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REVIEW ARTICLE

# The good, the bad, and the ugly about surgical approaches for inflatable penile prosthesis implantation

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## Abstract

The penoscrotal (PS), infrapubic (IP), and subcoronal (SC) incisions are used for inserting an inflatable penile prosthesis (IPP). Each surgical approach has its advantages and disadvantages and experts continue to debate which technique has the best outcomes. We performed a critical review of the published English-language studies up to April 2020 investigating the PS, IP, or SC approach for IPP placement. The PS approach is the most frequently used incision. The available data do not suggest a difference between PS and IP approach in size of the implanted prostheses, achieved penile length, patient satisfaction, infection rate, and risk of urethral injury. The risk of dorsal nerve injury, even if low, seems to be greater for IP approach. IP technique is associated with shorter operative time and earlier use of IPP compared with PS approach. Despite limited available data it is reasonable to assume that SC approach, compared with other approaches, has longer operative time and similar infection rate. The time to device activation with SC technique could be similar to the IP approach, but there is only minimal data that can confirm this hypothesis.

## History of the surgical approaches

The inflatable penile prosthesis (IPP) is the gold standard to treat erectile dysfunction in nonresponders to medical therapy and patients with Peyronie's disease [1]. Placement of the semi-rigid implants preceded the IPP historically. The rods were reported with several surgical approaches, including penoscrotal (PS), infrapubic (IP), subcoronal (SC), suprapubic, and perineal [2]. The history of the surgical approach for semi-rigid unitary implants is chronicled in Table 1.

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## The origins

Beheri [3] was the first to describe the use of a paired penile implant placed within the cavernosal bodies. The polyethylene rods were placed through a midline dorsal incision near the base of the penis [3]. This paper marked a paradigm change in the surgical technique of penile prosthesis implantation; subsequently all techniques required incision of the tunica albuginea in order to place the device inside the corpora cavernosa.

Scott et al. [4] were the first to report the use of an intracavernosal IPP. A vertical incision from symphysis to the umbilicus (suprapubic approach) followed by long corporotomies to facilitate inserting the cylinders since the Furlow Insertion Tool was not invented until 1980 (Fig. 1). Throughout the 1970s, the cylinders were filled with saline and plunged in dry ice until they were frozen stiff to facilitate insertion [5]. Scott utilized the abdominal vertical incision until 1983 when he injured a dorsal nerve on a patient who had undergone many revisions. Scott switched his approach to PS and coincident to his embracing this incision, Scott also invented the Metal Scott Retractor (Fig. 2) and Reservoir Insertion Device [6]. Interestingly, Wilson sustained the nerve injury on a patient and switched to PS approach in 1986. Wilson subsequently adapted the Scott Retractor design to

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**Table 1** History of surgical approaches for PP implantation.

| Year | Author | Type of prosthesis | Surgical approach |
|---|---|---|---|
| 1936 | Bogoraz [33] | Rib cartilage implant | NA |
| 1964 | Lash et al. [34] | Silicone implant | NA |
| 1966 | Beheri [3] | Prosthesis of polyethylene | Midline dorsal incision near the root of the penis first intracavernosal penile implant |
| 1967 | Pearman [35] | Silicone implant | Longitudinal dorsal incision made in the midline and about mid-shaft of the penis. Placement between Buck's fascia and tunica albuginea |
| 1973 | Scott et al. [4] | IPP with two pumps | Suprapubic approach |
| 1975 | Small et al. [36] | Semi-rigid PP (Small-Carrion prosthesis) | Perineal approach |
| 1979 | Barry and Seifert [37] | Semi-rigid PP (Small-Carrion prosthesis) | PS approach |
| 1980 | Jonas and Jacobi [38] | Malleable prosthesis | Semicircular incision on the dorsal surface of the penis in the coronal sulcus |
| 1981 | Smith [39] | Semi-rigid PP (Small-Carrion PP, Finnel PP) | SC approach |
| 1985 | Barrett and Furlow [7] | IPP | IP approach |
| 2008 | Perito [8] | IPP | Minimally invasive IP approach |
| 2016 | Weinberg et al. [12] | IPP | SC approach |

*PP* penile prosthesis, *IPP* inflatable penile prosthesis, *PS* penoscrotal, *IP* infrapubic, *SC* subcoronal, *NA* not available.

disposable versions now marketed by both Boston Scientific and Coloplast (Fig. 2) [2].

