We describe a case of complete guillotine-type penile amputation at the proximal penile shaft. The blood flow was established 10 h after trauma. Circulation in the replanted penis was quite good but there was progressive prepuce necrosis after the hematoma. Cosmetic and urinary outcome was good 6 weeks later. The repair of deep dorsal penile vessels helps in corpus tissue healing and glans circulation. The blood supply from the corpus tissue is sufficient for the survival of the replanted penis even when the repaired dorsal vessels were occluded. Surgical pitfalls in replantation procedures and complication management are discussed. ©2008 Wiley-Liss, Inc. Microsurgery 28:000–000, 2008.

Although amputation of the penis is a rare event, it nevertheless requires the best method of repair due to the unique urinary, sexual, and psychological role that it plays in the life of an individual. Penile loss is a unique problem to be addressed both physically and psychologically. Accidental, iatrogenic, and self-inflicted penile amputations have been reported to occur sporadically in the past three decades. In the newborn, injuries to the external genitalia are almost related to iatrogenic events.1 Glanular amputations happened during circumcision surgery. The glans could be accidentally clamped during traction of the prepuce and amputated.2 In adolescents and adult patients, penile amputations were highly related to domestic violence by the patient’s sex partner, pelvic trauma, or self-mutilation injury. Regarding the best urinary function and sexual symbol, microsurgical penile replantation should be performed.3 The viability rate of the amputated penis was directly related to the ischemic time, availability of microvascular technique, and extent of injury. Successful microsurgical replantation gave the best result than any other reconstruction procedure. When vessel diameters are too small or no recipient vessels can be found, glanular composite grafting in distal penile level amputation was reported as a surgical option. It was, particularly, frequently seen in a pediatric group and also gave good results.4 Its success was believed to be dependent on sinusoidal circulation. However, composite grafts can be complicated by skin necrosis, venous congestion, urethral fistula or stricture, and loss or failure of erection.5

We report a male patient with a traumatic amputation at the base of the penis due to domestic violence. This 43-year-old male patient sustained a guillotine-type penile amputation during a family conflict with his wife. His penis was cut from the base of the shaft and the stump was retracted to the pubic area (Figs. 1A and 1B). Only proximal one-fourth of the penile shaft was left on the pubic area. The amputated penis is grossly intact which consist entire prepuce, three-fourth distal the corporal body, and intact glans. Good arterial inflow and back flow was established 10 h after the accident. Four superficial dorsal veins were later repaired to enhance venous drainage. Although the replanted penis was initially without problems it suffered from fluid accumulation several hours after surgery (Fig. 2). At the end of the first week, the color, texture, and circulation of the glans did not change any further, but there was continual prepuce necrosis due to distended hematoma that compromised the cutaneous circulation (Fig. 3). The repaired deep dorsal artery and superficial veins were all thrombotic and removed with necrotic prepuce tissue. All the necrotic prepuce was removed 2 weeks later instead of a skin graft. The glans and corpus tissue healed well without blood vessel nutrients (Fig. 4). Hyperbaric oxygen (HBO) treatment was induced 5 days after replantation to facilitate wound healing. There was no wound infection during the treatment. The patient experienced a good cosmetic result and was discharged 4 weeks later (Fig. 5). No fistula or stenosis developed at the anastomotic site and the foley catheter was withdrawn 6 weeks after trauma. The patient can void well in a standing posture. Postreplantation urodynamic study was normal and the voiding habit was as before. After 1 year follow up, he has a normal-appearing circumcised penis. He states that he is able to maintain erection for intromission and also ejaculation in a climax.
OPERATION TECHNIQUE

Under general anesthesia, the patient was in the supine position and the penile amputee was preparing on another sterile draped table. Neurovascular structures including deep dorsal artery, superficial dorsal vein, and dorsal sensory branch were dissected and tagged with 7-0 nylon. The dissection was moved to the stump to identify the proximal end of dorsal vein and arteries. The profundi central arteries were ill defined and embedded in the corpus carvernosum tissue. The urethra was approximated first in replantation procedures. It was repaired in an end-to-end fashion after passing the 18# Fr Foley catheter as a support. The urethral mucosa and the corpus spongiosum were approximated and sutured with 5-0 vicryl stitches. Next, the tunica albuginea of the corpora cavernosa was approximated in the same manner. Water-tight suture is necessary to decrease the edge oozing after revascularization. Vein graft of 2 cm from dorsal hand was harvested and interposed between the two ends of the artery. The dorsal artery was measured 0.8 mm in diameter and was repaired with 10-0 nylon stitches in an interrupted manner. Filling blood flow into the shrunken penis and a good back flow from the dorsal veins were seen. The vein is bigger in diameter and was repaired in the same manner. There were a total of four dorsal veins repaired for better drainage. The remaining foreskin was brought together covering the replanted vessels and nerves. The patient was transferred to the intensive care unit after surgery, and 5,000 units of intravenous heparin was administered per day. The replanted penis was laid on the dorsal scrotum in the natural mid-axis of the body to prevent any kinking of the penile vessels. Urethral orifice should be released from any pressure from the
foley catheter to prevent the pressure ulcer. The ulcer will result in an unpredictable hypospadia problem after healing.

