**Appendix 2: Data tables, FA7391 Preservation of Traumatically Amputated/Avulsed Parts**

**Characteristics of Case Reports and Series**

| **First Author Year** | **Country** | **Study Timeframe** | **Population** | **Preservation Technique** | **Surgical Intervention** | **Outcome measured** | **Main findings for Preservation Technique** | **Main findings for Patient Outcomes** |
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| **Case reports** | | | | | | | | |
| Akyurek 2020 | USA | Presentation to follow up at 4 years | 72-year-old (y/o) female with scalp avulsion when kicked by fallen horse in snow and freezing conditions. | Avulsed scalp left under snow for 4 hours | Reattachment of avulsed scalp with microvascular anastomoses of the superficial temporal artery and vein. | Survival of reattached avulsed scalp. | Unintentional preservation of scalp under snow allowed for replantation; tissue was still soft/pliable after retrieval. | Uncomplicated/complete survival of replanted scalp, normal appearance at 4 years. |
| Borenstein 1990 | Israel | June 1984 and June 1987 | 2 female teenagers with complete avulsion of the scalp and ¾ ears. | Case 1: Scalp with 2 auricles was wrapped in wet gauze and placed in a plastic bag surrounded by ice. Transferred to hospital 2 hours after injury.  Case 2: total avulsion of scalp and left auricle. Preservation technique not included in article. | Replantation of the avulsed scalp with microvascular repair and replantation of the ears. | Survival of replanted scalp; survival of replanted ears. New hair growth; movement of eyebrows. | Total avulsion of the scalp, although associated with significant morbidity, can be replanted successfully with microvascular repair. | Case 1: 95% of the scalp and left auricle survived, and new hair growth, eyebrow movement at 3 months post-op.  Case 2: partial survival of scalp, some grafting required; no survival of replanted ears. Normal hair growth and eyebrow movement at 3 months. |
| Braga-Silva 2016 | Brazil | Not reported | 55 y/o female with amputation of distal ring finger from knife. | Patient presented without amputated part and wound was sutured. After returning home, the amputated finger placed in sealed jar and refrigerated at 4°C for 15 days. | Reposition and flap procedure performed to reattach the amputated fingertip. | Survival of fingertip; function; cosmesis; 2-point discrimination. | Prolonged cooling of amputated fingertip may allow replantation in selected cases although it may be associated with increased risk of infection, necrosis and thrombosis. | Good function, cosmesis and 2-point discrimination at 8-year follow up. |
| deLagausie 2008 | France | 12/2000 - 2008 | 4 y/o male with traumatic amputation of penis. | Placed in ice without direct contact. | Replantation. | Survival of replanted penis. | 6 hours cold ischemia time. | Total ischemic time 6 hours between amputation and replantation. Normal function at 8 year follow up. |
| Dvořák 2020 | Czech Republic | Not reported | 38 y/o male with traumatic avulsion of the left ear. | Ear wrapped in moistened gauze and stored on dry ice, arrived frozen/rigid. | Replantation/revascularization performed despite initial freezing of ear; required subsequent debridement and reconstruction due to necrosis and infection. | Survival of replanted part; physiologic appearance. | Storage on dry ice and freezing of ear likely contributed to freeze injury with results fully expressed 3 weeks after replantation. No chronic hypersensitivity noted as a result of the freezing injury, but patient complained of cold intolerance. | Successful replantation despite frozen avulsed/amputated ear; long-term outcome: ear slightly smaller/retracted, no pain or hypersensitivity, patient satisfied with result but had cold intolerance of ear. |
| Elsahy 1974 | Canada | Date of case not reported. Follow up at 7 months. | 14 y/o male with avulsed left nasal ala from a dog bite. | Nasal ala was initially lost in a garden for 2 hours then after retrieval taken to hospital where it was immersed in saline and refrigerated at 7°C for 2 hours before surgery. | Replant with composite graft. | Survival of graft. | No preservation of the tissue for the initial 2 hours followed by immersion in saline at 7°C; Tissue survived replant/graft. | Successful grafting 4 hours after injury following 2 warm ischemia and 2 hours cold ischemia; initial discoloration of the graft without necrosis but by 7 months normal skin color. Author attributes complete success to lack of debridement. |
| Facio 2015 | Brazil | Not reported; Follow up at 8 years. | 30 y/o male with amputated penis. | Amputated part not cooled for initial 5 hours after amputation, then stored 1 hour directly in a clean plastic container with saline and ice cubes. | Replantation with microvascular repair | Survival of amputated penis; aesthetic appearance; erectile function, urinary pattern | Total ischemia time was 6 hours including 5 hours warm ischemia followed by 1-hour cold ischemia before successful replantation. | Survival of transplanted penile, slight necrosis of skin at discharge. Effective erectile function, good urinary  pattern, intact penile body and adequate aesthetic acceptance at 2 year follow up. |
