

# Penile Incarceration with Metal Objects

## A Review of Procedure Choice Based on Penile Trauma Grade

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**Objective:** To outline treatment guidelines according to level of penile trauma for penile incarceration by metal devices.

**Method:** A post-1950 (hand-held powered cutting tool era) Medline search was performed. Cases were divided into four groups: string techniques and variants with and without aspiration of blood from the glans; aspiration techniques; cutting devices; and surgical techniques. Trauma grade (according to Bhat et al., 1991), site time (incarceration time), removal technique, removal time, anesthesia and recovery time were assessed.

**Results:** The string technique and variants were used for grades 1–3. They had short removal (30–120 min), site (3–72 h) and recovery (1–24 h) times. Occasional glans decompressive with blood aspiration was required. Anesthetics included none (wrapping without glans aspiration), i.m. morphine and general (glans aspiration). Pure aspiration techniques used multiple needle punctures for grades 2–3. Aspiration cases had short site times (8–14 h), but required a spinal or general anesthesia. Cutting device cases (grades 1–5) required general anesthesia, had a short removal times (45–90 min), but long site (7 h–30 days) and recovery (2–66 days) times. Surgical degloving was utilized mainly for grade 5 cases, required spinal or general anesthesia, had short site (2–30 days), but long recovery (9–28 days).

**Conclusions:** The string, wrapping, aspiration techniques and cutting devices are suited for grades 1–3. Cutting requires a shield to avoid blade trauma and water-cooling to prevent thermal injury. Suspected underlying devitalized tissue (e.g. grade 4) is examined by Wood's lamp. Failure to identify gangrenous tissue will result in post interventional complications and a prolonged recovery time.

**Key words:** penis, incarceration, string technique, wrapping technique, aspiration, cutting devices, surgery, metal objects.

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Presentation of penile incarceration with metal objects such as steel bushings or iron pipe is a recurrent worldwide occurrence (1–9). Incarceration from metallic and nonmetallic objects has been reported throughout the world since 1755 (10), with the largest series in the USA reported by Dakin in 1948 (11). Men between ages 15 and 56 (12) usually present metal objects, with skin damage resembling traumatic avulsion injury (13). In the past, some patients were denied treatment at emergency departments (EDs), due to the staff's inability to resolve the problem (9, 13, 14). The reported motives for placing a metal incarcerating device include enhancement of sexual response (2, 3, 13, 15, 16–19), erectile dysfunction self-treatment (5, 6, 20–22) and psychiatric disturbance (4, 23). To investigate the relation between trauma, procedure and outcome, a Medline review of the post-Dakin literature on penile incarceration with metal objects was undertaken as this period includes the use of hand-held motorized cutting tools.

## PRESENTATION

Patients present to the ED or clinic at widely diverse times after penile incarceration, ranging from 3 h (2, 3, 5, 14, 15, 16, 24) to 1 month (6, 21, 25). Bhat et al. have delineated a grading scale for penile incarceration: grade 1, distal edema only; grade 2, distal edema, skin and urethral trauma, corpus spongiosum compression, decreased penile sensation; grade 3, skin and urethral trauma, no distal sensation; grade 4, separation of corpus spongiosum, urethral fistula, corpus cavernosum compression, no distal sensation; and, grade 5, gangrene, necrosis, or distal penile amputation (12).

Surrounded by edematous penile tissue, incarcerating metal objects can be extremely difficult to remove. With incarceration, distal edema becomes clinically significant after several hours.

Venous and lymph returns are impeded resulting in swelling and cyanosis while arterial flow continues. If timely removal of the strangulating metal object is not

accomplished, arterial flow is compromised and a cascade of events may follow. Reported complications occurring with time and degree of incarceration include: urethral stricture (12); urinary retention (3, 12, 13, 18, 26); urethral fistulas (12, 21); skin ulceration (12); desquamating epithelium and bullae (18, 20); priapism (12, 18, 23); decreased or loss of penile sensation (12, 15, 18); gangrene of the penile epidermis and subcutaneous tissue (20, 21, 23); and, tissue incision by the metal object (21).

## DIAGNOSIS

Urinalysis with culture and sensitivity and testing for STD may aid in management of the case (18). Urethral disruption and fistulas can be evaluated by retrograde urethrography (20). Pulsation distal to the incarcerating metal object may be assessed by Doppler flowmeter (18, 20). Arteriography is time consuming and yields unreliable results (18). Intravenous fluorescein followed by Wood's lamp examination (27) will identify devitalized tissue. Chartreuse and spotty fluorescence which glow brightly when stoked with a hemostat indicate viable tissue (27).

## TREATMENT

Since penile incarceration with industrial gauge metal objects is uncommonly encountered, the variety of solutions reported often reflects both the novelties of the problem and available resources. The challenge of the presentation of grades 1–3 is to remove the device without damaging the edematous tissue, prior to the onset of gangrene. Many treatment teams facing their first case have reported several unsuccessful approaches before finding a solution (1, 13, 15, 16, 18, 22, 25, 26).

