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A Rare Case of Traumatic Forequarter Amputation of the Upper Extremity: Treatment Course and Outcome

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ABSTRACT

Traumatic Forequarter Amputations (FQA) are exceedingly rare and carry major functional and psychosocial consequences. This report describes the emergency replantation of a 22-year-old male who sustained a complete interscapulothoracic amputation of the right upper extremity after his arm was caught in an industrial waste compactor. He arrived 62 minutes post-injury hemodynamically stable, with sharply demarcated wound margins and minimal contamination. CT imaging confirmed complete amputation with fractures of the clavicle, scapula, humerus, and a rib, along with a transected subclavian artery, hemato-pneumothorax, and extensive soft-tissue emphysema.

Given the mechanism, short ischemia time, minimal limb destruction, and immediate availability of a multidisciplinary surgical team, emergency replantation began 122 minutes after injury. Parallel preparation of the thoracic stump and amputated limb minimized warm ischemia. Revascularization was achieved using long autologous venous interposition grafts, with total ischemia time of 348 minutes. Skeletal fixation included intramedullary humeral nailing and plate arthrodesis of the acromioclavicular joint. Early complications included reperfusion syndrome requiring hemofiltration and venous graft thrombosis requiring revision. Secondary reconstruction involved extensive nerve grafting, corrective clavicular osteotomy, and suprascapular neurotization. Rehabilitation emphasized edema reduction, preservation of passive mobility, and neuromuscular stimulation.

At follow-up, the replanted limb survived with coarse sensory recovery but absent motor function, aligning with outcomes typically reported for shoulder-girdle-level replantation. This case highlights that, despite limited functional expectations, forequarter replantation may provide meaningful psychological and body-image benefits and remains a viable option in carefully selected patients with minimal tissue destruction and short ischemia times.

Keywords: Forequarter amputation; Replantation; Traumatic amputation; Upper limp; Brachial plexus injury; Scapulothoracic dissociation

