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Case Study: Reimplementation of the Proximal Third of the Arm

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ABSTRACT

Introduction*: Microsurgical reimplantation in patients faces challenges due to complex factors, concerning the comorbidities of the patient and the type and severity of the amputation. The one-year survival rate is 90, 9% [1]. Plastic surgeons and a multidisciplinary team will be needed to perform microsurgical techniques, such as the use of tridimensional models to reconstruct different body parts using top-notch technology [2]. This study aims to evaluate the technique of reimplantation of the third proximal left arm in a patient with a traumatic amputation.*

Background of the Case Study: *49-years old man suffered an amputation of his left forearm by an industrial grinding machine in his workplace on October 5th, 2017, which resulted in a total avulsion of his limb. The patient was taken to the Emergency room to perform a warm ischemic technique for around 30 minutes. Physicians kept the amputated forearm on ice for 3 hours and conducted the intraoperative ischemia for 4 hours. The surgery included an extent debridement of the devitalized muscles, injured tendons and vessels, and the osteosynthesis of the radius and ulna without complications. After one year, researchers conducted the metacarpophalangeal capsuloplasty, tenolysis of the extensors and opening of the first space and section of the pronator quadratus.*

Conclusion: *Revascularization within the first four hours was crucial because it prevented permanent damage to the tissues. The surgery technique focused on the reconstruction of the viable tissues, resulted in the reimplantation of the forearm.*

Keywords
Amputation of the forearm, Surgery reimplantation.

Introduction

In the mid-1500, three events opened opportunities for microsurgery in the field of reconstructive surgery. Firstly, Alexis Carrel observed the potential of cold storage to preserve tissues, described for end-to-end anastomosis in 1902 [3]. The discovery of heparin by Jay McLean in 1916 [4], played a crucial role to the future of surgery as well as the adaptation of the first dissecting microscope by Olof Nylen in 1921 [5]. Four decades ago, the microvascular surgery emerged thanks to Jacobson and Suarez, who introduced anastomotic techniques in 1.5-3.0 mm diameter small blood vessels using an operative microscope. Jacobson's microsurgical techniques, including the use of small vessel clamps, prevented frequent damage to anastomosed vascular walls, which was the cause of frequent failures [6]. In 1962, the successful reattached of a severed limb performed by Ronald Malt signalled the beginning of the reimplementation microsurgery. The patient was a 12-year-old boy who was taken to the emergency room with a severed forearm. Ronald Malt, the lead surgeon of the team, performed an internal reimplementation, repair of the brachial artery, both and the median, radial and ulnar nerve [7].

Reconstructive microsurgery has become a very sophisticated surgical specialty that is used in daily life by the plastic surgeon, who requires expertise in the field. When a limb is amputated, a high investment of time, cost, and resources is required by the health care team to ensure revascularization and reinnervation of the transplanted tissue to guarantee the vitality of the reimplant. It is essential to have a multidisciplinary team of plastic surgeons with expertise in microsurgical techniques, particularly with three-dimensional body reconstruction [7]. This research study aims to evaluate the result of pioneering surgery with the successful replantation of the proximal third of the arm after a traumatic amputation of the upper limb.

Case Study

On October 5th, 2017, a 49-year-old male patient suffered a left forearm amputation, caused by an industrial grinding machine at his workplace, City of Veracruz, Mexico (Figure 1 and 2). The diagnosis was a complete avulsion of the middle and distal third of the left forearm and extensive high-energy damage with rupture of skin, soft tissue, muscles, blood vessels, and nerves. The patient also presented closed transverse fractures of the distal humerus, type 3 open fractures of radius, and left ulna as well as fractures of the base of the 3rd, 4th, and 5th metacarpals. The waiting time lasted 1 hour 30 minutes from the moment the patient suffered the injury to the beginning of the surgery (Figure 1). The patient was taken to the emergency room for reimplantation of the left forearm. His vital signs were: 190/100 mmHg, HR 80 x', and oxygen saturation of 96%. The patient received regional anesthesia, including interscalene block with Ropivacaine 7.5% 15ml and lidocaine 2% 10 ml (200 mg), total volume of 40ml. The initial arterial blood gas analysis was taken with PH: 7.30, pc02:40 mmHg, p02:210 mmHg, HC03: 20 mmol/L, BE ecf: -5.7 mmol/L, THbc 9.9 g/dL. From the moment of the accident, the amputated forearm was exposed to warm ischemia for 30 minutes, and then it was exposed to cold ischemia (placing the limb on ice) for around 6 hours until revascularization was carried out.