Treatment of urine retention is a preliminary step. If the urethra is intact, a Foley catheter is recommended for grades 1 and 2 (2), while suprapubic catheterization is recommended for grades 3–5 trauma (12, 18, 20). Following removal of the metallic device and also after urethroplasty, urethral strictures are a potential complication and can be ruled-out with follow-up imaging (12, 18). Treatment techniques for penile incarceration can generally be divided into four groups: the string technique and its variants, with and without aspiration of blood from the glans; aspiration techniques; cutting devices; and surgery. The technique chosen may be influenced by the grade of trauma at presentation. Heparinization is recommended if penile pulsation is lacking 30 min after nonsurgical procedures (18).

## STRING TECHNIQUE AND ITS VARIANTS

The string technique was devised by Flatt (28) for removing rings from traumatized fingers. Bucy first utilized it in 1968 to remove a metal ball bearing device from an incarcerated penis (14). Some authors have chosen to aspirate blood from the glans before starting (4, 5) or during (14, 15) the string procedure. Instead of cord, Browning & Reed employed umbilical tape with glans drainage accomplished by injecting 150 units of hyaluronidase (15). The wrapping technique employs the latex band from a urinary leg bag as the compressive element (22). The width and elasticity of the latex band were atraumatic to the edematous tissue and compressed the glans without damage. From Table I, it can be seen that the string-technique (string, cord, umbilical tape) with glans drainage has been successfully employed for grades one to three (4, 5, 14). General anesthesia was used all except one grade 3 case with glans drainage where 15 mg i.m. morphine was utilized (15). The wrapping technique without glans drainage was employed for a grade 1 injury and required no anesthesia (22). A string technique variant failed for a grade 5 trauma with the final resolution being excision to Buck's fascia (20). The longest site time for the metal objects in the string-technique and variant group was only 72 h. Reported recovery times ranged from 1 to 24 h (15, 22). Both average site time (23 h) and recovery time (12.5 h) were relatively short.

## ASPIRATION TECHNIQUES

Only three pure aspiration cases have been reported, being used for grades 2 and 3 (Table II). The site time range of 8–14 h (average 11 h) was the shortest of the four groups. Each technique utilized multiple punctures under a general or spinal anesthesia. Cutting an earth-mover tread link with an electric saw failed and created a superficial wound when the saw slipped. This was followed by multiple punctures of the distal penis with 18-gauge needles into the subcutaneous tissue to drain lymph with subsequent decompression (9). Sinha used a 19-gauge needle with a 20 ml syringe to aspirate a total of 66 ml of blood from the shaft and glans bilaterally to achieve detumescence (24). Punekar et al. made multiple punctures to allow manual expression of fluid with ether soaks. The penis was then coated with liquid paraffin to permit removal of an incarcerating metal hammerhead (2).

## CUTTING DEVICES

Due to the dimensions and industrial grade of steel encountered in most penile incarceration cases, various

Table I. Penile incarceration after Dakin: string technique and its variants, with and without aspiration of blood from the glans

Author (date)	Object	Size	Grade*	Site time	Removal technique	Time	Anesthesia	RT
Rana & Sharma (1994)	3 washers	UKN	1	14 h	String, glans drainage	UKN	General	UKN
Detweiler & Perkins (2001)	Steel bushing	1.0 cm thick	1	18 h	Wrapping technique	120 min	None	1 h
Bucy (1968)	Ball bearing	2 × 1.5 cm	2	8 h	Cord, glans aspiration	30 min	UKN	UKN
Vahasarja et al. (1993)	Loop wrench	11 mm	2	72 h	String, glans aspiration	UKN	General	UKN
	Ball bearing	UKN	2–3	24 h	String, glans aspiration	UKN	General	UKN
Browning & Reed (1969)	Metal ring	UKN	3	3 h	Umbilical tape, glans drainage	UKN	15 mg morphine	24 h

\* Based on criteria of Bhat AL, Kumar A, Mathur SC, Gangwal KC. Penile strangulation. *Br J Urol* 1991; 68: 618–21. UKN = unknown; RT = recovery time.

cutting devices have been utilized, as manual ring cutters are insufficient. The selection of the tools needed depends not only on the inventiveness of the physicians, but also on the equipment available, size/thickness of metallic object, and grade of penile injury. Case reports have presented a variety of tools for the removal of the metal object causing penile incarceration including: hammer and chisel (12); hand saw (6, 12, 16); Dremel Moto-tool (3, 19), circular orthopedic saw with diamond teeth (26); and heavy drills (12).