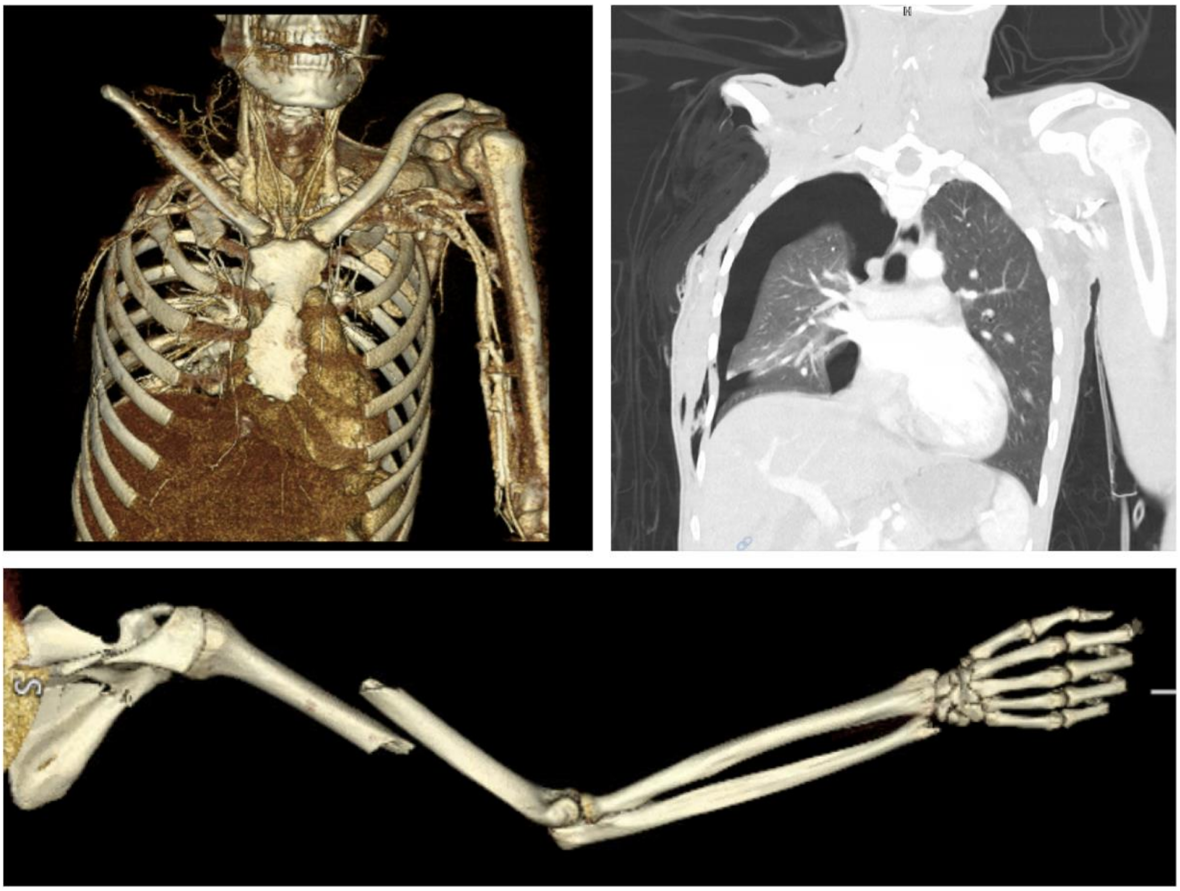
CASE REPORT

History and clinical presentation

A 22-year-old male sustained a traumatic interscapulothoracic forequarter amputation of the right upper extremity, including the scapula, after his arm was caught in an industrial waste compactor. He arrived 62 minutes post-injury alert and hemodynamically stable (GCS 15, BP 137/81 mmHg, HR 63/min). Endotracheal intubation, thoracic drainage, and arterial line placement were performed. The clavicle protruded at the amputation level. Despite transections of large vessels, no major hemorrhage occurred. The amputated limb had been disinfected and transported sterile, with sharply demarcated, uncontaminated wound margins. Humeroscapular musculature was mostly preserved, while thoracoscapular insertions were sheared from bone.

Imaging and diagnosis

CT confirmed complete interscapulothoracic amputation with: (1) a clavicular shaft fracture (AO 15.2A) remaining on the thorax with AC-joint exarticulation; (2) a scapular body and acromion fracture (AO 14By); (3) a humeral shaft fracture (AO 12A2); (4) subclavian artery transection distal to the thoracodorsal branch; (5) right hemato-pneumothorax; (6) 6th-rib fracture; (7) marked thoracic soft-tissue emphysema (Figure 1a-c).



Figures 1: Computed tomography image of the injury with (a). 3D reconstruction of the thorax, (b). representative coronary section showing pneumothorax, and (c). 3D reconstruction of the amputation with scapula and humerus shaft fracture.

Therapeutic decision

Given the sharply transecting mechanism, short ischemia time (71 minutes), young age, stable condition, and immediate availability of a specialized microsurgical team, emergency replantation was indicated.

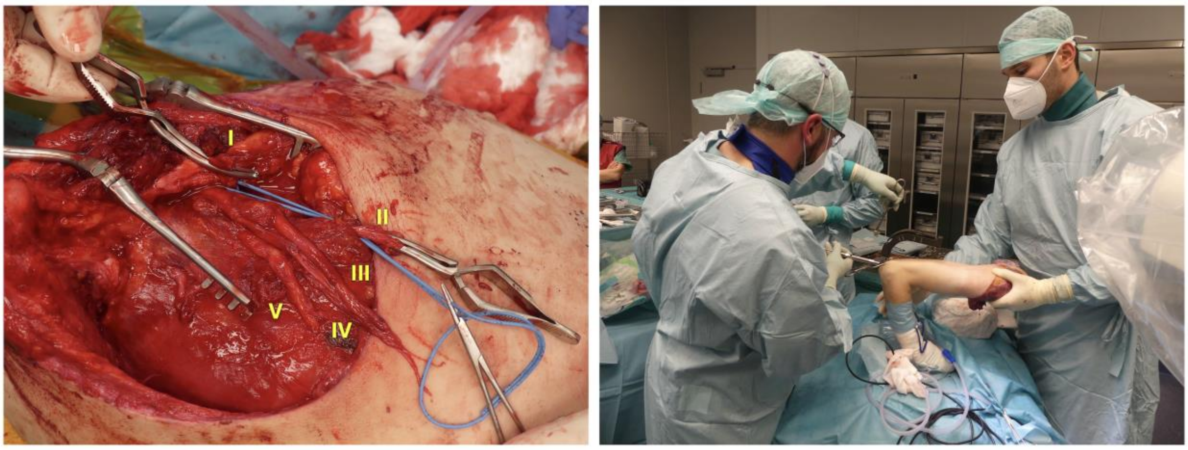
Acute phase – replantation and vascular reconstruction

Surgery began 122 minutes post-trauma. The patient was placed in left lateral decubitus; the right leg was prepared for venous graft harvest. The amputated limb was cooled (Figure 2a-c). Two teams worked simultaneously to minimize warm ischemia.

