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Original Article

Physical Therapy Rehabilitation for Hand Replantation: A Case Report

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ABSTRACT

Introduction Hand injuries are prevalent, accounting for 5.5% of trauma cases globally, with industrialization and motorization increasing their incidence in developing nations like India. Occupational hazards in unregulated sectors significantly contribute to hand injuries, often affecting young, economically active individuals. Traumatic upper limb amputations are rare but life-altering, necessitating advancements in surgical techniques like replantation and structured rehabilitation programs to restore functionality and improve quality of life. **Method** This case report examines the rehabilitation of a 21-year-old male who sustained a nearly complete distal forearm amputation from a machine injury. Following immediate hand replantation surgery and subsequent procedures for tendon repair and skin grafting, patient underwent late-stage physiotherapy interventions, including scar mobilization, joint mobilization, strengthening exercises, tendon gliding, and dynamic splinting. Evaluation measures included grip strength, range of motion (ROM), sensory assessments, and disability scores. **Result** Patient presented with severe stiffness, reduced grip strength (right hand: 2 kg vs. left: 30 kg), and diminished ROM. Sensory abnormalities and significant functional disabilities were noted. Following one month of intensive physiotherapy, including dynamic splinting, scar mobilization, and strengthening exercises, patient demonstrated improvements in grip strength, ROM, and overall hand function. Intervention addressed contractures and enhanced tendon mobility, facilitating functional recovery. **Conclusion** This case highlights the critical role of structured rehabilitation in hand replantation recovery. Early initiation of active and passive exercises, scar management, and dynamic splinting significantly improved functional outcomes, supporting evidence that modern surgical techniques combined with intensive physiotherapy yield predictable success rates.

Keywords: Hand Rehabilitation, Hand Replantation, Physical Therapy, Amputation

INTRODUCTION

From total trauma patients with road traffic accidents and machines as the most typical modes of injury, Hand injury accounts for 5.5%. Hand injuries are common in developing countries such as India due to the recent increase in industrialization and motorization. In 2001, the Registrar General of India showed that 82.2% of the employed population works in unregulated sectors like manufacturing, retail trade, agriculture, etc, while only 17.8% works in an organized sector. This lack of safety measures has been well documented as an independent risk factor of occupational injuries. The patients studied for hand injuires had a mean age of 28 years. Whereas a study done in North India evidenced a mean age of 31.13 years of population with hand injuries. Most of the categories affected by hand injury as found in North India were agricultural workers (27.86%), labourers (23%), Students (23%), and service class (9.84%).[1] Injuries proximal to the carpus, from a major traumatic amputation of the upper limb, which is a rare but life-altering event. According to the survey of National Trauma Databank, 0.09% of persons

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hospitalized after trauma sustained a major upper limb amputation[1] and 34,000 people are living with a major amputation in the metropolitan cities.[2] Formulation of strategies for limb management, limb salvage and rehabilitation for such patients can be done by knowing the causes and patterns of trauma-related amputations.[3] Trauma-related amputations are more in the developing countries, while peripheral vascular disease and diabetes are the leading cause of amputation in developed countries.[3] The prevalence rate of amputees is estimated to be 0.62 per 1000 population of India as per the national report in 1981.[3] Machine injury and workplace accidents mostly lead to upper limb amputations. Generally, a smaller zone of injury, usually from a sharp amputation, results in a more successful replantation. [2] Moreover, any formal data concerning its incidence and change over the last decade are not available online and in any published literature. [3] When a traumatic upper limb amputation takes place, definitive treatment must be emphasized on providing the patient with the maximum level of function possible. [2] Replantation is as a surgical procedure of reconstruction of neurovascular and musculoskeletal structures, seeking the recovery of an amputee segment of the body. [4] Traumatic limb amputation is considered to be a sudden and emotionally devastating posture and a catastrophic type of injury. [4] Late functional outcomes between major upper extremity amputation and replantation at an average of 7.3 years post injury, was compared by Graham and his colleagues. In their study, the Functional outcomes were determined using the Carroll Standardized Evaluation and Integrated Limb Function, which assessed a person's ability to perform simple and complex tasks. 22 major upper limb replantation were compared with 22 similar level amputees with prostheses, and it was found that the functional abilities of the replantation group were significantly better than the prosthesis group.[2] Advances in modern microsurgical technology and a clearer understanding of tissue healing in response to trauma has resulted in a reasonably predictable success rate with replantation of an amputated limb. Using the most common parameter, survival of the replanted extremity, the success or failure of this procedure has been evaluated, which has been reported to between 80% and 94%. [4] A well-structured rehabilitation program is essential for proper functioning of the replanted hand. So, this case report aims at exploring a rehabilitation program for a replanted hand.

