

CHAPTER 10

PENILE INJURIES

GU Tract Structure	Ch 2 Kidney	Ch 3 Ureter	Ch 4,5 Bladder	Ch 6,7,8,11 Urethra	Ch 8,9 Scrotum Testis	Ch 8,9 Spermatic Cord	Ch 8,10 Penis
No. Patients With Injury to Structure	132	36	72	83	199	14	128
% of Total GU Injuries	19.1	5.2	10.4	12.0	32.8	2.0	18.5

GU: genitourinary

INTRODUCTION AND WOUND ANALYSIS

Some variability exists in published reports of casualties of the Vietnam War regarding the incidence of penile wounds. Salvatierra and colleagues¹ report that 16.2% of all genitourinary (GU) tract wounds involved the penis; Busch and colleagues,² 25%; Selikowitz,³ 5%; and, in a published report of genital wounds only, Umhey⁴ reports 8 of 25 (32%) patients with penile involvement. In Japan, primarily at the US Army Hospital, Camp Zama, we authors (JNW and JWW) managed penile injuries in 128 patients, and these constituted 18.5% of all the GU tract injuries. Table 10-1 reveals that 128 of the 452 (28.3%, or > 1 in 4) injuries of the external genitalia involved the penis. When compared with the World War II distribution of wounds to the GU tract,

TABLE 10-1
INJURIES OF THE EXTERNAL GENITALIA

Injured Organ	No. Patients*	Injuries	
		No.†	%
Scrotum–Testis	199	227	50.2
Penis	128	128	28.3
Urethra			
Anterior	48	48	10.6
Posterior	35	35	7.8
Spermatic Cord	14	14	3.1
Total Injuries:		452	100.0

*303 patients seen by the authors during the Vietnam War primarily at US Army Hospital, Camp Zama, Japan

†452 injuries; many patients had injuries to more than 1 organ

the incidence of penile injuries that we treated in Japan during the Vietnam War is similar. Culp⁵ reported penile wounds in 24 (15%) of 160 urogenital wounds managed in Europe during World War II, and Kimbrough⁶ reported 44 penile wounds (18.7%) of 235 genitourinary wounds in his World War II series. Wounds of the penis constituted the second-most-common in-

jury to the external genitalia, the first being the scrotal-testicular wounds. Table 10-2 details the distribution of the 128 penile injuries that we managed in Japan. Of these 128 injuries, 60 were classified as superficial with involvement of the skin, glands, and/or subcutaneous tissue. There were 68 deep injuries, of which 35 involved the corpora alone and 33 others involved the corpora and urethra together. The incidence of urethral involvement of all penile injuries was 33 of 128 (25.8%) in

the Japan series. Salvatierra and colleagues¹ report that 9 of 41 (22%) penile injuries involved the urethra. Fragment wounds were the most common cause of penile injury followed by gunshot wounds. In addition to the wounds, 3 injuries were secondary to blunt trauma and 2 others were from burns.

Approximately 95% of patients with penile injuries had other non-GU tract-associated injuries. Of the 128 patients with penile injuries, 39 (30.5%) had no other associated injury of the external genitalia. In these 39 patients, 31 (79.5%) of the penile injuries involved the glans or were superficial. There were 89 patients who had 1 or more associated injuries of the external genitalia. Superficial injuries were much less likely to be associated with other wounds of the external genitalia.

The diagnosis of penile injuries often was obvious on initial examination of patients injured in Vietnam. Sites of injury were carefully inspected and probed; in doubtful cases, examination of the penile shaft over a catheter proved helpful. Some fragments could be located by palpation, and some urologists used X-ray examinations of the soft tissues of the penis and perineal-genital area to determine the presence and size of metallic foreign bodies.

The primary concerns in the management of these penile injuries were to establish hemostasis and to minimize future deformity. The latter consideration led to a somewhat conservative approach toward debridement. When Buck's fascia was penetrated, anatomical approximation was performed in most cases. In such injuries, however, when the defect was large, to avoid angulation (or in instances of extensive contamination) these defects were debrided and managed by compression dressings. Salvatierra and colleagues¹ noted that bleeding of the corpora could not be controlled by clamping, and this problem was managed by pressure or suture ligation. Umhey states that in his series, "Buck's fascia and the skin of the penis were always closed primarily using chromic catgut in all cases."^{4(p660)} He made no attempt to remove small foreign bodies from the corpora cavernosa.

Salvatierra and colleagues¹ were able to close the skin defects in approximately half their patients. This was to allow for secondary closure at a later date, but they also noted that many of these defects reepithelialized without the need for surgical closure. These patients had placement of indwelling Foley urethral catheters to facilitate pressure dressings and avoid urinary retention secondary to penile edema.

TABLE 10-2
DISTRIBUTION OF PENILE
INJURIES

Category	No. Injuries*
Superficial Penile Wounds	60
Deep Penile Wounds	68
Corpora	35
Corpora-Urethral	33
Total Injuries:	128

* 128 patients total; some patients had > 1 injury

Often, medicated dressings with nitrofurazone gauze (Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ) were employed. Most patients received antibiotics most often consisting of high-dose penicillin, streptomycin, and/or chloroamphenicol sodium succinate (Chloromycetin). Umhey⁴ states that with antibacterial coverage, his infection rate was zero in his 8 cases of penile injuries, and also that small injuries to the glans penis were debrided and either left open or primarily closed.