Figures 2: Clinical site with patient positioned on left side, viewed (a). From the front and (b). From the rear; (c). Amputated limb stored in a sterile ice water cushion.

Thoracic stump preparation

Vascular stumps were exposed, refreshed, debrided, and flushed with heparinized saline; vasospasm explained minimal blood loss. Brachial plexus fascicles showed traction injuries precluding primary repair (Figure 3a). The great saphenous vein was harvested for grafting.



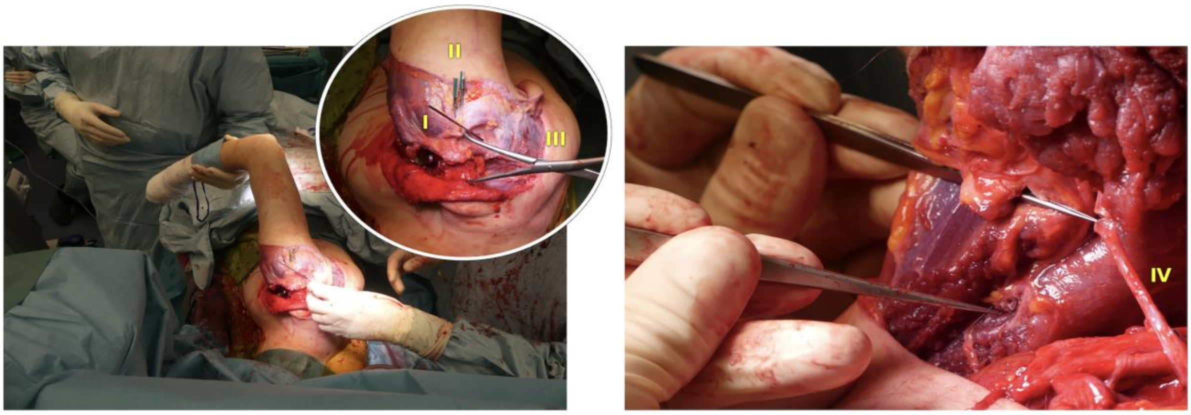
Figures 3: (a). Site of the patient's amputation zone (I – subclavian vein, II – subclavian artery, III – medial fascicle, IV – posterior fascicle, V – lateral fascicle), (b). Retrograde insertion of the humeral nail mounted on the guide arm into the amputation site.

Amputated limb preparation

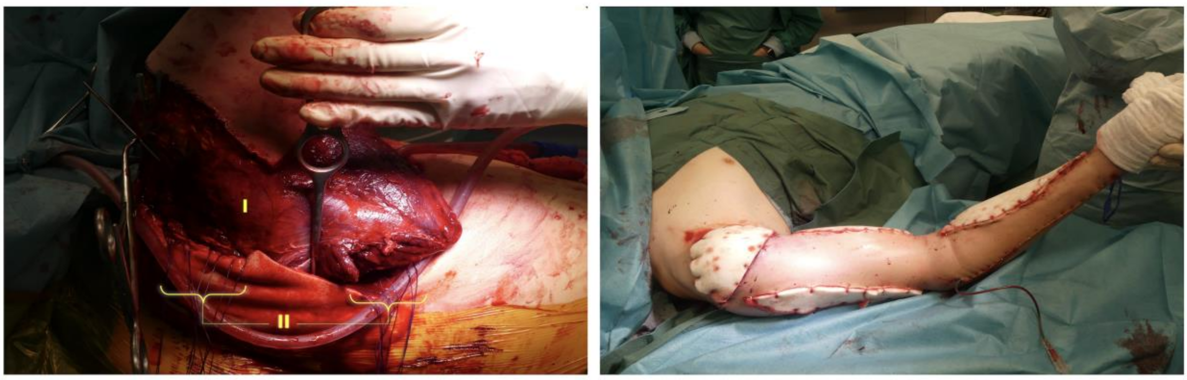
Arterial and venous stumps were flushed. The humeral fracture was stabilized by retrograde intramedullary nailing (Figure 3b). The acromion fracture was reduced and transfixed with a 3.0-mm K-wire.