It can be seen in Table III that cutting devices have generally been used for penile incarceration grades 1–3. Drills with have been employed for grades 3 and 5 (12, 18, 21). The metal device is either cut with two divisions 180° apart (3, 26), or with one cut and scoring of the opposite side, followed by use of an expander tool (18). To avoid damaging the surrounding edematous tissue, a shielding device is often placed under the surface to be divided. Shield materials chosen for both drilling (12, 18, 24) and sawing (6, 7, 16, 18, 19, 23, 23, 29) include wood (7, 26), silastic (3), and polyvinyl chloride (6). Superficial heat burns (9, 19) and wounds (9) have been reported. Thermal burns from the mechanical stresses of drilling and sawing are obviated by cool water irrigation (3, 12, 26), water sprays (18),

or atomizer water mist (30). During 90 min of heavy drilling of a ball bearing device, Bhat et al. utilized 20 liters of water (12). Topical and parenteral (18) antibiotics have been used after a grade 3 trauma with desquamating epithelium and epidermal bullae (18). Site time (average 8.3 days) and recovery time (average 15.6 days) were both longer than for the sting and aspiration techniques. An attempt to only cut the incarcerating metal object with a grade 5 trauma with conservative treatment of the devitalized tissue resulted in multiple urethral fistulas and required 66 days of recovery (21).

## SURGERY TECHNIQUES

Surgery was reserved for grade 5 cases except for one grade 2 case (Table IV). This level of trauma was treated with degloving to Buck's fascia (13, 20) or the corpus cavernosum followed by skin grafts (12, 13, 23, 25). The presence of postoperative devitalized tissue may necessitate the delaying of grafting (13, 20). Failure to assess underlying devitalized tissue can lead to infection, urethral fistulas, tissue resection, prolonged recovery time and penile amputation (8, 21, 31). Penile amputation with replantation using microsurgical techniques (32–34) for grades 4 and 5

Table II. Penile incarceration after Dakin: aspiration techniques

Author (date)	Object	Size	Grade*	Site time	Removal technique	Time	Anesthesia	RT
Sinha (1988)	Iron nut	1.5 × 2.0 cm	2	8 h	Aspiration 66 ml blood	UKN	General	24 h
Bermudez (1998)	Caterpillar tread link	3400 g	2	UKN	failed cutting, multiple punctures distal penis	UKN	Spinal	UKN
Punekar et al. (1978)	Hammer head	1.5 cm thick	3	14 h	Needle punctures with expression of lymph	UKN	General	UKN

\* Based on criteria of Bhat AL, Kumar A, Mathur SC, Gangwal KC. Penile strangulation. *Br J Urol* 1991; 68: 618–21. UKN = unknown; RT = recovery time.

Table III. Penile incarceration after Dakin: cutting devices

Author (date)	Object	Size	Grade*	Site time	Removal technique	Time	Anesthesia	RT
McLaughlin & Coyner (1988)	Steel bearing	0.03 cm thick 1.9 cm wide	1	UKN	Anspach saw with tungsten carbide bits	UKN	general	2 days
Kadioglu et al. (1995)	Water fountain part	UKN	1	1 month	steel saw	UKN	UKN	14 days
Schuster & Stockmal (1999)	Copper pipe steel ring	1.9 cm wide 1.9 × 0.95 cm	1	12 h	Drummel Moto-tool	UKN	None	2 days UKN
Chakarbarti & Das (1976)	Steel pipe	UKN	2	8 h	Steel cutting saw	UKN	UKN	5 days
Tiwari et al. (1977)	Iron nut	0.7 × 1.0 cm	2	15 days	Saw in 2 places	UKN	General	28 days
Greenspan (1982)	Steel ring	UKN	2	7 h	Dremel Moto-Tool with grinder	UKN	UKN	UKN
Bhat et al. (1991)	Metal ring	0.3 cm thick	2	4 days	Saw	UKN	UKN	10 days
	Metal nut	0.5 cm thick	3	8 days	Hammer, chisel	UKN	UKN	21 days
	Ball bearing	3.0 cm thick	3	5 days	Heavy drill	90 min	UKN	14 days
	Metal nut	0.5 cm thick	3	5 days	Saw	UKN	UKN	14 days
Snoy et al. (1984)	2 steel alloy bushings	UKN	3	33 h	Dental drill with flat carbide disk	25 min	General	8 days
Kato et al. (1987)	Steel ring	2 cm diameter	5	30 days	Drill, diamond bit	90 min	General	66 days
Steiner (1978)	Metallic nut	1.0 cm thick	UKN	8 days	Goldsmith saw in 2 places	UKN	UKN	2–4 days
Meadoff (1995)	Steel band	UKN	UKN	UKN	Hacksaw	UKN	UKN	UKN

\* Based on criteria of Bhat AL, Kumar A, Mathur SC, Gangwal KC. Penile strangulation. *Br J Urol* 1991; 68: 618–21. UKN = unknown; RT = recovery time.

has been suggested (18, 20). Amputation and replantation may benefit trauma with lack of distal pulsation at presentation or loss of sensation for greater than 1 week postoperatively (18, 35). The severity of grade 5 trauma, requiring surgery, was reflected in the longest average site (9.4 days) and recovery time (21 days) of the four treatment groups.

