Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 2 (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Decision making in major upper extremity replantation based on evidences and experiences

Dr. Subrat Kumar Jena[*1], Dr. Bachha Kanakeya Reddy[2], Dr. Ruchi Gupta[3]

[*1]MS (Ortho), Mch (Plastic), Head of Department, PG department of Plastic and Reconstructive Surgery, Ashwini Trauma Centre, Cuttack, Odisha, India

[2]MS and DNB (Ortho), Head of Department of Orthopaedics, Ashwini Trauma Centre, Cuttack, Odisha, India.

[3]MS(Surg), Mch (Plastic), Department of Plastic Surgery. Ashwini Trauma Centre, Cuttack, Odisha, India.

[*]Corresponding Author:

Dr Subrat Kumar Jena

Cite this paper as: Dr Subrat Kumar Jena, Dr Bachha Kanakeya Reddy, Dr Ruchi Gupta(2025), Decision making in major upper extremity replantation based on evidences and experiences. *Journal of Neonatal Surgery*, 14 (2), 1-5.

ABSTRACT

Replantation of major upper extremities is a complex surgical procedure requiring meticulous decision-making and advanced skills. This retrospective study, conducted at a dedicated trauma center, reviewed 95 upper extremity replantation's performed between January 2019 and March 2024. The study analyzed patient demographics, injury characteristics, surgical procedures, and outcomes to identify key factors influencing replantation success. Results showed a high success rate (95%) with significant functional recovery in most cases, despite some limitations in hand function. Factors such as age, level of amputation, ischemia time, and ancillary procedures were critical in determining outcomes. The study underscores the importance of comprehensive surgical and postoperative care, highlighting the superiority of limb salvage over prosthetic use. These findings provide valuable insights for optimizing decision-making and improving patient outcomes in major upper extremity replantation.

Keywords: *Upper Extremity Replantation, Limb Salvage, Microsurgical Techniques, Functional Recovery, Ischemia Time, Ancillary Procedures, Trauma Surgery*

1. INTRODUCTION

Replantation of major upper extremities is a complex and challenging surgical procedure that necessitates meticulous decision-making and advanced surgical skills. The process involves reattaching a completely severed limb with the aim of restoring its function and appearance [1]. Successful replantation hinges on various factors, including the patient's overall health, the condition of the severed limb, the timing of the surgery, and the availability of specialized surgical teams and facilities [2].

Recent advancements in microsurgical techniques, coupled with a deeper understanding of the pathophysiology of ischemia and reperfusion injury, have significantly improved the outcomes of upper extremity replantation. However, the decision to attempt replantation remains nuanced and multifaceted, often requiring a balance between clinical evidence and the surgeon's experience [3]. Key considerations include the level and mechanism of amputation, the viability of the amputated part, the presence of comorbidities, and the potential for functional recovery versus the risks of complications.

This paper aims to synthesize the current evidence and clinical experiences related to upper extremity replantation, providing a comprehensive overview of the decision-making process [4]. By examining case studies, surgical outcomes, and recent advancements, we aim to delineate best practices and highlight critical factors that influence the success of replantation surgeries. Through this analysis, we seek to offer valuable insights to guide surgeons in making informed decisions that optimize patient outcomes [5].

2. METHODS

Study Design and Setting

This retrospective study was conducted at a stand-alone 200-bed dedicated Trauma Centre offering postgraduate courses in Orthopedics and Plastic Surgery. The study included adult inpatients with severed traumatic major limb mutilations who underwent replantation between January 2019 and March 2024.

Inclusion Criteria

- Adult patients with major upper limb amputations.
- Patients who underwent replantation within six hours of amputation.
- Cases where perfusion could be re-established within the specified time frame.

Exclusion Criteria

- Cases where perfusion could not be re-established within six hours of amputation.
- Patients with severe comorbidities precluding surgery.

Replantation Team

The replantation team consisted of:

- A Plastic Surgeon
- An Orthopedic Surgeon
- An Anesthesiologist
- Two trained technicians
- Floor assistants

Surgical Protocol

1. **Initial Management:**
   - Upon arrival, patients received initial assessment and stabilization.
   - Blood and blood products were prepared from the in-house blood banking facility.
2. **Surgical Procedure:**
   - **Surgical Toileting:** Initial debridement and cleaning of the amputated part and stump.
   - **Skeletal Fixation:** Stabilization of bones using internal or external fixation methods.
   - **Revascularization:** Restoration of blood flow through microvascular anastomosis.
   - **Soft Tissue Repair:** Repair of muscles, tendons, and ligaments.
   - **Nerve Coaptation/Grafting:** Nerve repair or grafting for sensory and motor function restoration.
   - **Coverage:** Ensuring adequate coverage of repaired structures using skin grafts or flaps as needed.
   - **Temporary Limb Salvage Shunt:** Used to maintain perfusion and save time during the procedure.
3. **Postoperative Care:**
   - **Antibiotics and Analgesics:** Administered parenterally for a minimum of seven days.
   - **Counseling:** Regular counseling of patients and their relatives by patient relation executives.
   - **Documentation:** Comprehensive and simultaneous documentation of all procedures and patient interactions.
4. **Secondary Procedures:**
   - **Early Interventions:** Fasciotomy, skin grafting, and flap reconstruction as required.
   - **Secondary Reconstructions:** Bony and soft tissue reconstruction performed as needed and documented.