HISTORY

A 21-year-old right-handed male patient sustained an injury when his dominant hand was caught in a cutting machine, he was cleaning. A bandage was applied and he was brought to the hospital where he arrived within 1 hour of injury in an unconscious state. His right forearm was bandaged and tunicate was applied as the forearm showed evidence of crush injury, (fig 1). The patient was then sent to Sancheti Hospital, Pune with an amputated hand in a polythene bag placed inside a plastic box filled with ice. Hand replantation was performed on the amputated part by an orthopedic hand surgeon. After one month, tendon repair and skin grafting procedures were done with a gap of one month respectively. Postoperatively patient received only 4 physiotherapy sessions once a week, as accessibility was an issue, almost 5 months after surgery the patient visited a tertiary care hospital in Ahmednagar and was referred to the physiotherapy department with complaints of pain around the suture site with severe stiffness in the wrist and fingers. The patient reported a desire to do activities of daily living for independent living status. The patient provided informed consent for the retrospective review and subsequent professional presentation of his treatment case.

Fig.1

Hand therapy examination

On examination, the patient complained of throbbing pain around the scar which was intermittent in nature, and severe stiffness in the wrist joint and fingers of the right hand. Combined finger flexion was 6 cm with scale measurement, fig of 8 measurements revealed a 2 cm difference compared to left wrist joint. (Right- 48cm, left -46cm). A Keloid scar of 14 cm in length on the anterior aspect of the forearm was adherent. The patient had severe weakness of flexors and extensors of wrist and hand muscles, with the cylindrical grip strength right – 2kg & left- 30 kg, pinch grip strength -0kg on the right and 1 kg on the left measured with a hand-held dynamometer. As some of the carpal bones were removed as shown in the x-ray (Fig. 5), it was a pseudo-wrist joint with an altered contour of the wrist. When the sensory examination was performed patient reported hyperaesthesia on the palmar aspect in the C5 to C7 dermatomal area whereas the dorsal aspect of the hand showed diminished sensations in the C5-C8 dermatomal area as compared to the left extremity. The disability of shoulder and hand questionnaire scored 76.7/100 which is a severe disability for the patient

Fig.2

Fig.3

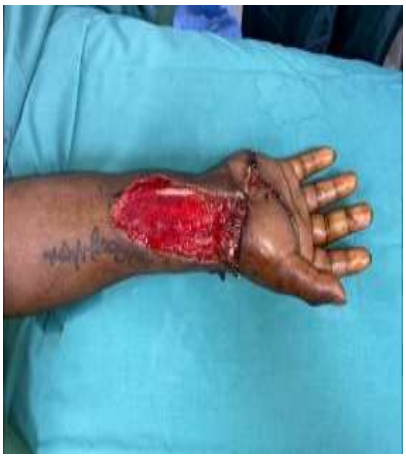

Fig.4

Fig.5

Fig.6

Physiotherapy intervention

Physiotherapy intervention included scar mobilization, Maitland joint mobilization grade 1 & 2 for MCP, PIP, and DIP joint of the right hand, grip strengthening exercises including ball squeezing activity, finger extension with rubber band, paper holding and finger pulley exercises and gripping with Thera putty. For prevention of hand contracture hand positioning was done using a dynamic splint shown in Fig 7. The patient was also given the tendon gliding exercises with the purpose of isolating the glide of FDP and FDS to improve finger movement. Gentle passive stretching for flexors of hand and wrist.