Figure 1: Amputation of the forearm by the industrial machine at patient's workplace.

The amputated limb suffered from different contamination sources, including industrial- type grease and metallic microfragments that resulted in severe damage to the subcutaneous and muscular cellular tissue in all compartments. Therefore, surgeons carried out surgical wound care to the amputation injury. Following the emergency care, surgeons carried out an extensive debridement of the devitalized muscles and injured tendons and vessels, and osteosynthesis of the radius and ulna. Osteosynthesis was performed with a 3.5 mm DCP plate, followed by the fixation of the distal metaphyseal fracture of the left radius with two wire screws of 2- and 1.6-mm Kirchner-type. Dermalon 9-0 was used for the termino- terminal anastomosis of the ulnar artery and the two proximal veins. It was possible for the reimplantation of the muscles of the anterior ulnar and posterior radial compartments and the median and ulnar nerve. The osteosynthesis of the left humerus was possible with an anterolateral plate to the middle third with a distal lateral approach using a 4/5 mm DCP plate. Intraoperative ischemia time (figure 3) was 4 hours, anticoagulation was with heparin 2000 units every 24 hours, as well as clopidogrel 75 mg every 24 hours for 3 months. Bleeding was 300 cc and surgery time of 16 hours.

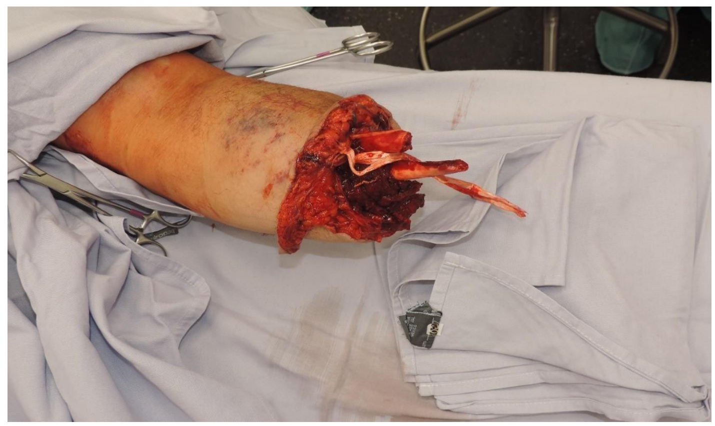

Figure 2: Proximal forearm of the amputated left forearm by the shredded machine.

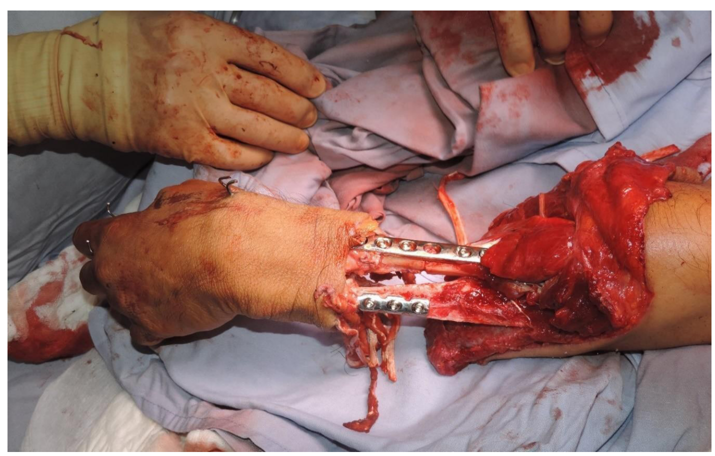

Figure 3: Extensive debridement of devitalized muscles, injured tendons, and vessels. Osteosynthesis of the radius and ulna.

