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Penile replantation: report of two cases and review of the literature

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【**Abstract**】Penile amputation and successful replantation is very uncommon, and there is no routine standardized procedures for dealing with this medical condition. Here we report two cases of penile amputation and replantation involving different degrees of vascular insult leading to different pathogenesis, clinical presentation, surgical approach and prognosis. This report described the microsurgical procedure and postoperative care using bipedicled scrotal flap to achieve successful engraftment and function. A review of the published data and future methods to increase success of such surgical procedures is provided.

Key words: ***Penis; Amputation, traumatic; Replantation; Surgical flaps***

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Penile amputation, regardless of the etiology, is a rare injury type. Since Cohen et al[1] described the first microsurgical replantation in 1977, microsurgical repair has become the standard method to treat penile amputations. This report presents two cases of penile replantation after 3.5-15 hours of warm ischaemia before microsurgical replantation. The clinical course, surgical technique and outcomes are presented. The management of complicated penile replantation is also reviewed.

CASE REPORT

Case 1

A 34-year-old man suffered from amputation of the penis approximately 2 cm distal from the pubic area with a sharp knife. He was sent to the local hospital 50 minutes after the event, with the penis placed in a 4°C hypothermic container. And 3.5 hours later the patient was transferred to our hospital. Tetanus prophylaxis was conducted. The removed penis was sterilized with 0.5% povidone iodine solution and then placed in a 1% sodium heparin-saline solution. The severed end of the penile body was doused several times in the solution, and then evacuation of the hematoma was performed by applying gentle pressure on the area of swelling. Nonviable tissue was debrided to allow clear identification of the deep dorsal veins, nerves and arteries. Figure 1A illustrates the amputated penis and the area of injury subsequent to preoperative preparation.

The patient was under general anesthesia, and the remnant portion of the penile body, which was approximately 2 cm long, was ligated with a tourniquet proximal to the base. Sterilization and debridement was performed in a similar manner as for the severed penile body described above. Subsequent to evacuation of the hematoma, the urethra was drawn out approximately 0.5 cm. The deep dorsal vein, dorsal nerve, and dorsal arteries were isolated. A 16F silicone Foley catheter was inserted in a retrograde manner through the severed penis portion, extending inward through the penile remnant and passed into the bladder, followed by an end-to-end anastomosis of the urethra mucosa and the corpus spongiosum using interrupted 4-0 synthetic absorbable suture. The cavernous body of the penis was reattached by suturing the tunica albuginea of each corpus cavernosum to the corresponding proximal segment using 4-0 polyglactic acid sutures. The two dorsal veins, nerve and one dorsal artery were anastomosed under a ×10 microscope with interrupted 9-0 nylon nonabsorbable sutures. Subsequently, Buck's and Colles' fascia was sutured with 3-0 interrupted synthetic absorbable suture to relieve tension, and the skin was approximated loosely with 4-0 PCG sutures.

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Revascularization was established 6 hours after the amputation. After surgery, the tourniquet was released, and the distal penis appeared to be revascularized, presented as gradual increase in redness and size. An arterial pulse was detected, the superficial penile veins displayed normal turgor, and no bleeding was found (Figure 1B).

Postoperatively, the patient was given broad-spectrum cephalosporin (Cefuroxime 1 500 mg twice daily), low-molecular-weight heparin (Nadroparin 7 500 IU/day), narceine (60 mg i.m. four times daily) and Prostaglandin (E1 10 IU twice daily) for 2 weeks. Additionally, infrared lamp irradiation treatment was performed every 24 hours for 2 weeks. On postoperative day 3, the penile skin started to necrotize. On day 12, the necrotic skin was superficially debrided, and a 0.5 cm^2 fistula was observed in the corresponding urethral segment. Two weeks later, the fistula was sutured with 4-0 interrupted synthetic absorbable suture, and a transposition flap to embed the whole injured penis shaft was created from the proximal scrotal skin. The glans was exposed (Figure 1C). Two months after the second operation, the embedded penis was released from the scrotum. At two years follow-up the patient had glans re-epithelialization with normal voiding, sensation, and erections (Figure 1D).