Barrett and Furlow [7] were the first authors to report the placement of IPP via a smaller transverse incision just above the penis rather than vertical abdominal incision and renamed it the IP approach (Fig. 3). Perito [8], the largest volume IPP implanter in the world, proposed the "minimally invasive IPP". This technique was done though a tiny skin incision, with hydrodilation of the cavernosa and dilatation only with the measuring Furlow. Perito also published videos of his 12 min technique; many physicians became interested and learned his unique technique by visiting Coral Gables, FL [8]. Perito's courses and proctoring has stimulated a resurgence of interest in IP in the last decade.

It is difficult to describe surgical procedures with prose. The reader is invited to visit the *Video Journal of Prosthetic Urology* (www.vjpu-issm.info) to see the three types of incision and insertion:

(1) Perito P. Minimally invasive infrapubic penile implant. VJPU. 2018;2:14.
(2) Wilson S. Tips of penoscrotal IPP. VJUP. 2014;1:28.
(3) Valenzuela R. IPP insertion and vasectomy using a single subcoronal incision. VJPU. 2015;2:46.

## The present day

Although five main surgical approaches for penile prosthesis implantation were initially described, two are of historical interest only. Scott's suprapubic approach was used in the early years of IPP, before the development of kink-resistant tubing, because large incisions were required to run the tubing into each inguinal canal to prevent kinking and malfunction (Fig. 1). The perineal approach was described originally for semi-rigid penile prosthesis implantation and adapted poorly to IPP (Fig. 4) [9].

The 2015 International Consultation of Sexual Medicine stated, "penoscrotal, infrapubic, and subcoronal are the three main approaches for inserting a penile prosthesis" [10]. The SC access for IPP placement was initially popularized by Egydio for IPP accompanied by Peyronie's correction and lengthening [11]. The first peer-reviewed article published of SC approach for IPP only occurred in 2016 [12]. Because of its late start, the IP and PS techniques remain the most used methods for IPP implantation [12, 13]. After 1990, the PS approach surpassed the IP and became the most frequent access utilized in clinical practice and remains the most popular today despite the resurgence in interest in IP [14, 15].