After 30 days, the patient received an autograft in his left forearm, and he was sent to rehabilitation and physical medicine for assistance in flexion and extension of the elbow, wrist, and fingers after 3 months. Electromyography was performed on the triceps branchii muscles, extensor carpi radialis, extensor indicis proprius and brachioradialis. After 6 months, the patient showed improvement and recovery in the distal muscles (finger extensors). Muscle strength was evaluated according to the conventional scale, resulting in improvement in forearm muscle strength, the adequate elevation of the left shoulder and elbow flexion and extension. There was also an improvement in the pronation and supination of the forearm. Sensitivity was established based on the territorial method of the median and left ulnar nerve. One year later, the following procedures were carried out; metacarpophalangeal capsuloplasty, tenolysis of the extensors and opening of the first space and section of the square pronator quadratus. Currently, the patient presents a slight impossibility for the extension of the wrist and fingers and the flexion of the metacarpophalangeal joints (Figure 4 and 5).

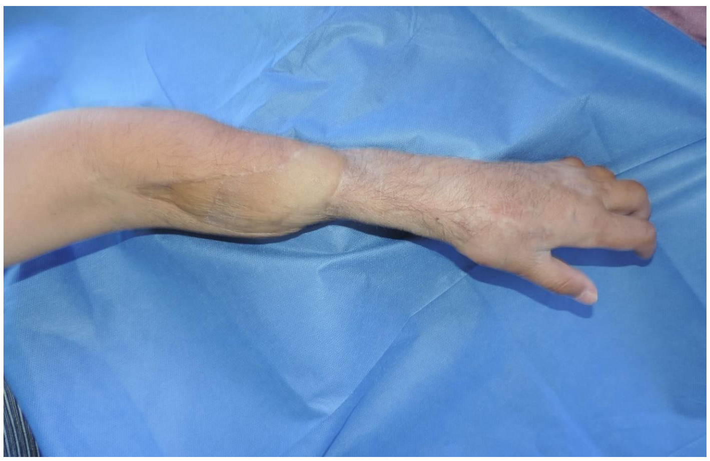

Figure 4: One-year recovery phase after performing metacarpophalangeal capsuloplasty, tenolysis of the extensors and opening of the first space and section of the pronator quadratus.

Figure 5: Recovery of the flexion and extension of the elbow and the pronosupination of the forearm. Sensitivity was evaluated based on the territorial method of the left median and ulnar nerve.

Discussion

Over the course of the last 60 years, technological innovation emerged for microsurgical techniques, instrumentation, and surgery with microscopes, hypothermia, and suture materials. A wide variety of techniques has been reported during reimplantation surgery with success rates of 80 to 90% [1]. Kwon pointed out that the following factors affect the survival rate of reimplantation: the mechanism and area of the injury and the preservation method of the amputated limb. On the other hand, gender, alcohol consumption, and ischemia do not have a significant influence on the survival rate. Other factors such as injury severity, type of injury, age, warm ischemia time, and patient characteristics must be taken into consideration for the success of reimplantation of an amputated limb [9]. Limb replantation and transplantation remain surgical emergencies due to limits in the viability of tissue under ischemia [10]. Amputated regions, particularly those containing large volumes of muscle, need to be revascularized within 4 hours to avoid permanent tissue damage [11].

Figure 6: Functional result of the reimplantation after one-year recovery.