## CONCLUSIONS

It is difficult to make well-founded conclusions from a retrospective analysis of case reports of penile incarceration with metal objects. Many of the cases had

insufficient data for a comprehensive review. However, by reviewing the choices of treatment and their relation to the grade of trauma, several generalizations can be made (Table V). After screening for UTI, STD, urethral disruption and fistulas, Bhat et al. suggest that the trauma be graded (12). Generally, the longer the site time, the higher the grade of trauma and the greater the risk of devitalized tissue. Grades 1–3 can be treated with the string and variant, aspiration and cutting techniques. If the epidermis and urethra are intact, antibiotics do not seem indicated. String, latex urine bag straps, and umbilical tape are simple to apply and commonly available in EDs and clinics. General

Table IV. Penile incarceration after Dakin: surgical techniques

Author (date)	Object	Size	Grade*	Site time	Removal technique	Time	Anesthesia	RT
Wasadikar (1997)	Metal ring	1.4 cm inner diameter	2	30 days	Excision to corpus cavernosum	UKN	Spinal	UKN
Castro & Perez (1952)	Steel pipe	0.5 × 8.5 cm	5	15 days	Amputation glans	UKN	General	9 days
Schellhammer & Donnelly (1973)	Iron pipe	UNK	5	6.5 days	Excision to Buck's fascia	UKN	General	UKN
Tiwari et al. (1977)	Iron nut	1.7 × 2.4 cm	5	8 days	Excision to corpus cavernosum	UKN	General	26 days
Klein & Smith (1987)	Ball bearing	UNK	5	7 days	Excision to Buck's fascia	UKN	Spinal	UKN
Okumura et al. (1993)	Metal ring	UNK	5	4 days	Metal cutting tool, excision necrotic tissue	UKN	UKN	28 days
Osman et al. (1996)	Constriction penile ring	1.0 cm thick	5	2 days	Amputation after failure conservative debridement	UKN	UKN	NA

\* Based on criteria of Bhat AL, Kumar A, Mathur SC, Gangwal KC. Penile strangulation. *Br J Urol* 1991; 68: 618–21. UKN = unknown; NA = not applicable; RT = recovery time.

Table V. Treatment suggestions for penile incarceration with metal devices

- Grade incarceration trauma according to Bhat et al. 1991
- Screen for UTI and STD
- Rule out urethral disruption and fistulas: retrograde urethrograph
- Assess distal pulsation with Doppler
- Treat urinary retention
  1. Grades 1–2 Foley
  2. Grades 3–5 suprapubic catheterization
- Suspected devitalized tissue in grades 3–4: i.v. fluorescein with Wood's lamp examination
- Removal of metal object
  1. String technique and variants:
    - (a) String, cord, umbilical tape for grades 1–3
    - (b) Anesthesia with glans aspiration: general, i.m. 15 mg morphine
    - (c) Wrapping technique without glans aspiration, no anesthesia
  2. Aspiration technique
    - (a) Grades 2–3
    - (b) Multiple punctures in shaft and glans
    - (c) General or spinal anesthesia
  3. Cutting devices
    - (a) Grades 1–3
    - (b) Motorized hand held saw or drill
    - (c) Shield and water cooling
  4. Surgery
    - (a) Grade 5, grade 4 if devitalized tissue identified
    - (b) Spinal or general anesthesia
- Heparinization if distal pulsation is lacking 30 min following removal of metal object

anesthesia or i.m. morphine may be required for glans aspiration. Aspiration techniques have been employed for grades 2 and 3. While the recovery time seems to be relatively short, a general or spinal anesthesia were utilized in the three reported cases. However, this technique failed for a grade 2 trauma.

Cutting devices have been used for all grades. The Dremel Moto-Tool or equivalent seems to be capable of cutting most penile incarcerating metal devices. A shield and cooling water irrigation, spray or mist is needed to prevent tissue and thermal trauma. The presence of devitalized tissue, in grade 5 and possibly grade 4 trauma, requires degloving. As surgery is indicated by the presence of gangrenous tissue, intravenous fluorescein with Wood's lamp examination should reduce doubt and the risk of complications. The longer site and recovery times for cutting devices (8.3 and 15.6 days) and surgical techniques (9.4 and 21 days) reflect both the grade at presentation and the complications reported when devitalized tissue is not treated after removal of the incarcerating metal object. Preservation of a gangrenous grade 5 incarcerated penis may not be possible in cases where presentation is late in the course of the trauma.

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