Case 2

A 25-year-old man presented to the emergency room 15 hours after distal penile amputation, which occurred as a result of self-mutilation due to psychiatric problems. The penis had been completely severed 2 cm proximal to the corona, transecting the urethra and the corpora, and devascularizing the distal portion (Figure 2A). A second wound 1 cm from the penis root dorsally severed the penis by two-thirds. The amputated part had been placed in sterile ice saline and accompanied the patient. A tourniquet was applied around the proximal stump to gain vascular control of the proximal cavernosum during surgery. The patient presented with hemorrhagic and traumatic shock. The preoperative and postoperative measures were the same as described in case 1. The urethra mucosa and corpus spongiosum were anastomosed using interrupted 5-0 synthetic absorbable suture. The cavernous body of the penis was reattached by suturing the tunica albuginea of each corpus cavernosum to the corresponding proximal segment using 4-0 polyglactic acid sutures. The two dorsal veins, dorsal artery and dorsal nerve were not anastomosed (Figure 2B). On postoperative day 3, the glans was still pink, with good blood flow after puncture, but the penile skin started to necrotize. On day 14, serious infections were noted, the necrotic skin was superficially debrided, and the amputated penis was relieved.

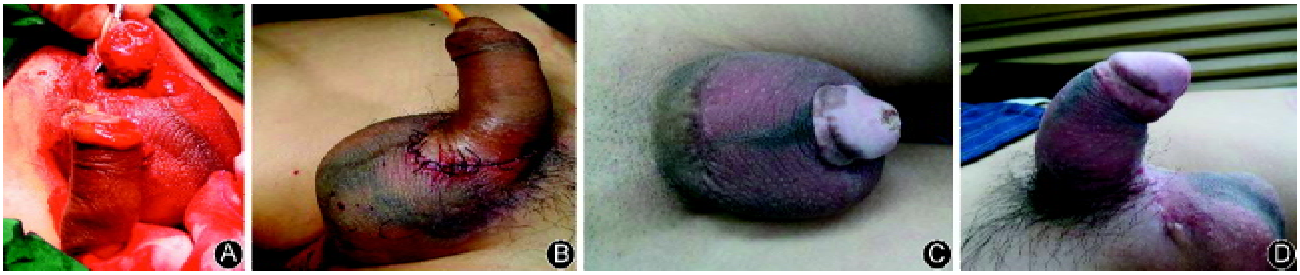

Figure 1. Case 1. **A:** Penis midshaft and stump before replantation; **B:** Postoperative view of replanted penis; **C:** The whole injured penis shaft embedded in the proximal scrotal skin; **D:** Reimplanted penis had excellent cosmetic appearance 2 years postoperatively.

Figure 2. Case 2. **A:** Penis midshaft and stump before replantation; **B:** View of replanted penis postoperatively.

DISCUSSION

Penile replantation was first described in medical literature in 1929. In 1977, the first successful replantation of an amputated penis using microsurgical techniques was reported.[1] In the last decade, numerous successful microsurgical techniques for penile replantation have been described. Due to the rarity of penile amputation, the number of reports dealing with this situation and the postoperative patient care is limited. Evalu-

ation of the relative effectiveness, safety, restoration of penis function, and sensibility of the glans following different treatments for penile replantation is crucial for surgeons.

For organ preservation and preparation of the amputated part of the penis, various preoperative adjunctive measures have been used[2-5] : (1) thoroughly washing the amputated penis with 0.9% saline and placing it in a pressurized hypothermic container at 4°C; (2) wrapping the amputated penis in moist gauze inside a plastic bag sealed within a second plastic bag containing iced slush; (3) placing the amputated part of penis in an ice container; (4) sterilizing the amputated penis and preparing it for anastomosis with 1% chlorhexidine solution, and immersing it in a 1% sodium heparin-saline solution; and (5) irrigation of the amputated penis with normal saline and antibiotics. Successful reimplantation is possible after 16 hours of cold ischemia or 6 hours of warm ischemia.[6]

Before replantation, a suprapubic cystostomy or urethral catheterization is routinely performed. Debridement of nonviable tissue is required to allow clear identification of the veins, nerves, and arteries. In all of the cases, end-to-end anastomosis of the urethra and corpus spongiosum was conducted using interrupted synthetic absorbable suture. Then, reapproximation of the tunica albuginea of the corpora cavernosa was performed. In the end, the Buck's and Colles' fasciae were reapproximated, and the skin was closed. In dealing with arteries, veins, and nerves, there are several choices:[2-5] (1) realignment of the penile structures (urethra, corpus spongiosum, and corpus cavernosum) without anatomizing the blood vessels or nerves; (2) microsurgical end-to-end anastomosis of the dorsal penile artery; (3) creating a distal spongiocavernosal shunt to provide venous drainage for patients whose dorsal vein was severely injured, thus preventing primary reanastomosis with a microsurgical technique; (4) anastomosing two dorsal veins using nylon nonabsorbable sutures; (5) microvascular anastomosis of the deep dorsal vein and one artery; (6) microvascular anastomosis of the deep dorsal vein and the dorsal arteries; (7) anastomosing two dorsal veins, the dorsal artery, and one dorsal nerve using microsurgical technique; and (8) anastomosing two dorsal veins, the dorsal artery, and two dorsal nerves using microsurgical technique. Heretofore, microsurgical anastomosis of the dorsal veins, dorsal artery, and dorsal nerve has been achieved in about 27 cases.