| Fernandez-Palacios 2009 | Spain | Mar 2009; Follow up at 3 weeks. | 28 y/o male with left hand amputation while at sea. | Hand stored inside a plastic bag on ice inside an isothermal box; prolonged transport time due to remote (ocean) location. | Hand replantation with revascularization. | Survival of replanted hand. | Replantation was possible at 13 hours post injury because of storage on ice inside a plastic bag, avoiding direct contact with ice. | Post-transplant infection treated followed by recovery at 3 weeks after. No further follow up provided. |
| Firdaus 2017 | Malaysia | Jan 2017 | 8 y/o male with left arm above elbow amputation from motorcycle accident. | “a witness  immediately buys an ice bag from shop nearby  and the amputated part was well preserved.” | Replantation of arm 3 hours post injury. | Circulation. | Cooled with ice – specific description not provided. | Good circulation in the immediate post-operative period (in-hospital). No further follow up described. |
| García-Murray 2009 | Mexico | Nov 1996-May 1997 | 27-year-old female hostage with bilateral ear helix amputations. | Both ears received 2 hours post amputation (2 hours warm ischemia), immediately wrapped in moist gauze, placed in sterile plastic bag, kept inside a bucket filled with ice/water and inside a refrigerator. Checked several times a day for an adequate amount of ice. Ears transported to hospital 3 hours pre-op. | Replantation attempts delayed for 54 hours after incident. | Survival of replanted ears; appearance; sensation. | After initial 2 hours without preservation, 52 hours cold ischemia time (54 total hours ischemia time). | Failed microvascular replantation due to endothelial damage. Successful salvage procedure with reattachment of ears, reconstruction and free flap.  Fourth day: small blisters on the anterior surface; one month: ears normal in appearance.  12 months: almost normal coloration of skin, no residual deformity, normal appearance of both ears, scars are barely visible;  18 months: pin-prick sensation - two-point discrimination at 10mm was present on some areas of both ears. |
| Gunasagaran 2022 | Malaysia | Date of case not provided; 1 year follow up. | 42 y/o female with left thumb amputation from machete. | Amputated thumb found on side of road (unknown time interval after injury), placed in plastic bag with ice cubes. When arrived 2 hours later, ice cubes melted, and thumb immersed completely in ice water. Thumb rewashed with normal saline, wrapped with moist gauze, stored in ice box. | Replantation with microvascular anastomoses and fusion of metacarpal-phalangeal joint. | Successful replantation; opposition, range of motion at interphalangeal (IP) joint, grip/pinch strength, fingertip sensation. | No frostbite or maceration of the amputated thumb noted after storage on ice/ice water. | Successful replantation despite 2 hours storage directly on ice followed by ice water; able to oppose thumb, range of motion at IP joint 5-45 degrees, 22 kg grip strength, normal sensation radial aspect. |
| Henry 2020 | UK | Date of case not provided; 6 week follow up. | 34 y/o male with amputated penis. | No preservation for 15 hours, then put on ice/transported with patient. | Replantation with microvascular re-anastomosis 8 hours after arrival for total ischemia time of 23 hours. | Survival of replanted penis; sensation; erectile function. | No preservation in the case for initial 15 hour (the longest reported warm and total ischemia time for penile replantation); replantation performed despite British Assoc of Urological Surgeon guidelines allow for 4 hours of warm ischemia time and 16 hours cold ischemia time (max of 24 hours). | Survival of penile transplant noted at 6 weeks with return of sensation and spontaneous erection. Epidermal loss over the penile shaft required debridement and skin graft at 2 months. |
| Kyrmizakis 2006 | Greece | Dates of cases not provided; follow up to 6 months. | 2 males, ages 47 and 20 years old with amputated ears. | For both cases: auricle placed in plastic bag with saline, surrounded by ice, transported with patient. | Replantation as composite graft | Survival; complications | Both cases had cooling of the amputated ears by placing in plastic bag with saline, surrounded by ice. Cold ischemia time for case 1 was 4 hours and for case 2, 3 hours. | Case 1 successful replantation as composite graft but required revision at 3 months. No complications at 6 months except 10% decrease in size c/w normal.  Case 2: Survival at 3 weeks successful with composite graft. Revision at 3 months, no complications at 4 months. |