**DISCUSSION**

The first successful microsurgical replantation of the penis was accomplished by Tamai et al. in June 1976, followed by Cohen et al. in August 1976. Single dorsal penile artery repair in penile replantation is supported in Landstrom’s work. It is agreed that the use of microsurgical technique for penile replantation can give better outcome when compared with nonmicrosurgical technique for penile preservation. Still there is a disagreement regarding the number of vessels to be repaired. Microscopic methods provide better circulation in wound healing and decrease the complications including urethral injury, fistula, and stricture.

Landstrom et al. defined that the penile amputation should be a complete transection from the body without any attachment. In their review, the complication rate after replantation is very high. A total of 16 penis replantations in 28 cases suffered from complications. Fourteen of these 16 cases had prepuce skin necrosis. The possible mechanisms resulting in skin necrosis are prolonged ischemic time, hematoma, or inadequate circulation. In practice, the wound edge oozing into the space between prepuce and tunica albuginia cannot be drained effectively. The foreskin was gradually detached from the shaft deep fascia. Increased pressure compromised the circulation of prepuce and resulted in skin necrosis. In the early era of penile replantation, it was even recommended that the foreskin should be removed in the initial reconstruction procedures, because slough of skin is almost expected because of insufficient blood supply. The suggestion is not well confirmed in the literature after microsurgical techniques are applied. With regard to the very high complication rate of the prepuce necrosis, timing of debridement and foreskin excision in part or in whole should still be closely monitored.

We anatomize one dorsal artery and four dorsal veins in this patient. Deep central artery was not repaired as given by Zenn et al. Ishida et al. recommended the provision of venous drainage as much as possible to reduce postoperative edema and necrosis. Decongestion of the venous system may play a role in improving tissue oxygenation and promoting better wound healing. In our opinion, exudation is also related to the tissue reperfusion injury and tissue trauma that cannot be corrected surgically. The other possible mechanism of hematoma formation is the “sinusoid” tissue character. Ruptured corpora cavernosa is very bloody after revascularization. Achieving a complete hemostasis is very difficult. Multiple drainages, even, delayed primary closure should be an option for surgeons to prevent the hematoma disaster.

On the basis of the above findings, prolonged ischemic time is only one factor in complication formation. On the contrary, the glans, copora spongiosum, and copora cavernosum were healing well during the hospital course and even the repaired dorsal vessels were all thrombotic. We believe the blood flow from corpus tissue is sufficient for the long-term shaft and glans’ survival. Deep dorsal vessels help the replanted penis pass the first week and then the sinusoid tissue can replace its role. The urethra healed in the same rate as the corpus tissue. The successful rate in penile replantation seems to increase by adding more vessels.
Hyperbaric oxygen (HBO) can be used not only in postreplantation venous congestion but in further tissue ischemia. HBO supersaturates the plasma with oxygen that flows in the microcirculation when red blood cells cannot. HBO increases the activity of superoxide dismutase, preserves high-energy phosphates in tissues, and was shown to inhibit xanthine oxidase. These effects reduce oxygen free radicals, reduce cellular gap permeability, and therefore allow endothelial cells in aerobic metabolism. From this patient, HBO seems to enhance wound healing in corpus cavernosum via sinusoid circulation. The viability of the glans was maintained because this tissue may be regarded as a controlled arteriovenous fistula. Bux et al. reported the success of penis replantation is possible simply by soft-tissue reapproximation under HBO treatment if arteries are not available for microsurgical repair. HBO treatment was also a valuable adjuvant procedure to control infection. In our case, HBO also helps to control infection, facilitate wound healing, and promote granulation tissue growth over the denuded penis.

**SUMMARY**

The ultimate goal of penile replantation is to restore a functional and aesthetic penis. Expedient penile reconstruction is essential and therapeutic delay is associated with complications. Microvascular techniques should be used in penile amputation at any level. The replanted penis receives blood supply from deep dorsal vessels in the early stage and could survive independent from these vessels after the continuity of the sinusoid was established 1 week after surgery. Prepuce had better closed loosely or even delay primary suture to prevent the hematoma that compromises the viability of the foreskin. HBO can be a valuable adjunctive treatment modality in such a surgery.

**REFERENCES**