Early in our Japan experience, we received patients who had extensive tissue destruction from high-velocity fragments with contamination and large, soft-tissue, penile defects; their initial care in Vietnam had consisted of meticulous attempts at skin coverage. This often resulted in subsequent ischemia and tissue necrosis. It was uncommon in our early experience in Japan to see penile wounds being initially debrided and treated open. With increased experience, surgeons in Vietnam initially managed more of these wounds by the open technique. Occasionally, patients had *no* primary treatment of their penile injuries other than the establishment of catheter drainage. This was necessitated by some patients' massive injury to multiple organs; surgeons had little opportunity to manage the less-life-threatening penile wounds. In addition, the need for hospital beds and rapid evacuation often dictated against an involved operative procedure on the penis when the patient had received extensive other life-threatening wounds. This occurred during very busy times like the Tet offensive (Jan–Feb 1968).

The details of the initial treatment in Vietnam of these 60 superficial soft-tissue penile wounds were difficult to discern from inspection of transfer records because often the wounds were relatively minor and the operative notes reflected only the treatment of other injuries to major organ systems. Accordingly, we do not have a statistical assessment of the primary treatment in this group; however, the initial treatment of the 68 soft-tissue deep penile wounds was recorded and is outlined in Table 10-3. Although the majority of patients had debridement and initial primary closure, many others had debridement without primary closure; the wound was treated open with dressings. In 2 patients, debridement with primary closure of corporeal defects was accomplished by utilizing free dermal patch-grafts. Four patients in this group had no treatment because of the urgent nature of their other injuries and the necessity for bed space in Vietnam. We have treatment data on 22 of the 25 patients with wounds of the glans: 9 of the 22 were treated with the open technique and 13 were treated with primary repair (3 of the latter included a primary meatoplasty). In our experience with these patients, meatal stenosis was not an early problem.

TABLE 10-3
INITIAL MANAGEMENT OF DEEP
PENILE SOFT-TISSUE WOUNDS

Treatment	No. Patients
Debridement and Primary Closure	47
Debridement: Open	15
Debridement: Primary Closure of Corpora With Free Dermal Patch-Graft	2
No Treatment	4
Total Patients:	68

* number of patients (60) does not equal the number of treatments (68) because some patients had more than 1 wound

Reports originating from the experience in Vietnam do not reflect any problems with wounds of the penis. The more superficial minor injuries generally healed without complications, and the patients with more major injuries were obviously not followed because of the necessity of evacuation. The 60 superficial penile wounds that we followed in Japan had a relatively low incidence of complications. The incidence of minor superficial skin infections is not known but was not uncommon; however, these infections did not necessitate specific therapy. Also, the patients with burns, 1 of which involved the glans, were not specifically observed for the development of problems.

Table 10-4 lists the more significant complications of these superficial injuries. Penile edema of various degrees was relatively common but 4 patients had rather significant postinjury edema that required local soaks and analgesics. In 2 patients who had retained metallic fragments in the subcutaneous tissue, the fragments were removed by simple excision. One patient had a significant subcutaneous and cutaneous scar with symptomatic adherence of the subcutaneous tissue. This was managed by excision. Two patients had extensive loss of the penile skin that required skin grafting. We had 10 patients with penile injuries who required plastic reconstruction in Japan: 2 with superficial and 8 with deep penile injuries. It is important to note that many of the complications we have reported should perhaps be more appropriately termed "normal sequelae of initial injury and treatment"; their occurrence does not imply inadequacy of the initial management.

The extraurethral complications and deep penile injuries are detailed in Table 10-5. Significant tissue necrosis, gan-

**TABLE 10-4
COMPLICATIONS IN
SUPERFICIAL* PENILE INJURIES**

Complication	No. Patients† With	
	Complication	Treatment
Retained Fragments	2	Excision
Penile Edema	4	Conservative
Scar Contracture	1	Excision
Extensive Loss of Penile Skin	2	Skin Graft‡

*Of the skin, penile soft tissue and glans

†N: 60 patients

‡Scrotal-tunnel and split-thickness skin grafts

**TABLE 10-5
EXTRAURETHRAL COMPLICATIONS IN DEEP PENILE INJURIES**

Complication	No. Patients With Complication	Treatment	No. Patients Treated
Tissue Necrosis, Gangrene, and Infection	12	Debridement, DPC	12*
Chordee With Impotence	2	Prosthesis	1
Chordee With Painful Erection	2	None	2
Retained Missile Fragments	2	Excision	2

*8 patients required plastic reconstruction (see Table 10-6)

DPC: delayed primary closure

TABLE 10-6
PLASTIC RECONSTRUCTION OF PENILE WOUNDS

Depth of Injury	No. Patients With Injury	Reconstruction	No. Patients With Reconstruction
Superficial	2	Scrotal tunnel	1
		STG	1
Deep	8	Penile pedicle graft	3
		Scrotal pedicle graft	3
		Scrotal pedicle and STG	1
		STG	1
Total Reconstructions:			10

STG: split-thickness graft

grene, infection, and tissue loss was noted in 12 patients, who each required debridement and delayed primary closure; 8 of the 12 required plastic reconstruction of the skin. Some of these patients were incompletely treated in Japan because of the severe nature of their other wounds; others received initial debridement and open treatment. Chordee with impotence was noted in 2 patients, and 1 of these patients required 2 operations including the placement of a silastic prosthesis. Two additional patients experienced chordee with painful erections and were untreated in Japan. Retained missile fragments were excised in 2 additional patients.