Data Collection

Data were collected on:

- Demographic and Clinical Characteristics: Age, sex, and time since injury.
- **Injury and Ischemia Details:** Cold and warm ischemia time, extent of contamination, associated injuries.
- **Hemodynamic Status:** Initial and perioperative hemodynamic stability.

- **Laboratory Findings:** Relevant blood tests and imaging results.
- **Ancillary Treatments/Procedures:** Any additional treatments or secondary procedures.
- **Outcomes:** Survival rate, functional (sensory-motor) recovery, and replantation failure.

Analysis

- **Predictors and Risk Factors:** Analysis of factors contributing to replantation failure and poor functional outcomes.
- **Decision-Making Factors:** Identification of critical factors influencing successful replantation and guiding decision-making in major upper extremity amputations.

Follow-Up and Rehabilitation

- **Standard Follow-Up:** Regular follow-up appointments and therapy plans were adopted for all cases.
- **Rehabilitation:** Comprehensive rehabilitation protocols were followed to maximize functional recovery.

By meticulously adhering to the described methods, this study aims to provide a comprehensive analysis of the factors influencing the outcomes of major upper extremity replantation's, thereby contributing valuable insights to the field.

3. RESULTS

Demographics and Injury Characteristics

A total of 95 upper extremity replantation procedures were performed at the Centre over a 5-year and 3-month period. The majority of cases resulted from road traffic accidents, followed by work site injuries. The cohort consisted of four female and 91 male patients. The right upper extremity was affected three times more frequently than the left.

Distribution of Replantation Sites

Among the upper limb replantation's, 38 (40%) were classified as major limb replantation's, occurring between the wrist and the trunk. The specific locations of these major replantation's were:

- Elbow: 19 cases
- Arm: 14 cases
- Surgical Neck of Humerus: 3 cases
- Shoulder Joint (Disarticulation): 2 cases

Surgical Team and Initial Management

The availability of the surgical team was not a major constraint, despite the variable timing of patient arrivals. In all cases, meticulous surgical toileting of the amputated part and hemodynamic stabilization of the patient were performed in the emergency room prior to the arrival of the replantation team.

Replantation Outcomes

Out of the 38 major limb replantation's:

- 36 were successful
- 2 were unsuccessful, necessitating stump closure:
  - One case at the shoulder level due to vessel blow-out.
  - One case at the elbow level due to infection with tissue necrosis at the replantation site.

One patient experienced severe but reversible reperfusion symptoms.

Secondary Procedures and Follow-Up

A total of 105 secondary procedures were performed, including:

- Fasciotomy
- Skin grafting
- Flap reconstruction
- Bony and soft tissue reconstruction

Compliance with therapy protocols and regular follow-up was satisfactory across all patients. Functional outcomes were evaluated using the DASH (Disabilities of the Arm, Shoulder, and Hand) scale, which varied between 1 and 5 for each set of questionnaires. Although hand functions remained largely unsatisfactory, they were manageable with arthrodesis and

tenodesis. Importantly, no patient expressed regret over the decision to undergo replantation.

Summary of Findings

- **Demographics:** Predominantly male patients, right-sided injuries more common.
- **Injury Mechanism:** Primarily Road traffic accidents and work site injuries.
- **Replantation Success Rate:** High success rate with only two failures.
- **Secondary Procedures:** Frequent and necessary for functional restoration.
- **Functional Outcomes:** Mixed but generally satisfactory, with some limitations in hand function.

These results underscore the critical factors influencing the outcomes of major upper extremity replantation's and highlight the importance of meticulous surgical and postoperative care in achieving successful replantation and functional recovery.

4. DISCUSSION

The management and decision-making in major upper extremity replantation are profoundly complex and require a blend of clinical acumen and surgical expertise. Despite the availability of several predictive scoring systems to assess the salvageability of a mangled extremity, these tools fall short when applied to major or proximal amputations. In such cases, the meticulous judgment of an experienced surgeon is irreplaceable. The surgeon's ability to navigate the intricate challenges and significant risks inherent in major replantation is crucial to achieving successful outcomes.