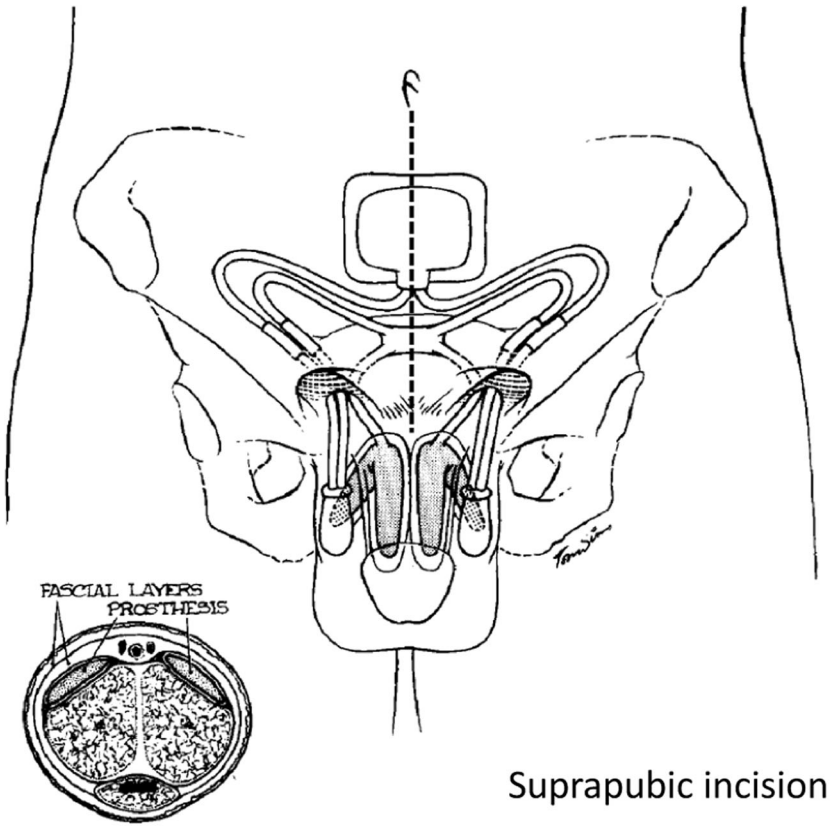



**Fig. 1 History: Scott's original suprapubic approach.** Suprapubic incision.

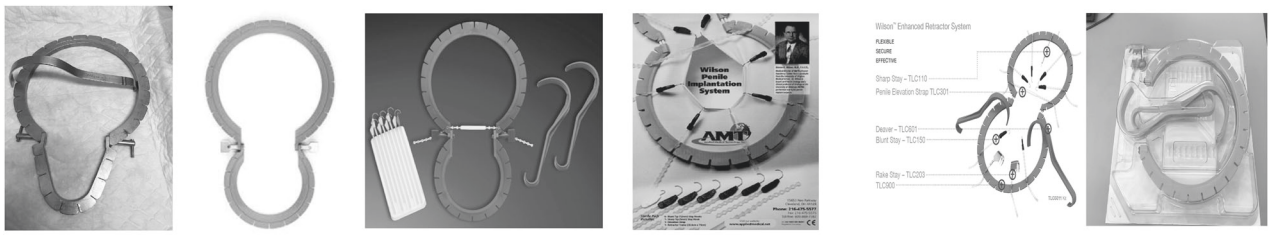



**Fig. 2 Evolution from metal Scott to Wilson disposable "Scott retractor". a** 1983—original Scott metal retractor. **b** 1992—improved metal Scott. **c** 1993—AMS "SKW" disposable retractor. **d** 1996—Mentor "Wilson" disposable retractor. **e** 2018—Coloplast "Wilson" enhanced retractor.

## Surgical approaches in comparison: the data

Each surgical approach for IPP implantation has its advantages and disadvantages (Table 2) as well as a considerable variability in the technique from one implanter to another. The choice of surgical access to implant an IPP begins with a surgeon's training and is impacted by both exposure to opinion leaders and his personal experience with good and bad outcomes. Meanwhile, the experts continue to debate which technique has the best outcomes [9, 14, 16–18].

## Our view of the advantages and disadvantages of surgical approaches

### The good of the PS approach

(1) Excellent exposure of both proximal and distal corpora cavernosa (Fig. 5a) even for patients with obesity or corporal fibrosis [9, 19].
(2) Little risk of injury to dorsal neurovascular bundle [9, 19, 20].