Plastic reconstruction of penile wounds was accomplished in 10 patients in Japan (Table 10-6). Two had superficial wounds with significant skin loss, 1 of which was treated with a scrotal tunnel and the other a split-thickness graft. Eight of the 10 patients had deep penile injuries that required plastic reconstruction of the penile injuries: 3 were repaired with penile skin flaps, 3 with scrotal-pedicle flaps, 1 with a scrotal flap as well as a split-thickness graft, and 1 with a split-thickness graft taken from the thigh. Seven of the 8 patients with the deep penile wounds that required plastic reconstruction also had urethral injuries (see Chapter 11, Anterior Urethral Penetrating and Blunt Injuries).

CASE REPORTS

Deep Penile Traumatic Injury Involving the Corpora Cavernosa

Case 10-1

C. L., a 21-year-old soldier, incurred fragment wounds of penis and superficial right hemiscrotum 16 September 1969 in the Republic of Vietnam (RVN). The completely transected left corpora was debrided and primarily repaired with chromic catgut and the scrotal injury debrided and closed. The urethra was not injured. His wounds healed primarily and he returned to duty. His main complaint 8 weeks postinjury was marked pain with chordee on erection preventing intercourse. Moderate fibrosis of the left corpus and adjacent tissue was found on examination.

Comment on Case 10-1

The number of patients who had lacerations or other injury to the corpora and subsequently developed fibrosis with significant chordee is unknown. This complication may well be inevitable depending on the type and extent of injury. Perhaps more-thorough initial debridement could have avoided this complication. However, because of the problems of buckling with large corporeal defects, we still endorse the philosophy of minimal debridement and primary repair in this type of injury.

Case 10-2

P. R., an 18-year-old soldier, incurred blunt trauma to the dorsum of the penis from a rocket-propelled grenade on 25 August 1969. His initial signs and symptoms were pain, swelling, and ecchymosis; the patient was not hospitalized. He was subsequently evacuated to Japan 13 September 1969 for persistent localized pain, swelling, and tenderness with severe lateral curvature of the penis. On examination, there was tenderness and induration of the superficial dorsal vein of the penis. The patient was evacuated to the continental United States (CONUS) without follow-up.

Comment on Case 10-2

After the trauma, several patients developed painful swellings in the region of the dorsum of the penis that persisted for varying lengths of time. The specific finding of traumatic thrombophlebitis was seen uncommonly and resolved with time and local therapy. This patient undoubtedly had a more-extensive injury with involvement of the corpora, which resulted in fibrosis of the erectile tissue and tunicae.

Case 10-3

J. W., a 21-year-old soldier, incurred a blunt injury to the dorsum of the penis from discharge of a grenade launcher on 8 July 1968. Initially, he had pain, swelling, and hematoma. The local reaction subsided, but subsequently he could not obtain a satisfactory erection. However, he was able to ejaculate when evacuated to Japan 17 October 1968. Examination revealed marked fibrosis of both corpora cavernosa at the penile base.

Comment on Case 10-3

This is another case of posttraumatic fibrosis of the corpora and tunicae with subsequent interference with erection. Presumably, this difficulty in erection is physiological and due to obstruction of the erectile tissue at the base of the penis. This patient may well need a penile prosthesis at a later date. The emotional impact of these injuries is difficult to evaluate and may well contribute to the impotence.

Case 10-4

P. M., a 23-year-old soldier, received a gunshot wound to the base of the dorsal penis and left corpus cavernosum in 1969. Following debridement and primary repair,

he developed herniation of the erectile tissue at the site of the corpora injury; the defect was subsequently repaired in RVN with chromic catgut sutures. The patient developed a recurrence of the herniation of the erectile tissue as well as penile buckling. He was evacuated to Japan April 1970; reexploration revealed a defect in Buck's fascia in the tunica albuginea. The defective scar tissue was excised back to normal fascia and closed with 00 nonabsorbable polyester sutures. Partial impotence and chordee developed, which required insertion of a penile prosthesis.

Comment on Case 10-4

This defect may well be secondary to inadequate repair of the initial injury. However, because of the angulation created with closure of these defects when the defect is extensive, initial debridement was perhaps justifiably minimal. Another possible reason for this complication might relate to the dissolution of the chromic catgut sutures. It may be justifiable to consider using nonabsorbable monofilament suture in these types of injuries even when there is significant contamination and devitalized tissue.

Penile Injuries Requiring Significant Plastic Revision

Ten patients with penile injuries required significant plastic revision of the skin defects in Japan (see Table 10-6). Case summaries of 5 of these patients are presented.