In terms of protecting anastomosis sites and the phallus as well as preserving the amputated part of the penis, various wound care methods can be used postoperatively:[2-5] (1) administration of broad-spectrum antibiotics and heparin or low-molecular-weight heparin; (2) treatment with hyperbaric oxygen; (3) immobilization and protection of the penis by bulky dressing, frames, cages, removal of the penile skin with subsequent burying of the penis in the scrotum, and a subcutaneous tunnel created in the suprapubic area; and (4) use of medical leeches on the penis after nonmicroscopic replantation as a means to augment venous outflow and to decrease edema.

Fifty cases of replantation using nonmicrosurgical techniques and at least 30 cases of replantation by microsurgical technique with varying degrees of reanastomosis of the dorsal vein, arteries, and nerves have been reported. Even after microsurgical replantation, spontaneous erections and the ability to intromit during sexual intercourse with full sensation in the glans are very rare. Of those managed microsurgically, at least 27 cases are successful. Microvascular reconstruction of the dorsal arteries, veins, and nerves is the preferred method of repair for the amputated penis. Adequate erectile function is possible with both microvascular reanastomosis and macroscopic replantation, with more than 50% of men able to achieve erection with either technique.[6] However, complications such as urethral strictures, skin loss, and sensory abnormalities are much higher without microvascular repair. Normal penile sensation is restored in 0 to 10% of patients after macroscopic replantation,[6] whereas in more than 80% of microscopic replantations.[7]

Many factors contribute to good outcomes of penile replantation including the degree of injury, type of injury (crushed, lacerated, or incised), duration of warm ischemia, the equipment used, and experience of the operative team.[5] In this first case, microsurgical replantation was successfully performed with a satisfactory result. This is because this patient presented with a relatively short ischemic time (50 minutes of warm ischemia followed by 3.5 hours of cold ischemia), as well as our ability to clearly identify and successfully join the vital components of the penile structure. In addition,

we used the assistant method of dilatation of blood vessels and antithrobus. The adverse effect observed in our case was skin loss due to necrosis of the proximal part of the penile skin and urethral fistula, probably because we only anastomosed the deep dorsal arteries, a branch of the internal iliac artery, while the external pudendal vessels were not. Due to the dual vascular drainage in the penis, the superficial and deep dorsal veins, tributaries of saphenous and santorini plexus were both anastomosed for good venous return[8]. It may be advisable to anastomose the superficial system also to avoid skin necrosis. In the second case, whose dorsal veins, artery and dorsal nerve were not anastomosed, serious infections were noted, and the amputated penis was relieved. Venous outflow is a critical factor for the success of replantation.[5]

Penile full-thickness skin loss is a significant problem after macroscopic repair. The skin cover of an amputated penis may be necrosed due to various reasons, like prolonged ischaemia, infection or venous congestion following replantation. One effective strategy is to denude the phallus of all skin and bury it in the scrotum, leaving the glans exposed, and separate the structures after 2 months. The use of scrotal flap to treat different kinds of penile defects has been described in previous reports. Kayikcioglu et al[9] used a scrotal advancement flap to treat an urethral fistula following penile replantation and Tillett et al[10] described glanuloplasty with scrotal flap after partial penectomy. However, scrotal flap was only used for reconstruction of patch defects of penis in all the reports. The present report describes the use of bipedicled scrotal flap for the management of extensive and circumferential skin loss after penile replantation. The scrotal skin is thin, redundant and similar to the penile skin in color. Compared with skin graft, this flap provides better skin laxity for erection, superior skin color match and durability for sexual intercourse. The scrotum can provide adequate skin cover for extensive penis defects. In this case, the wound on the donor site could be closed easily and resulted in a hardly visible linear scar. At a follow-up period of 2 year, partial recovery of the sensation of the replanted part was observed after resurfacing with the scrotal flap. The only disadvantage of the flap is the hair on the scrotal skin. However, the patient does not care much about it because the hair is sparse on the central scrotum.

In conclusion, venous outflow is a critical factor for the success of replantation. By reviewing and compiling case reports of microsurgical replantation, we concluded that microsurgical re-anastomosis of the dorsal penile vein, penile arteries, and dorsal nerves can be identified as the standard method for penile replantation. Microsurgical repair is associated with greater graft survival, decreased amount of skin loss, and better erectile function as well as cosmetic results. Individual conditions also play an important role in the success of replantation.

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