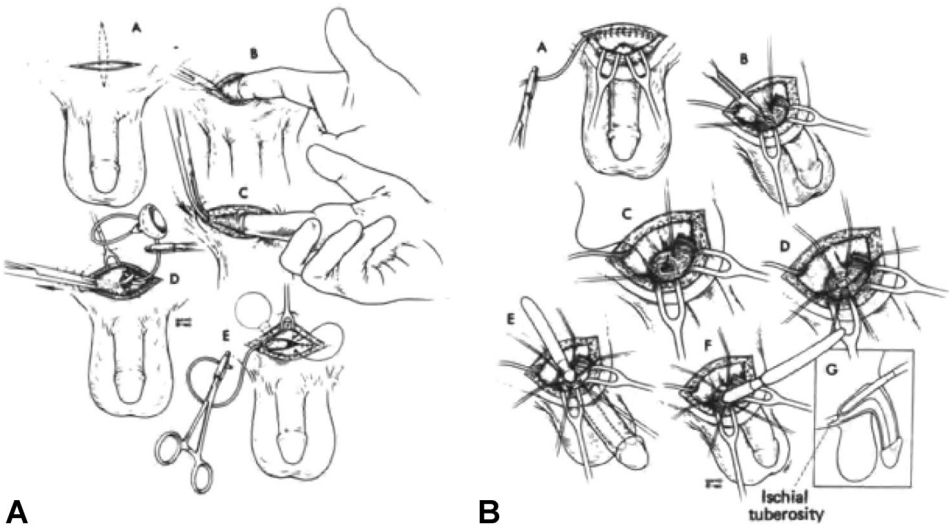



**Fig. 3 History: first description of infrapubic approach. a** Reservoir placement. **b** Cylinder placement.

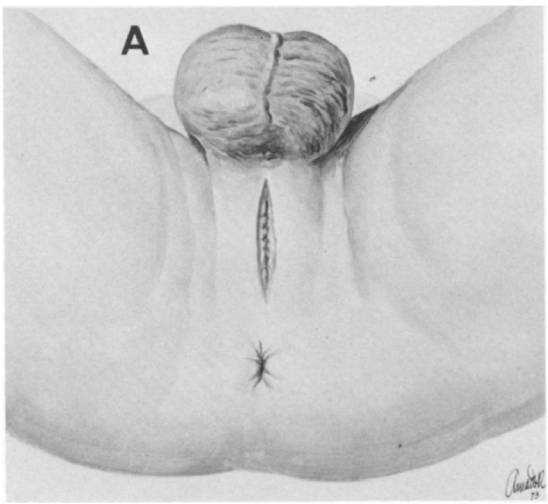



**Fig. 4 History: perineal approach.** Perineal incision.

(3) Pump placement is facilitated (Fig. 5c) [19].
(4) The small scrotal incision leaves negligible scar [20].
(5) One incision double implant of IPP and artificial urinary sphincter is possible [21].

### The bad of the PS approach

(1) Blind placement of the reservoir into the space of Retzius (Fig. 5b) [6].
(2) Scrotal swelling can delay device activation [18–20].
(3) Risk of injury of scrotal urethra; the urethra is easily seen and can be repaired [6].

### The ugly of the PS approach

(1) None. There is no irreversible complication with PS incision [6].

### The good of the IP approach

(1) Easier, safer reservoir placement under direct vision (Fig. 6c) [20, 22].
(2) Diminished scrotal swelling resulting quicker pump activation [18, 20, 22].
(3) Shorter operative time in skilled hands [9, 20].
(4) Incision is remote from patients with incontinence and allows abdominoplasty (Fig. 6a) [20].

### The bad of the IP approach

(1) Limited visualization of distal corpora cavernosa [22] (Fig. 6b).
(2) Pump placement is not optimal with the risk of pump migration [22].
(3) Severe obesity and fibrotic corpora are challenging [6].
(4) Revision surgery after the IP approach, if required, is associated with increased difficulty and worse surgical outcomes [6].
(5) Scar of IP incision is visible [20].

