Use of Internal Joint Stabilizer after Transradial Amputation and Elbow Instability: A Case Report

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Introduction

Transradial amputations are most commonly indicated after a severe traumatic injury to the wrist or hand. Concomitant elbow injuries such as fractures and/or dislocations resulting in joint instability complicate forearm amputations because elbow function is crucial to recovery time, limb functionality, and potential prosthetic use. We report a case of a traumatic mangled upper extremity requiring transradial amputation with concomitant elbow instability treated with application of internal joint stabilizer and ligament repair. Informed consent was obtained from patient.

Case

This patient is a 75-year-old female with past medical history of schizophrenia who was involved in a motor vehicle accident and sustained a severe left upper extremity injury with significant degloving and a dysvascular hand. (Figure 1A&B) Upon arrival, a CT angiography of the left upper extremity showed no flow of the radial or ulnar arteries distal to the fracture site concerning for arterial injury. The patient was taken emergently to the OR for limb salvage versus amputation. Upon intraoperative exam, there was significant degloving to 80% of the circumference of the distal forearm with complex disruption of the radial and ulnar arteries as well as significant tendon and bony destruction. The left hand showed poor capillary refill and no waveform on any digits with pulse oximetry. A transradial amputation was performed and a negative pressure wound therapy device was applied. The patient was also found to have an ipsilateral elbow dislocation which was closed reduced intraoperatively. Following reduction, the elbow remained grossly unstable. The patient was taken back to the operative room two days later for repeat debridement and negative pressure wound therapy exchange. Due to the patient's age and previous psychiatric history of schizophrenia, the use of an elbow internal joint stabilizer was recommended to facilitate return of range of motion and protected functional use in the setting of loss of the hand. The patient agreed and was taken to the operating room three days later for definitive reconstruction. (Figure 1C) Intraoperatively, proximal avulsion of the lateral ulnar collateral ligament (LUCL) was identified and primarily repaired with a suture anchor. The hinged internal fixator was applied. (Figure 1D) It is the authors technique to place the center axis pin first utilizing the set guides. This is followed by placement of a suture anchor just anterior to the center axis of rotation and axis pin location. Once the fixator position was finalized, the elbow was taken through full range of motion with satisfactory stability achieved. Finally, the transradial amputation was formalized with primary tension free closure. A brief period of immobilization was performed for pain control and then gentle range of motion was initiated. Discharge direct to home under care of family was performed at 7 days following the last surgery.

At 2 weeks post-operative clinic visit, the patient's stitches were removed. She achieved elbow range of motion from 20 degrees to 60 degrees. We recommended she continue to work on range of motion and begin gentle functional use of the arm. At the 6 weeks post-operative clinic visit, the patient reported mild phantom limb pain, but it did not interfere with her daily living. The surgical incision was well-healed, and range of motion was observed from 20 degrees to 110 degrees. X-rays showed stable alignment of the internal joint stabilizer and concentric reduction of the elbow joint (Figure 1E). At the 12-week post-operative clinic visit, the patient reported reduced pain and significant improvements in functional use. Her range of motion had improved with extension to 0 degrees. She was noted to have some difficulty with pronation and supination. At 8 months post-operative, the patient had been fitted for a prosthetic and showed promise with her initial prosthesis training as well as ongoing occupational and physical therapy sessions. She was provided a conventional transradial prosthesis with myoelectric controlled terminal device in order to achieve her functional goals and bimanual tasks.