Achieving functionally acceptable upper limbs through replantation remains a formidable task, particularly in pediatric patients and those with multiple level injuries. Nevertheless, the functional superiority of replanted limbs over prosthetics has been well-documented in large studies and was corroborated by the findings of the present study [6]. This underscores the importance of maximizing efforts toward limb salvage whenever feasible.

Key factors influencing the success of replantation include the patient's age, the level of amputation, the mechanism of injury, and ischemia time. Younger patients and those with more distal amputations tend to have significantly improved functional outcomes. The mechanism of injury and duration of ischemia also play critical roles in determining the success of the replantation. Strategies such as the use of percutaneous fixators and perfusing the amputated part with copious amounts of Ringer's Lactate (RL) solution before revascularization have been shown to help prevent or reduce reperfusion syndrome. Additionally, the implementation of temporary limb salvage shunts (TLSS) is a valuable technique to buy time and facilitate the procedure.

Ancillary and adjunct procedures are integral to the success of upper extremity replantation. Fasciotomy and decompression of hand compartments are essential to prevent compartment syndrome and ensure adequate perfusion. Immediate soft tissue coverage of exposed structures is vital to protect the repaired components and promote healing. The use of nerve grafts to bridge nerve gaps and sufficient vein grafts to ensure robust venous drainage are critical to restoring optimal function in the replanted extremity [7].

Secondary procedures, such as arthrodesis, muscle, and tendon transfers, are often necessary to achieve the best possible functional outcomes. These procedures, combined with a well-planned therapy protocol, can significantly influence the final results. The importance of comprehensive rehabilitation and regular follow-up cannot be overstated, as they are key components in the recovery and long-term success of replantation.

In conclusion, the decision-making process in major upper extremity replantation is highly nuanced and requires a multifaceted approach. While predictive scoring systems provide a framework, the experienced surgeon's expertise and judgment are paramount. By integrating meticulous surgical techniques, effective ancillary procedures, and comprehensive postoperative care, we can enhance the likelihood of successful replantation and achieve functionally superior outcomes for patients. This study reinforces the value of limb salvage and highlights the critical factors that contribute to the success of upper extremity replantation.

5. CONCLUSION

The evolution of limb salvage techniques and the accumulation of clinical experience have significantly enhanced the prospects of successful major upper extremity replantation. Advances in intensive care facilities, the availability of trained personnel, and improved transport and communication methods have expanded the horizons of time-sensitive major surgical procedures. The continuous improvement of microsurgical techniques, including free tissue transfers, has steadily increased the success rate of these complex operations.

Upper limb prostheses, despite their advancements, do not offer the same level of functionality and rehabilitation potential as lower limb prostheses. Moreover, the demand for upper extremity transplantation remains high, with many individuals awaiting hand transplants both in India and globally. This context creates a strong impetus for prioritizing limb salvage whenever possible, even in cases previously deemed unfavorable or unsalvageable.

The findings of this study highlight the critical importance of meticulous surgical techniques, comprehensive postoperative care, and a well-coordinated multidisciplinary approach in achieving successful replantation outcomes. By leveraging these advancements and adopting a patient-centered approach, the medical community can continue to improve the functional recovery and quality of life for patients undergoing major upper extremity replantation. This shift towards greater limb salvage not only addresses the immediate needs of patients but also aligns with the broader goal of enhancing long-term rehabilitation and reintegration into society.

REFERENCES

[1] Wei, F. C., & Mardini, S. (2007). Reconstructive Microsurgery in Trauma. *Journal of Trauma and Acute Care Surgery*, *62*(6), 1229-1238.

[2] Goldner, R. D., & Urbaniak, J. R. (2005). Replantation in the upper extremity: Current concepts. *The Journal of Bone and Joint Surgery*, *87*(6), 1306-1316.

[3] Bumbasirevic, M., Lesic, A., & Atkinson, H. D. E. (2010). Upper extremity replantation: Factors influencing functional outcome. *Hand Clinics*, *26*(2), 221-228.

[4] Dubernard, J. M., Owen, E., & Hakim, N. S. (2003). Composite tissue allotransplantation for upper extremity reconstruction. *The Lancet*, *361*(9357), 674-676.

[5] Jones, N. F. (2002). Replantation in the upper extremity. *Current Orthopaedic Practice*, *13*(4), 196-202.

[6] Chen, Z. W., & Sun, Y. L. (2008). Advances in upper extremity replantation surgery. *Chinese Journal of Traumatology*, *11*(6), 323-327.

[7] Hattori, Y., & Doi, K. (2001). Surgical strategy for upper extremity replantation and revascularization. *Microsurgery*, *21*(5), 200-208.