**Table 2** Pros and cons of surgical approaches for IPP implantation.

| | Advantages | Disadvantages |
|---|---|---|
| **PS approach** | • Excellent exposure of corpora cavernosa<br>• Avoidance of dorsal neurovascular bundle<br>• Ability to secure the pump in the scrotum<br>• Excellent cosmetic result<br>• Specific cases: severe obesity, need also for an AUS, excessive corporal fibrosis | • Blind placement of the reservoir<br>• Greater postoperative scrotal swelling<br>• Greater risk of scrotal urethral injury[a]<br>• Specific cases: previous pelvic surgery makes space of Retzius difficult |
| **IP approach** | • Reservoir placement under direct vision<br>• Less postoperative scrotal swelling<br>• Faster surgical procedure<br>• Specific cases: previous abdominal surgery, advanced cardiovascular disease, dependence on pads or diapers, concomitant abdominoplasty | • Greater risk of dorsal nerve injury[a]<br>• Limited visualization of distal corpora cavernosa<br>• Lack of access to the most dependent part of the scrotum for pump fixation<br>• Revision surgery with increased difficulty and worse surgical outcomes<br>• Not excellent cosmetic results<br>• Specific cases: severe obesity, distal fibrosis |
| **SC approach** | • Excellent visibility of corpora cavernosa and urethra<br>• Additional surgical reconstructive procedures easily performed<br>• Avoidance of concern of wound healing overlying the implanted pump<br>• Optimal cosmetic result<br>• Particularly suitable for local anesthesia<br>• Specific cases: PD, patients with phimosis who desire circumcision | • Relatively recent introduction compared with the other two "more traditional" techniques<br>• Need for distal penile incision and penile degloving may promote skin changes or glans necrosis |

*IPP* inflatable penile prosthesis, *PS* penoscrotal, *IP* infrapubic, *SC* subcoronal, *AUS* artificial urinary sphincter, *PD* Peyronie's disease.

[a]Theoretical disadvantages not confirmed by the literature.

### The ugly of the IP approach

(1) Risk of dorsal nerve injury, a complication from which there is no cure [6]. While a paper in 2018 claimed that there were no reports of this complication in the literature [9], both Drs. Scott and Wilson sustained one in the 1980s. Wilson has also been an expert witness in six additional cases sustained with IP (all successful) that came to litigation in USA. Decreased penile sensation occurs most often following revision cases when the anatomy is not so clear.

### The good of the SC approach

(1) Excellent visibility of corpora cavernosa and urethra [12] (Fig. 7a).
(2) Additional surgical reconstructive procedures (Peyronie's, esthetic enhancements) can be easily performed [12].
(3) Similar to IP, time to pump activation is quicker and reservoir insertion easier [9].
(4) Particularly suited to local anesthesia because of the unhampered visual field after the anesthetic injection and less postoperative pain [13, 23].
(5) Wilson believes reservoir placement seems as easy as IP and pump placement as easy as SC.
(6) Optimal cosmetic result with a single incision (Fig. 7b) [12, 13].

### The bad of the SC approach

(1) Relatively recent introduction [12] limits the number of studies regarding this surgical approach and the follow-up time of patients.
(2) Requires more operative time than IP or PS [12, 13].

### The ugly of the SC approach

(1) The SC access requires degloving of the penis, therefore, complications such as sensorineural alterations, skin loss, glans necrosis, and lymphedema are rare but reported [6, 24].

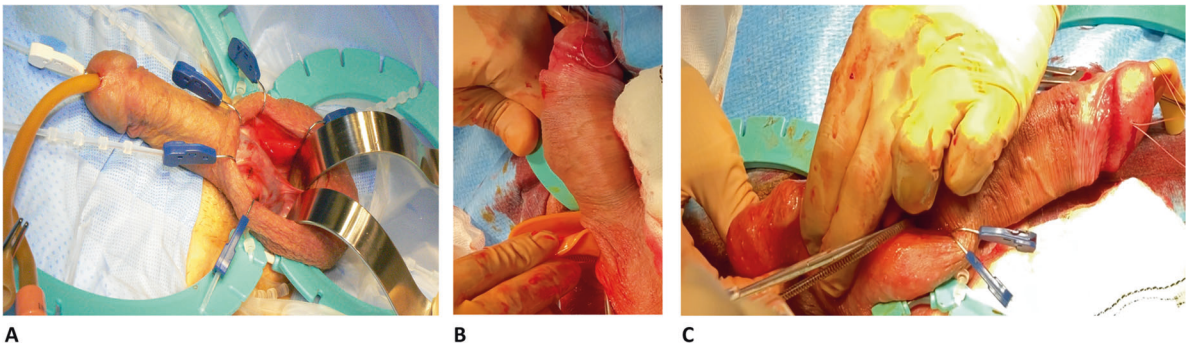



**Fig. 5 Penoscrotal approach. a** Excellent corporal exposure. **b** Blind reservoir placement. **c** Dependent pump placement.