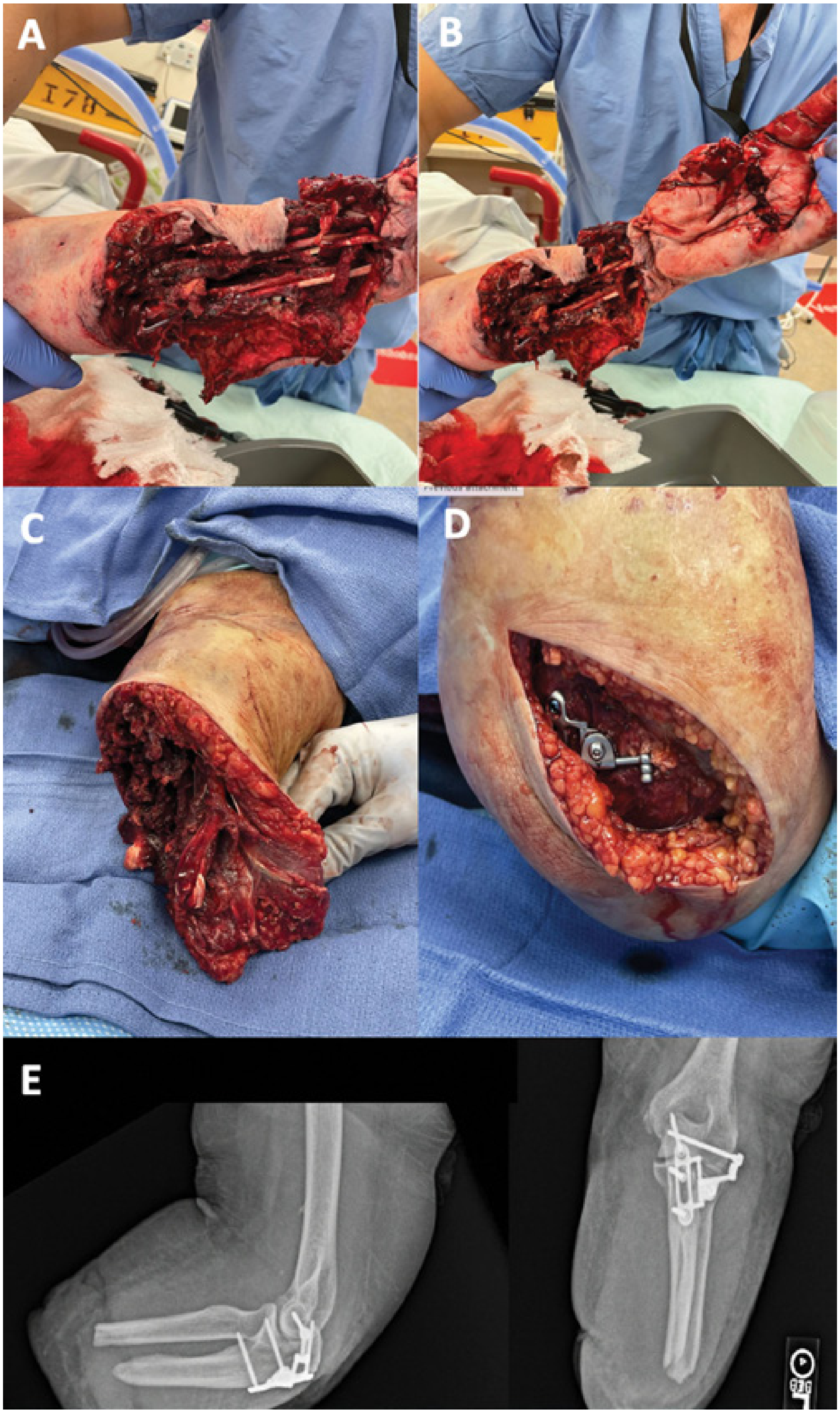

Figure 1. (A&B) Significant degloving injury to the left upper extremity upon presentation to the trauma center; **(C)** Our patient's extremity after debridement and application of negative pressure wound vacuum; **(D)** Placement of internal joint stabilizer in the left elbow; **(E)** Six-week postoperative x-rays demonstrate stable alignment of the internal joint stabilizer and concentric reduction of the elbow joint.

At the 20 months post-operative clinic visit, the patient was wearing the prosthesis at least two hours a day. She was continuing to wear it more and was getting more proficient with it. Occupational therapy was also continued to help improve function.