Replantation procedure

Replantation began 178 minutes after injury. The acromioclavicular joint was reduced, held with a Weber clamp, and fixed with two 3.0-mm K-wires. The amputated limb with scapula was placed into the dorsal wound pocket (Figure 4a,b) and stabilized in slight abduction using a Trimano Fortis system. A 9-cm venous graft was anastomosed retrogradely to the axillary artery, with venous outflow reconstructed anterogradely using another graft. Because the cephalic vein was destroyed, a vena comitans of the axillary artery was mobilized and connected to the cephalic vein via graft. Reperfusion occurred after 348 minutes of ischemia. Definitive stabilization used a lateral LCP 3.5/2.7-mm plate bridging the AC joint and clavicular shaft fracture. Thoracoscapular musculature was reattached with transosseous absorbable sutures (Figure 5a). Prophylactic fasciotomies of upper and lower arm and carpal tunnel release were performed. Skin defects were covered with Coldex sheets (Figure 5b). Total operative time was 465 minutes, with transfusion of 2000 IU heparin, four PRBC units, and three FFP units.



Figures 4: (a). Bony refixation of the amputated limb by transfixation of the acromioclavicular joint (I – K-wire along the crista scapulae to fix the acromion fracture, II – two K-wires through the AC joint, III – spanning Weber forceps), (b). Reconstruction of the subclavian artery with (IV) autologous vein interposition graft.



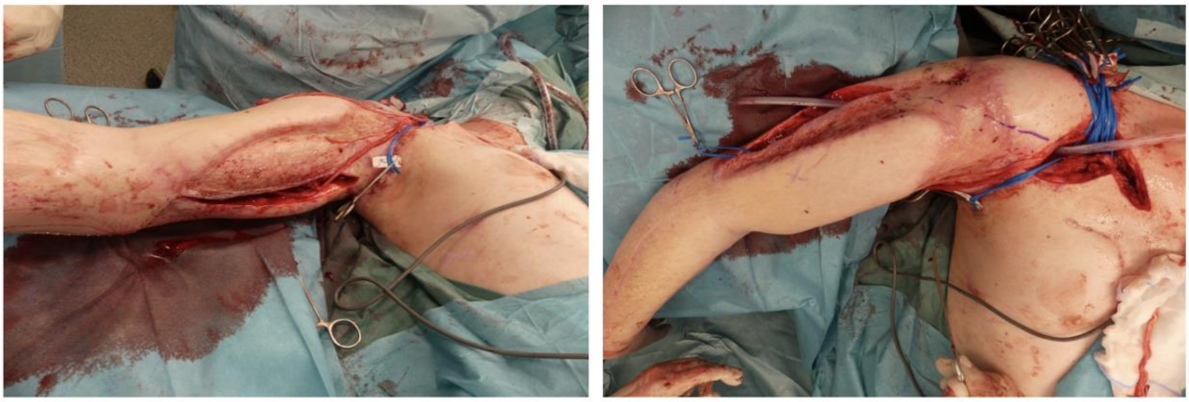
Figures 5: (a). Refixation of the thoracoscapular musculature (I – scapula, II – transosseous sutures), (b). Clinical picture at the end of surgery with Coldex coverage of the armpit and the wounds after compartment division.

Postoperative course

Hourly perfusion checks were performed with the limb elevated. Reperfusion syndrome (hyperkalemia, metabolic acidosis, rhabdomyolysis) required temporary hemofiltration, but perfusion stayed adequate despite swelling. A venous interposition-graft thrombosis caused diffuse lividity with preserved capillary refill; on postoperative day 6, thrombectomy and axillary vein reconstruction using a great-saphenous-vein graft were performed. Wound debridements were required on days 10, 17, 19, and 24. On day 39, the remaining axillary defect was reconstructed with a pedicled pectoralis major flap and split-thickness skin graft.

Secondary phase – nerve reconstructive procedures

At three months, the lateral fascicle received two 16-cm grafts to the musculocutaneous nerve, and the posterior fascicle three 35-cm grafts to the radial nerve. Median fibers were restored via a vascularized ulnar nerve graft from the medial fascicle. Bilateral sural and saphenous nerves were harvested, and a corrective clavicular osteotomy with plate fixation was performed. At six months, distal coaptation of the vascularized ulnar graft to the median nerve was completed, followed by suprascapular nerve reconstruction using a 14-cm superficial peroneal nerve graft for neurotization of supraspinatus and infraspinatus (Figure 6a,b). Management included anticoagulation, structured physiotherapy, manual lymphatic drainage, and multimodal pain therapy.