Case 10-5

E. H., a 36-year-old soldier, was injured in RVN while riding in a jeep on 8 July 1969. A mine explosion caused severe injury to the right lower extremity (necessitating an above-the-knee amputation) and fragment wounds to the head and left leg. The skin of the distal penis was totally avulsed, which was treated with initial debridement of the subcutaneous tissue and open dressing. The patient was evacuated to Japan 1 week later, and after 2 dressing changes to the penile wound and continuous neomycin sulfate soaks, the now-clean penile wound was covered circumferentially by scrotal skin utilizing the scrotal-tunnel technique (Figure 10-1. a,b).

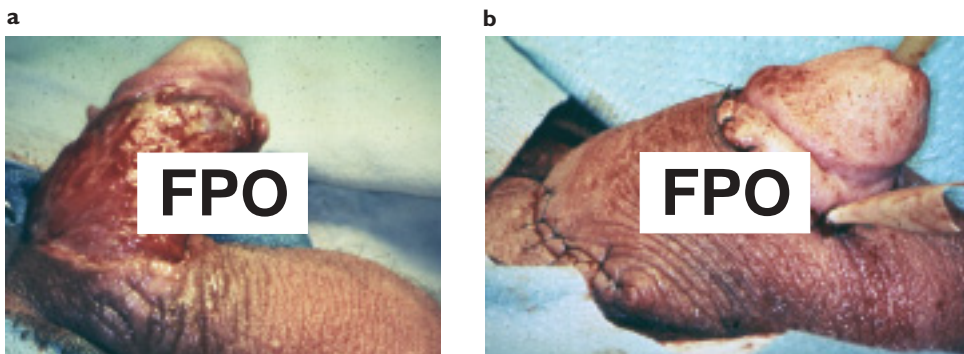


Fig. 10-1. The penile skin defect discussed in Case 10-5 (a) after redbridement and wound dressing changes in Japan, prior to coverage with scrotal skin. (b) Intraoperative appearance after covering skin defect, utilizing the scrotal tunnel technique.

Comment on Case 10-5

Extensive contaminating defects of the penile skin and subcutaneous tissue should be managed initially by debridement and open technique with dressings. Skin covering was best accomplished out of Vietnam at the higher levels of the evacuation system. The simplest technique of skin coverage in degloving injuries appears to be using adjacent scrotal skin; however split-thickness skin grafts may be more functional and cosmetic.

Case 10-6

M. G., a 33-year-old soldier, incurred multiple mine fragment wounds to all extremities, the abdomen, right testis, and penis. After debridement and right orchiectomy in RVN, the patient was evacuated to Japan 6 days postinjury, on 6 March 1969. On the following day, all wounds were redebrided and a perineal urethrostomy was performed. The penis was redebrided on 12 March. Between operations, the patient had frequent dressing changes with nitrofurazone gauze [Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ] and neomycin sulfate soaks. On 17 March, he had a split-thickness skin graft to cover the suprapubic wound and redebridement of the penile wounds. On 28 March the now-clean penile wound had a good granulating base. The penile defect was covered with rotational flaps of scrotal skin. This graft healed per primum (Figure 10-2. a,b,c,d,e).

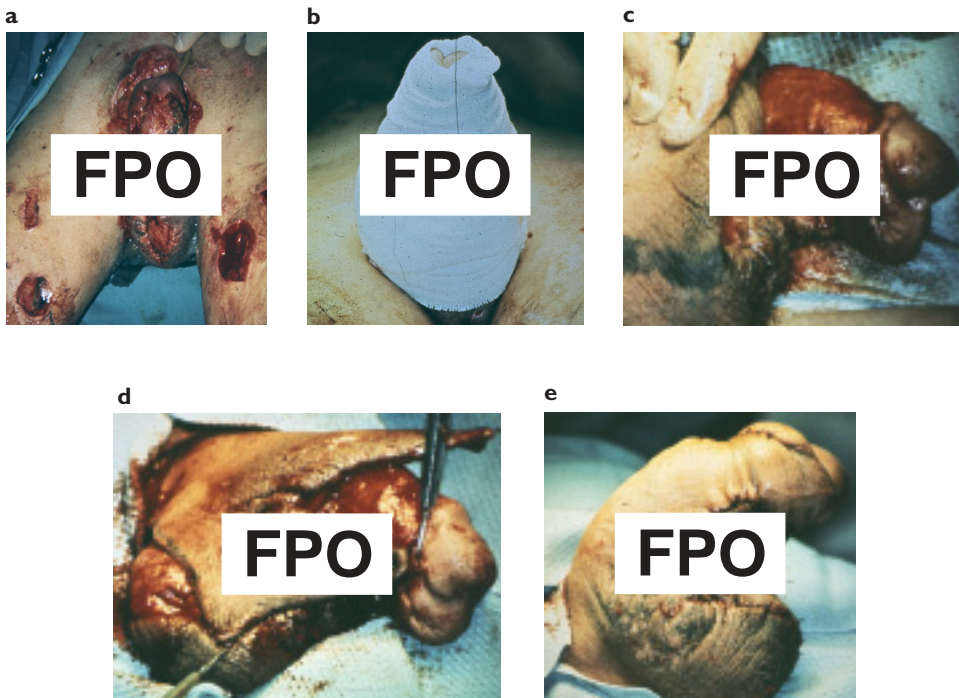


Fig. 10-2. (a) The wounds of the patient in Case 10-6 on M. G.'s arrival in Japan 6 days postinjury prior to first debridement. (b) After initial debridement of all wounds and perineal urethrostomy. (c) Four weeks after the initial wounds: after multiple redebridement and dressing changes the penile skin defect is clean and has a fine granulation base, prior to skin coverage with scrotal skin flaps. (d) Development of penile scrotal skin flaps. (e) Completion of scrotal pedicle penile plastic.