| Li 2020 | China | March 2017 – March 2019 | 3 y/o boy with right leg amputation at knee level after an attack by a psychotic man with a sword. | Initially taken to hospital without any described specific care of the amputated leg (warm ischemia time: 2 hours). Leg then wrapped in saline-soaked gauze, placed in a plastic bag with ice for 400 km transfer to higher level of care. (cold ischemic time <6 hours). | Replantation of leg following resuscitation (2 hours from admission to revascularization). | Survival of replanted leg; motor and sensory function, aesthetic appearance. | Cold ischemia time “much less than 6 hours”. | Patient was discharged 4 weeks after admission and had restored partial motor and sensory functions 6 months after surgery. During follow-ups, the patient underwent sustained rehabilitation and recovered well. Two years after replantation, secondary knee reconstruction was performed and yielded favorable aesthetic and functional improvement. |
| Liang 2004 | China | Jan 21, 2002 – Jan 2003 | 30 y/o male with left ear amputation by knife. | Auricle retrieved from assailant 5 hours after amputation. At hospital auricle cleaned and “preserved in ice” for 5 hours. | Replantation with microvascular anastomosis. | Survival of replanted auricle. | Prehospital: none; Warm ischemia time 5 hours.  In-hospital: cooling “in ice” (cold ischemic time 5 hours) | Successful replantation 10 hours after complete amputation of auricle. One year follow up showed color, contour, temperature similar to right ear except slight less sensitivity to touch than opposite ear. |
| Makki 2020 | Denmark | Dates of cases not reported. | Case 1: 43 y/o male, amputation of 2/3 upper lip by human bite  Case 2: 30 y/o male, ½ upper lip amputated in bicycle-motor vehicle collision. | Avulsed lips both wrapped in saline-soaked gauze and placed on ice in a bag. | Replantation of lip. | Survival of lip replantation. | According to the authors, these cases showed the importance of securing and taking the amputated tissue to the emergency department refrigerated with a view to possible urgent microsurgical replantation as soon as possible within 24 hours. | At the 8-day follow-up, both patients had 100% healed cleft lip and flap survival. At the 12-month follow-up, case 1 had a cosmetically acceptable result with full movement in the upper lip and sensibility still improving. Case 2 did not participate in the follow-up. |
| May 1981 | USA | Date of case not recorded. Follow up to 9 months. | 28 y/o male with amputation of 4 fingers of the left hand from a paper cutting machine. | Digits placed in plastic bag surrounded by iced saline. (Unclear if any cooling of digits occurred before arrival at hospital; patient presented with amputated fingers soon after injury.) | Replantation of all amputated fingers with microvascular repair over 22 hours. | Survival of replanted fingers. | Because of the time required to replant all digits, a cold ischemia time of up to 28 hours was recorded for the final digit. All digits survived replantation. The case suggests that the margin of safety in digit replantation may be greater than previously thought. | Survival of all replanted digits at 10 days post-op and no skin blistering. All digits survived at 9 month follow up. |
| Musa 2016 | Nigeria | Date of case not reported. | 15 y/o male with avulsion of penis from a grinding machine, with scrotal laceration and devitalized tissues. | Initially taken to local hospital and resuscitated. Amputated penis wrapped in gauze at hospital and sent with patient to higher level of care, arrived 30 hours after the injury. No cooling of amputated tissue. | Skin grafting to penis and scrotum with scrotoplasty at 8 days. | Ability to urinate; skin necrosis of graft. | Replantation not possible as penis mummified at 30 hours post amputation | Patient who presented about 30 hours after injury with the penis mummified precluding reimplantation of the amputated penis. |
| Salem 2009 | Egypt | Date of case not provided. Follow up to 3 months. | 23 y/o man with penile amputation. | Amputated penis kept dry in plastic bag, double bagged in a contained with ice and slush for 2 hours. | Replantation and reconstruction of amputated penis. | Survival of replanted penis, doppler ultrasound, erectile function. | 2 hours cold ischemia prior to arrival at hospital, 5-hour surgical (warm ischemia) time. | Successful outcomes reported at 2 months (distal doppler flow, erectile function, urinary flow, cosmesis). |
| Selmi 2018 | Turkey | Date of case not reported | 11 y/o male with traumatic amputation of right testicle from bicycle. | Testicle found in muddy water, cleaned with soap/water, placed in jar of water for 2 hours before seen at emergency department. | Inguinal exploration and suturing of scrotum. | N/A | Testicle not replanted due to transportation and preservation conditions. | No testicular replantation attempted. |