Figures 6: Intraoperative site with (a). Nerve grafts placed on the skin surface as needed and medial access for locating the proximal nerve stumps, as well as (b). Transclavicular access to the plexus region and lateral access for radial reconstruction.

Figures 7: (a). Three-year follow-up: clinical appearance of the replanted right upper limb and (b). Functional comparison showing elevation of the contralateral (healthy) arm.

Tertiary phase – rehabilitation

After six weeks of hospitalization (two in intensive care), the patient began inpatient rehabilitation. The right arm showed marked lymphedema, complete flaccid paralysis, and absent sensation. Multimodal therapy (lymphatic drainage, compression, ultrasound, electrical stimulation) reduced lymphedema and preserved passive range of motion. Around seven months post-trauma, first reinnervation appeared as diffuse sensory recovery with persistent motor paralysis, while shoulder mobility remained fully maintained.

DISCUSSION

Major upper-limb amputations are rare in industrialized countries, with a European prevalence of 11.6 per 100,000 for amputations proximal to the elbow [1]. Forequarter Amputations (FQAs) are the most proximal and least common type. Traumatic FQAs with avulsion of arm, clavicle, and scapula have major functional, psychosocial, and occupational consequences. Only few successful replantations have been reported, mostly in children with preserved anatomy and short ischemia time [2,3]. Complete avulsion of brachial plexus roots remains a major challenge, often requiring secondary nerve grafts, neurotization, or tendon and muscle transfers. Replantation is considered when functional recovery, physical integrity, psychological benefit, and limb condition justify it; contraindications include severe contamination, destructive crush injury, ischemia over 6 hours, life-threatening trauma, or limited rehabilitation potential [4]. Outcomes vary widely: Sabapathy et al. reported useful elbow flexion, moderate shoulder elevation, limited finger motion, and coarse sensation after a 4.5-hour ischemia [3], whereas Venkataram et al. required reamputation after 8 hours due to necrosis and sepsis [5]. Successful upper-extremity replantations average ~340 minutes ischemia [6]. In this case, reperfusion at 5 hours 50 minutes approached the upper threshold.

Proximal replantations typically result only in limb survival and rudimentary sensation; meaningful motor recovery is rare [7]. The outcome here-coarse sensation without motor function-corresponds to expectations for scapular-level replantation. When ischemia is short and tissue destruction minimal, replantation remains reasonable despite long operating times and perioperative risks [8].

FQA results in profound functional, psychological, and biomechanical consequences. The complete loss of the upper limb and scapulothoracic articulation severely limits bimanual activities and prosthetic options, as most patients depend on cosmetic or lightweight body-powered devices with limited function. Targeted Muscle Reinnervation (TMR) and modern myoelectric prostheses can improve control and reduce pain, yet abandonment rates remain high, particularly in forequarter amputees [4,9-12].

High-level traumatic upper-extremity amputation carries a major psychological burden: depressive symptoms occur in up to 51 percent and post-traumatic stress disorder in up to 69 percent, most often within the first-year post-injury [13,14]. Anxiety disorders, other mood disturbances, and substance misuse are also more frequent than in the general population, with proximal amputations posing the greatest risk. Loss of an upper limb at or near the shoulder level strongly affects identity and self-worth, impairing psychosocial adjustment. Early identification, routine screening, and structured psychosocial support are therefore essential [15-17].

As the most proximal form of upper-limb amputation, FQA eliminates glenohumeral, scapulothoracic, and distal function as well as physiological arm swing and load transmission [18]. Resulting truncal imbalance requires substantial compensatory strategies and leads to overuse of the contralateral limb, predisposing to secondary musculoskeletal overload syndromes [19]. Although neuroplastic cortical reorganization and advanced prosthetic technologies including myoelectric prostheses, TMR, and osseointegration offer partial functional substitution, true biomechanical restoration after FQA remains limited [20].

These multidimensional impairments align with the S2k-Guideline on rehabilitation after major upper-limb amputation, which emphasizes the high long-term physical and psychological burden and the complexity of rehabilitation near the shoulder girdle, as well as the limited functional potential of prosthetic fitting and the need for early interdisciplinary planning [21].

Replantation success depends on ischemia under six hours [2,3,5,22], efficient operative coordination, stable fixation, radical debridement, long venous grafts, early nerve reconstruction [2,3,5] and intensive monitoring [5]. Despite limited functional recovery, replantation may offer substantial psychological and body-image benefits [2,3,5,23].

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