Comment on Case 10-6

This case illustrates the preferred method of treatment of extensive contaminating wounds of the penis and subcutaneous tissue: initial limited debridement followed by multiple redebridement with dressing changes. These large defects can be adequately covered and debrided with antibacterial umbrella and medicated dressings. Rotational flaps of normal scrotal skin have the advantage of maintaining a blood supply and their own lymphatic drainage.

Case 10-7

C. P., a 21-year-old soldier, incurred multiple fragment wounds on 29 April 1969 in RVN to all 4 extremities, the right scrotum and testis, penis and distal urethra, thorax, and face and oral cavity. The wounds were initially treated with debridement, a right orchiectomy, and tracheostomy. The penile–urethral wound was debrided with primary closure of the corpora cavernosa, meatotomy; the penile skin was primarily repaired and Foley urethral catheter drainage established. Delayed primary closure of extremity wounds was accomplished 3 May. The patient had 18 units of whole blood prior to his evacuation to Japan 14 May 1969. On admission to US Army Hospital, Camp Zama, Japan, his penile wound had completely separated and was infected; the skin was necrotic and the cultures revealed *Pseudomonas* and *Klebsiella aerobacter*. Four days later the penis was debrided and covered with nitrofurazone gauze [Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ], and a suprapubic cystostomy was accomplished. Daily dressings and soaks were instituted, and a scrotal tube was created on 28 May 1969. On 5 June 1969, a rotational skin flap from the scrotum to the large defect on the ventral penis was accomplished, and on 19 July the suprapubic catheter was removed. The patient had an adequate meatus and voided well. Erections were adequate. He was evacuated to CONUS and underwent a urethroplasty in March 1970; at that time, erections were normal.

Comment on Case 10-7

This case illustrates the not-uncommon occurrence of patients with injuries to the external genitalia also having massive wounds to other body parts. Readers might conclude that this penile urethral injury might have been better managed by minimal debridement and open dressings with delayed primary closure as an initial course of action. This patient was treated by attempts at reconstruction primarily, which may well have been contraindicated because of the extensive high-velocity wounds. These wounds can be adequately covered by dressings, and there appears to be no immediate urgency to cover these large skin defects initially. Suprapubic cystostomy, perhaps, should have been accomplished at the initial injury to avoid further trauma and contamination to the penis and urethra. We found that the creation of a scrotal tube and a later rotational pedicle graft was an effective way to cover many of these deep defects of the penis. Such an approach allows not only adequate skin coverage but also an excellent blood supply to the graft site.

Case 10-8

J. T., a 24-year-old soldier, incurred a gunshot wound of the right thigh on 22 October 1967 in RVN; the bullet also traversed the scrotum, penis, and left thigh. The wounds were debrided and treated open. The initial injury denuded a large amount of skin from

the thighs, left scrotum, and right side of the shaft of the penis. On evacuation to Japan on 29 October 1967, the penis was markedly swollen with large skin and subcutaneous defects and involvement of the right corpora with cellulitis and purulent drainage. This cultured *Pseudomonas* and *Proteus*. There was marked scrotal swelling. There were large, full-thickness defects of the right groin and left thigh. *Proteus* and *Pseudomonas* were also cultured from these wounds, which were treated with wet neomycin sulfate soaks. Surgical debridement of a necrotic portion of the right corpus cavernosa was accomplished. On 6 November the patient had a delayed primary closure of the left thigh wound and a split-thickness skin graft to the penis and right groin (the grafts were taken from the right lateral thigh). The patient was medically evacuated to CONUS 5 December 1967 with approximately 85% take of the penile skin graft (Figure 10-3. a,b,c,d,e,f,g).

Comment on Case 10-8

This case illustrates the preferred method of choice for contaminated wounds of the penis with large skin and subcutaneous defects. When the penile defect involves the deepest structures, including the corpora, we believe that scrotal skin, when available,