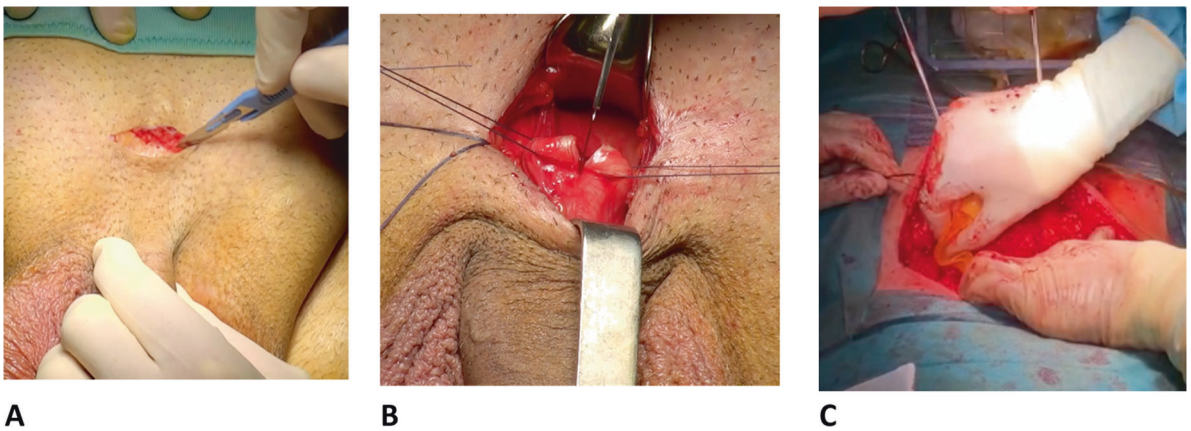
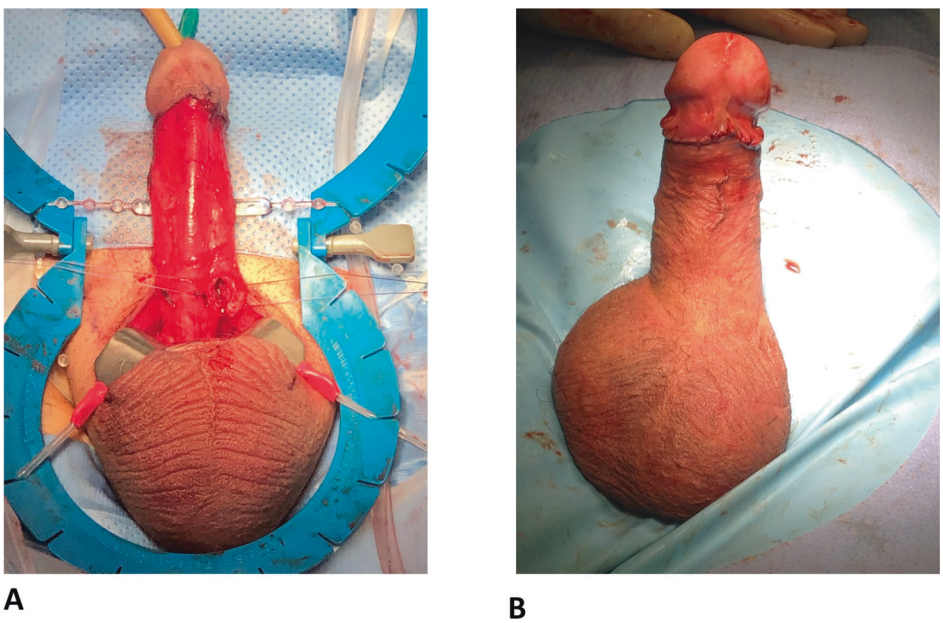



**Fig. 6 Infrapubic approach. a** Infrapubic incision. **b** Corporotomy. **c** Placement of reservoir under direct vision.

