional recovery, 30 satisfactory recovery and 14 poor function. Eighteen digits had good functional recovery (figure 2). Thirty digits had satisfactory

Figure-1: Oblique amputation at middle phalanx level

Figure-2: Patient writing normally

Figure-3: Index finger amputation and replantation

Figure-4: Thumb replantation

function with moderate limitation in range of movement at interphalangeal or metacarpophalangeal joints. Remaining fourteen digits had severe restriction of movement. Forty seven digits had satisfactory sensation and the remaining fifteen digits had poor sensation. Subjective criteria using a patient-centered questionnaire (The Disabilities of the Arm, Shoulder and Hand (DASH) score) was used by Dabernig et al.[19] to evaluate functional outcomes after replantation. DASH score ranges from 0-100. Good functional recovery was accessed by a DASH score of 60-100, satisfactory recovery with a DASH score of 30-60 and poor outcome was accessed by a DASH score of < 30.

DISCUSSION

Replantation survival rates of 80% to 90% have been described in selected reports.[4,5,11] The success rate (survival rate) of reimplantation in our study was 84%. Improving survival rates are due to better patient selection, improved microsurgical technique and equipment, and the liberal use of vein grafts. Replantation survival rates are directly associated to the experience and skill of the surgical team and selection of the patient population. Kleinert et al. suggest that functional criteria should include sensibility ratings, grip strength, range of motion, the absence of cold intolerance, and the return to work. Kleinert et al. found return to work to be associated more with personal motivation than type or level of injury.[11] With regard to overall sensory recovery following digital replantation, Tamai reported two-point discrimination sensibility less than 15 mm in 70% of his patients.[14] In Glickman and Mackinnon's review of over 400 digital replants, they found that the average static two-point recovery in thumbs replanted following a clean cut was 9.3 mm compared to 12.1 mm in those suffering a crush/avulsion-type mechanism. Fingers recovered on average 8 mm of static two-point recovery and 15 mm in crush/avulsion-type mechanisms. Overall, only 61% of thumbs and 54% of fingers recovered useful two-point discrimination.[21] 64% of the patients had satisfactory sensory outcome. Sensory recovery has been shown to be better following replantation where the mechanism was sharp cuts rather than avulsion injury. Despite these encouraging functional results, several problems still remain following replantation, which include the poor return of intrinsic muscle function in injuries occurring at the wrist and proximal.[22] In addition, persistent cold intolerance is a complaint of the majority of replanted patients.[11]

CONCLUSION

Successful replantation is not only survival of the digit but good functional recovery as well. Good functional recovery is interdependent on mechanism of injury, meticulous execution of surgery, physiotherapy, healing properties and cooperation of the patient. Judicious use of vein grafts, arterio venous shunting, continuous brachial plexus blockade may be thought of in salvage situations. Teamwork is key to success when multiple digits are to be replanted or prolonged surgery is required. When injuries are taking place in far off or remote places teleconsultation with mobile camera phone helps in evaluating replantation potential.

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