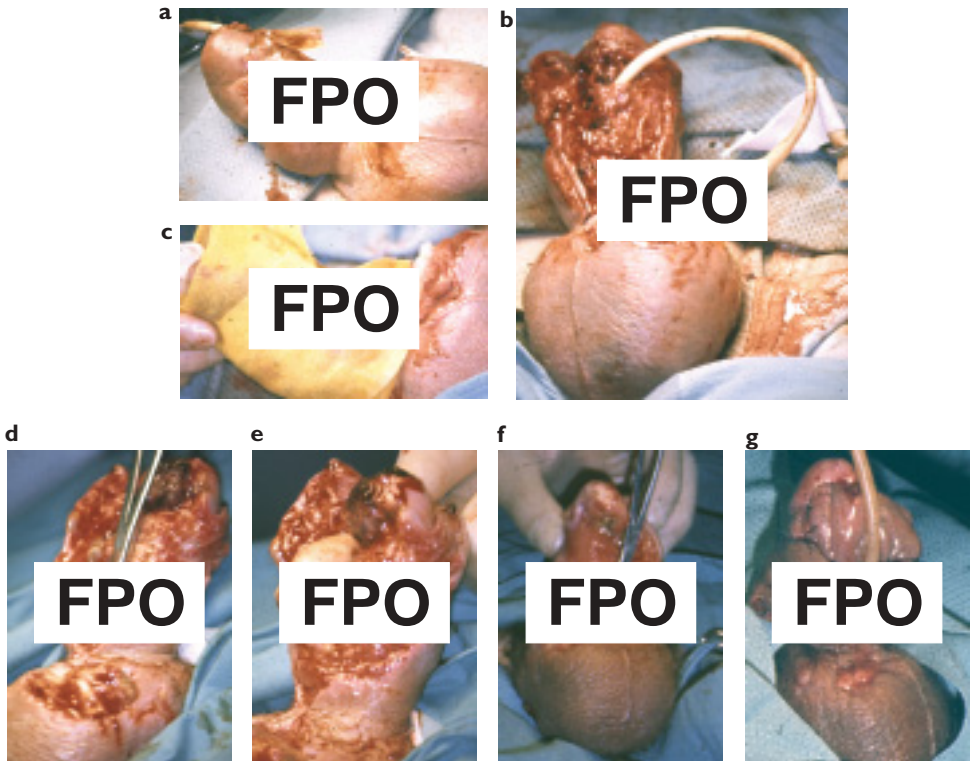


Fig. 10-3. Case 10-8. (a and b) Appearance of the wound in Japan 3 days postinjury: the patient (J. T.) had cellulitis, subcutaneous hemorrhage, edema and necrosis, and purulent discharge of penile-scrotal tissue. (c) After initial conservative debridement and suprapubic cystostomy, the wound was dressed with nitrofurazone gauze. (d and e) Appearance of the wound at second conservative debridement: partial sloughing of penile urethra and glans penis. (f) Three and one half weeks after 6 debridements and dressing changes in Japan, the defect in the penile skin and urethra is ready for plastic skin coverage. (g) Completed plastic skin coverage of the pendulous penis and urethra. Note preservation of most of the glans penis because of conservative debridement. Reconstruction of the penile hypospadias was accomplished in the continental United States.

provides a more cosmetic cover than does split-thickness grafts. However, this patient's scrotal skin was damaged by the initial injury and did not appear to be ideal for coverage.

Case 10-9

C. G., a 19-year-old soldier, received a direct hit in the external genitalia from an AK-47 with extensive penile–urethral injury. The pendulous penile structures were described as being shattered, as was a portion of the left testicle. Initial therapy consisted of heroic attempts at reconstruction of the extensively damaged penile skin and urethra, glans, and corpora over a Foley catheter. The left testicle was debrided and drained; the scrotum was closed except for a space to allow passage of the drain. The patient arrived in Japan 3 days later where the site of injury was inspected under anesthesia; extensive cellulitis, edema, subcutaneous hemorrhage, and purulent discharge from the tissues of the penis and left hemiscrotum were found. The penis was completely covered by skin and sutured under tension; subcutaneous drains emanated from the defects of the distal penile skin. The drains and sutures were removed, the penile and left scrotal hematoma evacuated, and obvious gangrenous tissue was removed prior to dressing with nitrofurazone gauze [Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ]. A suprapubic cystostomy was performed. Over the next 3 weeks, the patient underwent 6 dressing changes with (1) limited debridement and removal of only the obvious gangrenous tissue, (2) almost complete sloughing of the penile urethra and glans, and (3) complete healing of the left hemiscrotum. Three and one half weeks after admission to the hospital in Japan, plastic revision of the pendulous penis was performed by covering the large skin defect on the ventral penis, sliding available dorsal penile skin. There was no attempt to perform a urethroplasty at this stage. The patient was medically evacuated to CONUS 2 months postinjury with a proximal penile hypospadias and a mild meatal stenosis.

Comment on Case 10-9

We believe that this patient's extensive wounds would have been better handled by initial debridement and coverage with dressings. Suturing devitalized, contaminated, traumatized tissue under tension only leads to further skin and subcutaneous loss. Again we see the utility of covering these contaminated, devitalized wounds that have large segments of tissue loss only with dressings that will enhance debridement. (The management of this patient's urethral wounds is discussed in Chapter 11, Anterior Urethral Penetrating and Blunt Injuries.) The employment of suprapubic cystostomy in lieu of a Foley urethral catheter in these extensive wounds reduces the trauma and secondary infection.