**Fig. 7 Subcoronal approach. a** Exposure of corpora cavernosa and corporotomy using disposable retractor. **b** Finished subcoronal implantation.



## Comparison of outcomes of surgical approaches

Over the years, several studies compared the outcomes of PS and IP approaches for IPP implantation [9, 14, 16–18]. No study comparing the SC approach with the others for IPP placement is currently available in the literature.

### Operative time (PS vs. IP)

Multiple studies comparing operative time exist in the literature [18, 25–27]. The IP technique is associated with shorter operative time compared with the PS approach when both are performed by an experienced surgeon. One possible explanation lies in the fact that several steps are omitted compared with the PS, in addition the reservoir is placed under direct vision with IP incision making this step faster. SC requires more operative time than both IP and SC because closure of both the dartos and circumcision incision is time consuming [12, 13].

### Prosthesis size and achieved penile length (PS vs. IP)

According to some authors, a disadvantage of the IP approach could be a greater loss of penile length due to shorter prosthesis selection [20]. The available data [14, 18, 25, 28] do not suggest a difference between PS and IP approach in the size of the implanted prostheses, and the studies investigating this outcome do not analyze its impact on the postoperative penile length.

### Patient satisfaction (PS vs. IP)

Patient satisfaction is among the most important measure of success after IPP implantation [20]. Review of comparison literature [18, 25, 28] shows that both the IP and PS approaches lead to high patient and partner satisfaction rates, which does not seem influenced by the type of surgical technique chosen.

### Time to device activation (PS vs. IP)

Scrotal swelling can make the activation of IPP very uncomfortable. IP approach largely avoids the scrotal dissection, and consequently the associated edema and pain, permitting a more rapid activation of the device [20, 22]. Patients are typically instructed to wait 4–6 weeks after the PS approach to activate the IPP, while surgeons employing the IP incision often encourage earlier cycling of the implant to encourage the most capacious capsule to develop [10, 22]. Although there is no robust evidence in the literature [18, 28], currently the general consensus is that the SC approach, similar to IP, avoids scrotal dissection and also allows earlier use of IPP compared with PS technique.

### Infection rate (PS vs. IP)

Infections are among the major concerns for an implanter of IPP. There are multiple papers reporting infection rates of IP and PS [9]. The introduction of infection retardant coatings in 2001 (AMS/Boston Scientific) and 2002 (Mentor/Coloplast) has reduced the risk of device infection 50% [29]. A critical review of literature analyzing coated devices shows that the infection rate for experienced surgeons after any of the three incisions is <2% and may be as little as 0.46% [18, 19, 22, 25, 26, 28]. Current literature does not provide evidence suggesting a difference in the surgical approaches used for the IPP placement.

### Urethral injury (PS vs. IP)

Urethral injuries occur in 1–3% of PP placement, either an acute (intraoperative) or delayed (erosion) complication [30]. The distal urethra is most often damaged during dilation of the corpus cavernosum, while the proximal urethra is more commonly injured during exposure of the corpora cavernosa with PS incision or while isolating cylinder tubing during a removal and replacement surgery [30, 31]. A distal urethral injury with IP incision is most likely to happen during dilation [20]. This is probably due to the corporotomy being farther from the glans; the surgeon meets a bit of corporal resistance, pushes harder and the fibrotic stenosis breaks sending the momentum of the instrument into the fossa navicularis. In summary, urethral damage infrequently occurs with IPP implantation and there is no study comparing urethral injury rates between PS and IP techniques.

### Outcomes of the SC approach

Currently, only two studies describe the outcomes of SC approach for IPP implantation [12, 13]. Weinberg et al. [12] reported their findings regarding 200 patients who underwent IPP placement with SC access, after a combination of general and local anesthesia, using a modified no-touch technique. The authors reported a mean (range) total operative time of 73 (39–161) min, and three infections (1.5%) which required reoperation for device removal. Park et al. [13] described IPP implantation with SC access after local anesthesia in 557 men. The mean operative time was 53 min. Transient preputial edema was found in 137 men (24.6%). There were two patients with distal preputial partial skin necrosis (Fig. 8). Infection was a complication in three patients (0.53%).