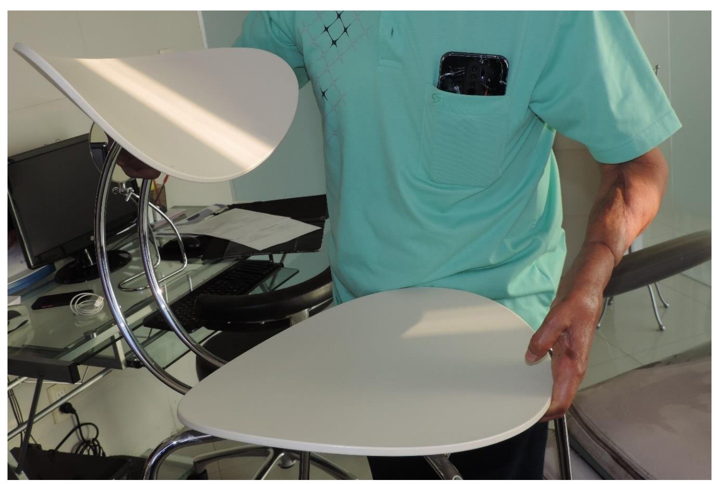

Figure 7: Functional result of the reimplantation after one-year recovery.

The recovery of function is greater than the possible complications, and in some cases, the aesthetic factor is valued more than the functional one. Patients often showed interest in replantation due to aesthetic preference and personal/cultural values. For instance, eastern culture focuses on the integrity of the body and physical appearance [1].

Figure 8: Functional result of the reimplantation after one-year recovery, including the active flexion of fingers to evaluate pinch strength.

CARTA DE CONSENTIMIENTO INFORMADO

CARTA DE CONSENTIMIENTO INFORMADO PARA PARTICIPACIÓN EN PROTOCOLOS DE INVESTIGACIÓN

Nombre del estudio:	**REEIMPLANTACION DEL TERCIO PROXIMAL DEL BRAZO: "REPORTE DE UN CASO".**
Patrocinador externo (si aplica):	
Lugar y fecha:	Noviembre 2021
Número de registro:	
Justificación y objetivo del estudio:	REMODELACION Y FUNCIONALIDAD DEL BRAZO REIIMPLANTADO
Procedimientos:	
Posibles riesgos y reacciones adversas:	Ninguno
Posibles beneficios que recibirá al participar en el estudio:	ÉXITO DE LA CIRUGIA, POR LO TANTO RECUPERACION DE LA FUNCIONALIDAD DEL BRAZO REEIMPLANTADO.
Información sobre resultados y alternativas de tratamiento:	
Participación o retiro:	La participación o el retiro es voluntario .
Privacidad y confidencialidad:	Se resguardara la confiablidad de los datos.

En caso de colección de material biológico (si aplica):

- [ ] No autoriza que se tome la muestra.
- [ ] Si autorizo que se tome la muestra solo para este estudio.
- [ ] Si autorizo que se tome la muestra para este estudio y estudios futuros.

Disponibilidad de tratamiento médico en derechohabientes (si aplica):	Se dará si el paciente lo amerita.
Beneficios al término del estudio:	

En caso de dudas o aclaraciones relacionadas con el estudio podrá dirigirse a:

Investigador Responsable:	DRA.CLAUDIA AMELIA JIMENEZ MARTINEZ
Colaboradores:	DRA ROSITA TORRES HERNANDEZ

Adolfo leal Guillen

Nombre y firma del sujeto

Adolfo leal Guillen

Nombre y firma de quien obtiene el consentimiento

Testigo 1

Nombre, dirección, relación y firma

Testigo 2

Nombre, dirección, relación y firma

Este formato constituye una guía que deberá completarse de acuerdo con las características propias de cada protocolo de investigación, sin omitir información relevante del estudio