Case 10-10

R. P., a 20-year-old soldier, sustained a blast injury to his genitalia and left hand when a gas stove exploded. After a suprapubic cystostomy was done in RVN, the lacerated corpora was debrided and multiple sutures were placed for hemostasis and a reconstruction. A right orchiectomy was performed and the denuded penis buried within the adjacent scrotum and groin. The glans penis was observed to be black 4 days later, at which time the patient was placed in the evacuation chain, arriving in Japan 7 days after the injury. The dressings were removed under general anesthesia with the penis being buried under tension. After removal of the sutures and the extensive peripenile

hematoma, complete gangrene of the glans penis and an undetermined portion of the pendulous penis and urethra was noted. Subsequent to cleansing and mechanical debridement, the exposed penis was covered with nitrofurazone gauze [Furacin Soluble Dressing, Roberts Pharmaceutical Corp, Eatontown, NJ] and a bulky dressing. Over the next 3 weeks, the patient had 6 dressing changes; limited debridement removed obvious gangrenous necrotic tissue, and almost three fourths of the pendulous penis was lost. Skin grafting was then performed with the penis being covered in part with scrotal skin and on the tip with a free split-thickness graft. After a meatoplasty for stenosis, he was evacuated to CONUS and underwent penile lengthening by releasing the suspensory ligament and appropriate relaxing incisions. The patient is currently married, has satisfactory intercourse, and has fathered 3 children (Figure 10-4. a,b,c,d,e,f,g).

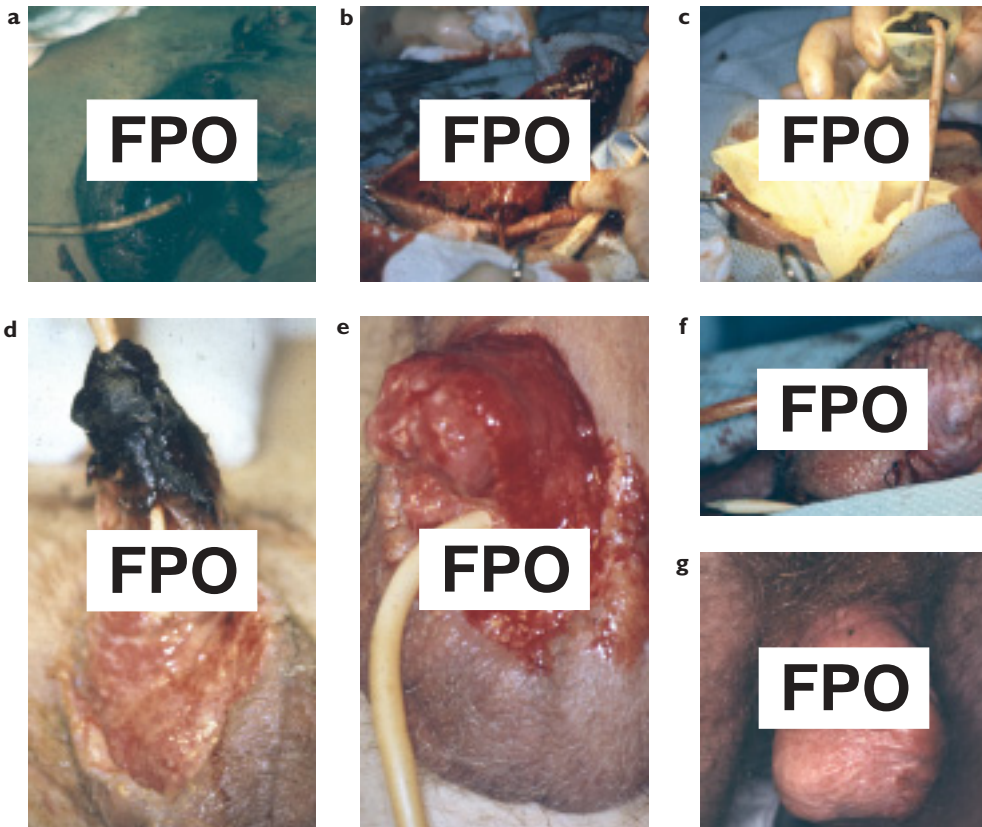


Fig. 10-4. Case 10-10. (a) The wound appearance 7 days postinjury on arrival in Japan: the penis is buried under a scrotal tunnel; the glans penis is black and necrotic; there is a scrotal hematoma; and a suprapubic cystostomy, which was done in Vietnam, are seen. (b) The wound after removal of the sutures, release of the scrotal tunnel, and evacuation of the scrotal hematoma: complete gangrene of the glans penis, and ischemic necrosis of an undetermined portion of the pendulous penis and urethra. (c) The penis after cleansing and conservative mechanical debridement. The exposed penis is covered with nitrofurazone gauze. (d) Ischemic necrosis of pendulous penile soft tissue and urethra 2 weeks postinjury. (e). Three weeks after 6 limited debridements and dressing changes and removal of obvious necrotic tissue, just prior to skin grafting, three fourths of the pendulous penis and urethra has been lost. (f) The penis after the penile shaft has been covered with scrotal skin flaps and a free split-thickness skin graft to the tip of the penis, simulating the glans penis. (g) The penis after penile lengthening by releasing the suspensory ligament several months after the injury.