Due to the limited data available, it is difficult to compare the outcomes of the SC approach with those of other surgical techniques. However, SC operative time would seem longer than other approaches, with infection rate similar to

**Fig. 8 Skin loss following subcoronal incision.** Necrotic skin debrided on postoperative day 10.

the other techniques. No case of dorsal nerve or urethral injury was described; therefore, it is reasonable to assume that the risk of these complications is low. The postoperative penile length seems preserved, however, there is insufficient data to compare this outcome with that of the other techniques. Probably the time to device activation could be similar to the IP approach since there is no scrotal incision, but there are no data that can confirm this hypothesis. No data regarding patient satisfaction and prosthesis size are available [12, 13].

## Conclusions

Multiple surgical approaches for PP implantation have been described over the decades; however, to date, the main approaches remain the PS, IP, and the more recent SC. Each surgical approach for IPP placement has its good and bad, and currently no technique has proven to be superior to the others in terms of efficacy and safety. In any case, an accurate evaluation of outcomes is made more difficult by the fact that the papers comparing directly the PS and IP approach are scarce, provide only limited data, and no study comparing the SC approach with the others is currently available in the literature.

We must remember that 75% of IPP in USA are done by surgeons who perform ≤4 a year [32]. Since the majority of implanters can be lumped into the term "occasional" rather than "high volume", we must gear our incision recommendation to these surgeons. For occasional implanters, we urge the PS approach because there is no "ugly", i.e., irreversible complication. IP incision has the advantage of quicker surgery, quicker recovery, and easier reservoir placement. Currently, however, the predominant approach utilized in clinical practice for IPP implantation is the PS. Among the reasons that can explain the popularity of this technique are its teaching in the major training institutions, the disadvantages of the IP approach perceived by occasional surgeons, and the relatively recent introduction of the SC incision for IPP placement.

The choice of the surgical access is based on the surgeon's training and it is acceptable for occasional implanters to use only one access. Higher volume implanters performing tertiary level cases should be competent to perform more than one surgical approach to in order to tailor the incision to the patient's anatomy and surgical history. In our centers, we have historically used the PS approach for the naïve patient with normal penis, because:

(1) it allows an excellent exposure of corpora cavernosa;
(2) the disposable Scott retractor allows minimalization of complications such as urethral injuries and crossovers; and
(3) it facilitates correction of unsuspected Peyronie's allowing easy access to the distal penis without a separate incision.

We prefer an IP approach when we desire to perform a concomitant abdominoplasty in obese patients, because with one incision we can implant IPP and remove fat in a quick and clean way. We have embraced the new SC incision on many first-time implants despite the disadvantage of a bit longer surgery and the rare skin loss or glans ischemia. Compared with our historical preference of the PS incision, we like the faster ability to cycle and the lessened burden of pain relief especially in the American climate of stricter control of Opioids. When additional surgical reconstructive procedures, e.g., Peyronie's or penile enhancement, need to be performed, we preferentially employ the SC approach. After degloving the penis, we employ the disposable Scott retractor to minimize complications (Fig. 7a) and basically turn it into the same operation as PS.

All three incisions work effectively to insure a satisfactory patient outcome. At the end of the day, incision choice is largely the responsibility of the surgeon and based on his comfort, knowledge, and experience. It should not be a cause of concern to the patient. Realistic patient expectations and proper preoperative counseling, not incision location, are the most important goals of both surgeon and

patient to insure a successful surgical outcome and a highly satisfied patient.

## Compliance with ethical standards

**Conflict of interest** SKW is consultant for AMT, Coloplast, International Medical Devices, and Lecturer for Boston Scientific. JRO is proctor and expert advisor for Coloplast, and proctor for Boston Scientific. CM has no conflict of interest to declare.

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