Fig.7 Dynamic splint

DISCUSSION

Comprehensive rehabilitation of a replanted hand depends on the patient's needs and available facilities. This case report demonstrated how rehabilitation provided a basic return to activity and facilitated the functional restoration of the replantated dominant hand of a 22-year-old male. Sarah M et al did a case study on the rehabilitation of a patient following hand replantation after near-complete distal forearm amputation. They treated the patients with hand therapy for a 13-month period. They divided treatment into 3 phases. In 1st phase (2 weeks-5weeks) of rehabilitation, consisted of AROM, PROM, pain management, oedema control, orthotic intervention, tendon gliding exercise (TGEs), gentle stretching, and intense home exercise program. They proceeded for phase 2nd (5weeks- 7 months) all the phase 1 exercise included along with Intensive AROM and TGEs were employed to minimize tendon scarring at the wrist and digits. Attention was given to optimizing wrist position for digital motion, specifically 30-degree wrist extension to maximize digital flexion. An additional desensitization tool was initiated consisting of three textured dowels (cotton, velvet, sandpaper), which were gently rolled over the sensitive skin of the healed incision for 2 min. Phase 3 (7 month – 12 month) included all the progressive exercise of phase 2.[5] Factors contributing to the patient's positive outcomes include, having immediate access to a specialty hospital for replantation by an orthopaedic hand surgeon, advances in modern technology, and a clearer understanding of tissue healing in response to replantation. The combination of these factors indeed has resulted in a reasonably predictable success rate with replantation of an amputated extremity.[6] successively, importance of improvement of hand replantation depend largely on surgical technique and type of injury.[7] successful recoveries were amputation occurred in narrow areas of injury and the clean cut. If crush and avulsion injury occurs, the return of sensation and regaining ROM is much likely in a limb.[8] According to the evidence, positive outcomes of the functional use of a replanted hand, such as with this patient in our study, have been correlated to the reconstruction technique; appropriate debridement and shortening, stable bony fixation, strengthened tendon repair, quality nerve repair, extensive vascular anastomosis, complete skin coverage and early intensive active rehabilitation.[9] Rehabilitation for this individual included, early TGEs and ROM, which according to the literature has also been found to correlate to positive outcomes for functional use of the hand. Recent studies have indicated that mobilization of repaired tendons can result in a quicker recovery of tensile strength, diminished adhesions, improved tendon mobility, and enhanced tendon healing.

Rehabilitation that involves early active mobility offers advantages such as a diminished need to protect the repair, promoting simplified post-operative protocols and probably earlier return with functional use of the hand.[10] In our study, the patients visited after the 6-month postoperatively with flexion deformity of MCP, PIP & DIP joint of right hand. In our case study, we prescribed the dynamic splint for the prevention of hand contracture of the hand. Scar mobilization increased the flexibility and pliability of the skin, and prevented itching. To increase the ROM of fingers, Maitland mobilization was given and significantly increase in the ROM of fingers was evidenced. In strengthening of hand, grip strengthening exercises were given, including ball squeezing activity, finger extension with a rubber band, paper holding, peg board activity, and finger opposition exercise, and showed significantly improved the strength of hand.

CONCLUSION

This case report described the rehabilitation of a 21-year-old male patient who suffered a nearly complete left distal forearm amputation followed by a hand replantation. Following a protocol focusing on dynamic orthotic intervention, active/passive exercises to improve ROM, grip strengthening, and sensory re-education over the course of a 1-month duration of physical therapy and after the three new surgical procedures introduced throughout treatment, the patient demonstrated a significant functional recovery.

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