Comment on Case 10-10

This is the only patient we know whose primary treatment in RVN consisted of covering most of the denuded penile skin with a scrotal tunnel. Obviously, this patient's primary injury was severe; regardless of the initial management employed, he may well have lost as much penis and urethra as occurred under this mode. We suggest, however, that some of the complications, mainly the infection and tissue necrosis, may well have been amplified by attempts at initial heroic reconstruction. And we suggest again that debridement be minimal with this type of injury; as before, the penis and scrotum demonstrate their excellent tolerance of prolonged coverage with medicated dressings.

DISCUSSION AND CONCLUSIONS

In the foregoing case reports, we have seen 4 patients whose more-complex, extensive, high-velocity, deep penile wounds were seemingly complicated by their initial management. In these cases, initial treatment consisted of rather heroic attempts at soft-tissue, corpora, and urethral reconstruction as well as attempts at primary skin coverage of large defects. These 4 patients developed varying degrees of secondary edema, hematoma, ischemia, gangrene, cellulitis, and infection; their wounds either spontaneously broke down or required surgical removal of sutures and prolonged periodic redebridement. Wounds of this type are universally contaminated, and their extensive tissue injury is frequently not apparent at initial examination. We believe that it is an error to extensively repair and cover these types of wounds with skin. Such an approach may lead to further damage by constricting traumatized tissue; the resulting ischemia can restrict drainage and enhance the development of infection. *It is an error to assume that these injuries must be reconstructed and covered with skin as part of their initial treatment.*

This experience leads us to make some conclusions regarding the management of patients with soft-tissue superficial and deep penile wounds. As a general philosophy, debridement should be complete but conservative when considering the size of the defect. In low-velocity and noncontaminated wounds, and in limited high-velocity wounds, primary closure after debridement may well be indicated. In the contaminated, extensive, or high-velocity wound, however, debridement should be followed by delayed primary closure of the wound with appropriate dressings being applied. Small defects in Buck's fascia and the tunica albuginea may be closed primarily with interrupted, long-lasting, absorbable sutures. Clean larger defects of Buck's fascia are best treated by compression to control hemostasis and delayed primary closure. In some clean wounds, skin closure of the penile shaft may be accomplished. Delayed repair is indicated in the large skin defects and in those with significant contamination. Urologists have several alternatives in repairing these skin defects. If vigorous mobilization and the use of dorsal relaxing incisions yield enough avail-

able penile skin, it should be used. Pedicle scrotal skin grafts or split-thickness grafts may also be considered.

As a recommended course of treatment, casualties with massive, often-extensive, high-velocity penile wounds with extensive skin loss and often with urethral injuries should be treated with

- suprapubic cystostomy;
- cleansing and minimal initial debridement (the surgeon's goal should be maximum tissue conservation without attempting extensive initial reconstruction);
- closure of defects of Buck's fascia and tunica albuginea, if indicated;
- wound coverage with appropriate dressings and antibacterial therapy;
- evacuation to a stable, definitive, treatment zone;
- periodic redebridement and dressing change;
- wound coverage with skin when the damaged tissue is clean; and
- delayed urethral reconstruction if urethral damage is severe.

In clean, degloving penile injuries, skin coverage with the scrotal-tunnel technique, free split-thickness skin grafts, or both should be considered. However, in view of the relatively high risk of infection in a war zone, such an approach might be risky. Only 1 patient with extensive penile loss (who was treated in Vietnam and evacuated to Japan) received the scrotal-tunnel technique as the primary therapy. This patient developed massive infection and necrosis. Both full- and split-thickness grafts may be used in the delayed repair of large penile skin defects.⁷⁻¹⁰ Each technique has its advantages and drawbacks, and methods of repair must be individualized.

When using split-thickness grafts, the skin preferably should come from non-hair-bearing areas such as the abdominal wall and inner aspects of the thigh. The thighs, however, often have associated wounds. Culp¹⁰ suggests utilizing relatively thick grafts (0.020–0.024 in.) More recently, McAninch¹¹ recommends for these defects nonmeshed split-thickness skin grafts (0.010–0.015 in. thickness) harvested from the anterior thigh with a pneumatic dermatome. Preferably, suture lines should be staggered and kept mainly on the dorsum of the penis to avoid ventral contraction and subsequent chordee. After a graft, the penis should be extended with a bulky dressing to keep it stretched to prevent retraction. Split-thickness grafts can be applied as a 1-stage procedure, but penile grafts never regain normal sensation.¹² Furthermore, the grafted skin may be less elastic and may contract. However, full-thickness pedicle–scrotal skin grafts may be easy to apply and have fewer complications. They have the added advantage of providing venous and lymphatic drainage. Additionally, they are thicker and can add bulk to the penis to fill extensive soft-tissue and corporeal defects.⁵ However, full-thickness pedicle grafts may potentially result in reduced sensation, are hair-bearing, and may necessitate 2 or more staged procedures. Two patients with relatively restricted superficial skin defects of the penis were treated primarily with coverage with adjacent prepuce.

Because of the restricted follow-up of these patients with penile wounds, the true incidence of impotence and chordee is unknown, but these sequelae obviously have occurred. The true impact of the emotional effects of such injuries is also difficult to assess, but the cosmetic appearance and insult of injury certainly can result in significant emotional response.

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