| Szlosser 2015 | Poland | Date of case not provided. Follow up to 8 months. | 82 y/o male with trans metacarpal amputation of 4 fingers by circular saw. | Amputated fingers "cooled" and "stored appropriately” 3 hours prior to arrival at hospital. | Replantation and revascularization. | Survival of replanted fingers. | 3 hours cold ischemia minimal; 4 hours warm ischemia (OR) time. 2/4 amputated fingers were replanted and at 8 months had minimal movement. | 2/4 amputated fingers were replanted and at 8 months had minimal movement; however, because the thumb was uninjured, hand grasp was preserved by the replantation. At 8 months follow-up,  an active range of motion of replanted fingers was 45° (mostly in the MP joints – a total grip strength of the hand 8kg (32% of the other side) and the Quick Disabilities of the Arm, Shoulder and Hand (DASH) score of 24. Patients’ post-op course was complicated by pneumonia. The patient was satisfied with the result. Age alone should not be an absolute contraindication to finger replantation. |
| Usui 1979 | Japan | June 1974 – July 1978 | 14 y/o male with left distal 1/3 leg amputation from a mower. | Cooling of the amputated part in ice water; 5-hour transportation time to the hospital. | Replantation/revascularization of leg. | Survival of replanted leg, cosmesis, function. | Successful replantation of this child's lower leg was attributed to the patient’s youth, ideal conditions for nerve repair, and the preservation of the amputated part in ice water. | Follow up over 4 years reported no joint contracture or deformity and the child was able to walk and run as fast as other children his age. The success of the replantation was attributed to the patient’s youth, ideal conditions for nerve repair, and the pre-arrival preservation of the amputated part in ice water for the 5-hour transportation time to the hospital. |
| Wei 1988 | Taiwan | May 1985 | 24 y/o female with complete amputations of her right thumb, index and middle fingers and left thumb through small finger by a paper cutting machine. | Prearrival: All 8 digits wrapped in normal saline-soaked gauze and preserved in an ice bag; 76-hour transportation time to the hospital. | Replantation and revascularization of left thumb, index finger and right thumb. | Cold ischemia times; Survival of transplanted fingers; cold intolerance; function | Transport time to a hospital from a remote island location was 76 hours, and total cold ischemia time were 84, 86 and 94 hours for the left thumb, right thumb and left index finger, respectively. Cold ischemia times were 84, 86 and 94 hours for the left thumb, right thumb, and left index finger. | All replantations were successful and at 8 months post-op there was no cold intolerance, and the patient was able to perform most routine household tasks. |
| **Case series** | | | | | | | | |
| Berger 1977 | Austria | June 1974 – July 1976 | 33 patients with 68 amputated parts, 41 considered incomplete. | This review did not describe the pre-arrival method of preservation or cooling except for 4 cases they described as improper first aid contributing to failed replant procedure:  - Liquid-filled glass (1)  - Floating in ice water (1)  - No cooling (2) | Replantation and revascularization. | Survival of replanted part. | Although improper preservation techniques were attributed to failure to attempt replantation in 4 cases, this review did not describe the specific pre-arrival method of preservation or cooling, except for 4 cases described as improper first aid contributing to failed replant procedure. In 9 of 11 cases, a functional replantation was not achieved; storage technique of the amputated part and injury mechanism were seen as the cause. | Warm ischemia time of more than 8 hours felt responsible for failure of replant in 2 cases; Cold ischemia times of up to 12 hours and a warm ischemia time of up to 6 hours considered the limit for replantation, although consideration of injury mechanism and storage technique are both necessary for exclusion of replantation. |
| O’Brien 1973 | Australia | Time period not reported | 8 patients with traumatic complete amputation of one or more digits (total 14 amputated digits). | All amputated digits were cooled as soon as possible after injury by placing them in a plastic bag and then inserting it in another bag containing ice, thus avoiding damage to the digit from contact with ice. Cooling not described for case # 6. | Microsurgical anastomosis of the arteries and dorsal veins, supplemented by procedures needed to re-establish function of the digit. | Survival of transplanted finger; range of motion. | The amputated fingers were "cooled in ice" (n=3), "cooled by ice in a plastic bag" (n=4), and not reported (n=1). For preservation methods linked to replantation failures due to complications, one was "cooled in ice," and one was not reported. | Of 14 digital amputations, 11 survived replantation (83%), with ischemia times of 7 to 14 hours. |