It is essential to consider the type of injuries and the inherent factors to avoid patient morbidity or unsatisfactory results. Replantation has offered successful outcomes in the surgery field, specifically for upper extremity amputations, thanks to trained staff and a multidisciplinary team. This study focused on the step-by-step system approach increased efficacy and efficiency. The importance of adequate surgical techniques for injuries containing large segments of muscle and nerve tissue will depend on the regenerative capacity of ischemic tissues [11,13]. However, some surgery techniques remain controversial. For instance, the use of anticoagulants during the intraoperative and postoperative period presents advantages and disadvantages for the reimplantation. Some benefits of the anticoagulants include preventing thrombosis in the first three postoperative days to improve vascular permeability. The use of prophylactic antithrombotic drugs, combined with intravenous heparin has demonstrated efficacy in optimizing replantation success and mitigating the risk of immediate vascular complications. In fact, it inhibits the synthesis of thrombin. The reported side effects are hemorrhage or hematomas that can further compromise vascular anastomosis [14]. Antithrombotic treatments improve the patient's condition after endovascular intervention by minimizing complications and avoiding increased bleeding. Limitations of the study include heterogeneous and insufficient data. Further prospective cohort studies and well-designed prospective randomized trials with appropriate subgroups are required to compare and validate results [15].

Informed Consent

The researcher asked the participant to sign the consent form for the publication of this study. The Consent form is attached to the report (APPENDIX A).

References

1. Carrel A. La technique operatoire des anastomoses vasculaires et la transplantation des visceres. Lyon Med. 1902; 98: 859-863.
2. Howell WH, Holt. E. Two new factors in blood coagulation: Heparin and pro- antithrombin. Am J Physiol. 1918; 328-341.
3. Nylen CO. The microscope in aural surgery: Its first use and later development. Acta Otolaryngol Suppl. 1954; 116: 226-240.
4. Ó Brien BM, Hayhusrt JW. Metallized microsutures and a new microneedle holder. Plast Reconst Surg. 1973; 52: 673.
5. Malt RA. Clinical aspects of restoring limbs. Adv Surg. 1966; 2: 19.
6. Mavrogenis AF, Markatos K, Saranteas T, Ignatiadis I, et al. The history of microsurgery. European Journal of orthopaedic Surgery and Traumatology. Springer Paris; 2019;(29) p. 247-254.
7. Nwosu C, Babalola MO, Ibrahim MH, et al. Major limb amputations in a tertiary hospital in North Western Nigeria. Afr Health Sci. 2017; 17: 508-512.
8. Askari M, Fisher C, Weniger FG, Bidic S, Lee WP. Anticoagulation therapy in microsurgery: a review. J Hand Surg AM. 2006; 31: 836-846.
9. Tamai S. History of microsurgery. Plast Reconstr Surg. 2009; 124 (SUPPL. 6): 282–294.
10. Lindfors N, Raatikainen T. Incidence, epidemiology, and operative outcome of replantation or revascularisation of injury to the upper extremity. J Plast Surg Hand Surg. 2010; 44: 44–49.
11. Assouline U, Feuvrier D, Lepage D, Tropet Y, Obert L, Pauchot J. Functional assessment and quality of life in patients following replantation of the distal half of the forearm (except fingers): A review of 11 cases. Hand Surg Rehabil. 2017; 36: 261–267. Available from: http://dx.doi.org/10.1016/j.hansur.2017.05.002
12. AG. True proximal third arm replantation: A rare case. Indian J Case Reports. 2018; 4: 492–494.
13. Padilla L, Argüero R, Di Silvio M, López-Gutiérrez J, Landero T, García J, et al. Vascular microsurgery course: 40 years at the Centro Médico Nacional 20 de Noviembre (ISSSTE) and 33 years at the Faculty of Medicine of the UNAM. Cirugía y Cir (English Ed. 2019; 86: 177–184.
14. Lorio ML. Hand, Wrist, Forearm, and Arm Replantation. Hand Clin. 2019; 35: 143–154. Available from: https://doi.org/10.1016/j.hcl.2018.12.005.
15. Naalla R, Singhal M, Dawar R, Maurya M. Salvage forearm to arm replantation. BMJ Case Rep. 2020; 13: 1–2.