Discussion

This patient's unique injury combination prompts the discussion of outcomes between transradial amputation and elbow disarticulation. Previous studies favor transradial amputation, specifically distal transradial amputation, over elbow disarticulation with benefits including increased pronation and supination and a more stable lever arm.[14,18] Free vascularized tissue transfers have even been used to preserve upper extremity amputation level and have resulted in improved residual limb function.[1] When an injury warrants a proximal transradial amputation, only 5 cm of residual ulna is needed for use of a non-hinge prosthesis and retention of elbow flexion.[3] This should be a goal when a proximal transradial amputation must be performed. Conversely, an elbow disarticulation loses native elbow flexion which decreases functionality for activities of daily living.[6] Another major concern is cosmetic appearance due to the more distal position of the prosthetic elbow. Because the humerus remains at full length, the center of rotation of the prosthetic elbow must move distally creating an inequality compared to the contralateral side.[20]

The rate of prosthetic acceptance has many attributing factors, some include weight of prosthesis, ease of use, stump-socket discomfort, time between injury and obtaining prosthesis, cosmetic appearance, ipsilateral hand dominance, and shoulder stiffness.[22] With recent technological advancements such as use of myoelectric protheses, 3D printed prostheses, and osseointegration techniques, some of these issues have decreased significantly.[2,19,20] This is crucial as patients that are more satisfied with their prosthesis have higher perceived functionality of the limb and lower rates of prosthesis abandonment.[24] Other factors to consider are hand dominance as patients are more likely to use a prosthesis on their dominant side; and time between injury and obtaining the prosthesis as a prolonged period of time increases abandonment.[14,16,24] Prosthesis training with occupational or physical therapy also has an impact on prosthesis rejection suggesting individualized training is also important.[13]

Most of the literature on elbow disarticulations includes it with other types of upper extremity amputations making it difficult to solely compare elbow disarticulations with transradial amputations. One of the few studies was by Dudkiewicz et al who found that 50% of patients with elbow disarticulations used a prosthesis.[5] Conversely, a review by Tintle et al reported a rate of transradial prosthesis use of 80% to 94%.[21] This high rate of prosthetic use has been mirrored in other studies as well.[10,16,18,22] This is likely due to the more mechanically advantageous lever arm that allows for generation of greater torque in a transradial amputation.14

Phantom limb pain is a complex phenomenon and is a major reason for prosthetic rejection in elbow disarticulations and transradial amputations.[5,21] However, this chronic pain did not seem to impair functional prosthesis wear or the ability to return to work for transradial amputees as they have the highest percentage in return to work when compared with elbow disarticulations or transhumeral amputations.[6,20-22] There is a wide range of mechanisms that have been described attempting to explain the pathophysiology, but there is still no clear explanation to the cause of phantom limb pain.[7] Despite our patient reporting mild symptoms related to phantom limb pain, this did not interfere with prosthesis application.

The schizophrenic population is known to have an increased risk of postoperative complications and lower functional outcomes after a surgical procedure in general.[4,9,11] Mental health plays a crucial role in outcomes after orthopedic injuries specifically affecting progress with physical therapy mentally and physically in order to achieve good functional results.[8,23] This aspect of our patient's past medical history in addition to her advanced age facilitated our decision to proceed with a transradial amputation and use of an internal joint stabilizer over an elbow disarticulation. The use of a hinged internal fixator to stabilize the elbow joint by maintaining concentric reduction during elbow motion allowed for more protection during early range of motion exercises decreasing time spent in a splint.[12,15,17] Our patient was able to perform early elbow motion and began using the residual limb sooner than if alternative treatments had been pursued. This advantage contributes to the early functional use of the residual limb as well as potential fitting and use of a prosthesis.

Conclusion

Thus, we describe a viable option for treatment of traumatic upper extremity injury requiring amputation with associated elbow instability. We utilized a technique that maintained as much length of the residual extremity as possible while using an internal joint stabilizer to promote early elbow range of motion and functionality. In the setting of advanced age and psychiatric illness, this may have decreased chances for complications and increased her likelihood of functional use.

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