

A narrative review on synchronous concurrent versus delayed sequential surgery in the artificial urinary sphincter and penile prosthesis implantation

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Background and Objective: In a patient who complains of both stress urinary incontinence (SUI) and erectile dysfunction (ED), prosthetic surgery with a urinary continence device and penile prosthesis implant can offer a definitive solution to address both problems. The AMS 800 artificial urinary sphincter (AUS) device is considered the standard of care to restore SUI while the inflatable penile prosthesis (IPP) device is thought to be superior to a malleable prosthesis to provide a more natural penile erection with higher patient satisfaction rates. The following article explores the current understanding of AMS 800 AUS surgery and IPP device in treating males with concurrent SUI and ED as well as evaluates the advantages and disadvantages of concurrent synchronous dual *vs.* delayed or staged device implantation.

Methods: The available literature on AUS and IPP implantation was reviewed on PubMed and Embase databases between 1 January 2000 and 1 December 2022. This narrative review evaluates relevant key features pertaining to prosthetic surgery with an emphasis on arguments for concurrent synchronous dual *vs.* delayed sequential surgery for AUS and IPP devices. Additionally, this paper provides a brief surgical description of the techniques and potential complications relating to both prosthetic procedures.

Key Content and Findings: While a great deal is known about the excellent outcomes of both AUS and IPP implantation, there is limited literature published on the outcomes of dual AUS and IPP surgery. The decision to proceed with concurrent synchronous dual *vs.* delayed sequential two-stage implants is likely determined by the patient's preference, the surgeon's expertise, and the availability of prostheses. In either situation, patients should be counselled regarding the advantages and disadvantages of undergoing synchronous concurrent *vs.* delayed sequential implants and associated surgical challenges are likely dependent on the patient's anatomy and the surgeon's preference.

Conclusions: For carefully selected patients with SUI and ED, dual implantation of AUS and IPP provides a definitive treatment to address both conditions at the same time. Patients should be counselled regarding the advantages and disadvantages of synchronous concurrent *vs.* sequentially delayed implants while technical considerations regarding the sequence of prosthetic device surgery are likely dependent on the patient's factors and the surgeon's preference and surgical expertise.

Keywords: Artificial urinary sphincter (AUS); penile prosthesis implant; surgical techniques; technical considerations

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Introduction

It is not uncommon for males who underwent prostate cancer treatments such as radical prostatectomy and/or radiation therapy to develop stress urinary incontinence (SUI) and erectile dysfunction (ED) (1-3). Furthermore, the presence of severe SUI adversely impacts sexual intimacy since sexual intercourse invariably exacerbates urine leak and the presence of climacturia also adversely affects overall sexual satisfaction (4).

In a patient who complains of both SUI and ED, prosthetic surgery with a urinary continence device and penile prosthesis implant can offer a definitive solution to address both problems at the same time. For those with moderate to severe SUI and/or radiation-related SUI who failed non-surgical therapy and wish to undergo surgery to restore urinary continence, artificial urinary sphincter (AUS) surgery remains the standard of care to restore urinary continence (5,6). The AMS 800 device (Boston Scientific, Minnetonka, MN, USA) has a proven long-term track record for clinical efficacy and safety (6) in patients with SUI and compared to other AUS-like devices in the commercial market (7). The penile prosthesis implant can be largely classified as malleable (semi-rigid or non-inflatable) or inflatable devices (8), and it is accepted that the inflatable penile prosthesis (IPP) device provides a more natural penile erection and higher patient satisfaction rates (9).

While a great deal is known about the excellent outcomes of both AUS and IPP implantation, there is limited literature published on the outcomes of dual AUS and IPP surgery. The following article explores the current understanding of AMS 800 AUS surgery and IPP device in treating males with concurrent SUI and ED as well as evaluates the advantages and disadvantages of concurrent synchronous dual *vs.* delayed sequential or staged device implantation. I present this article in accordance with the Narrative Review reporting checklist (available at <https://tau.amegroups.com/article/view/10.21037/tau-23-22/rc>).

Methods

The available literature on AUS and IPP implantation was reviewed on PubMed and Embase databases between 1 January 2000 and 1 December 2022 (*Table 1*). The following terms “artificial urinary sphincter”, “urinary incontinence”, “inflatable penile prosthesis”, “erectile dysfunction”, and “prosthetic surgery” were searched. Given the very limited published studies reporting clinical outcomes on both AUS and penile prosthesis implantation, a narrative review is

undertaken instead of a proper systematic review or meta-analysis, and a full Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was not adopted for this article. This narrative review evaluates relevant key features pertaining to prosthetic surgery with an emphasis on arguments for concurrent synchronous dual *vs.* delayed sequential surgery for AUS and IPP devices. Additionally, this paper provides a brief surgical description of the techniques and potential complications relating to both prosthetic procedures.

Factors for consideration in synchronous concurrent versus delayed sequential surgery in the AUS and penile prosthesis implantation

Preoperative counselling and informed consent

Interested patients should have the appropriate manual dexterity to operate each device and receive adequate counselling regarding the two different surgical procedures and relevant complications. While combined implantation of AUS and IPP devices is technically safe and reasonable in the right subgroup of patients, adherence to safe surgical principles is critical for excellent clinical outcomes. From a technical point of view, surgeons should be comfortable and confident to be able to perform both AUS and IPP surgeries independently before contemplating dual implantation (10,11).

The idea of combining a single surgery for AUS and IPP implantation is attractive to many patients who wish to undergo a definitive treatment to address both SUI and ED. However, synchronous concurrent prosthesis implantation is associated with potentially higher complication rates and the likelihood that some patients will find it difficult to operate two different pumps within the scrotal, especially when the scrotum is swollen during the early postoperative phase. In contrast, the two-stage sequential procedures may demand closer attention at the time of surgery given the lack of well-defined tissue planes to avoid accidental damage to the existing prosthetic components. It is important that patients receive adequate counselling regarding the advantages and disadvantages of synchronous concurrent dual *vs.* delayed sequential prosthetic implantation before deciding on the surgical choice (*Table 2*).

Surgical approaches

Traditionally, a perineal incision is made to place the AUS cuff in the proximal urethra followed by a separate inguinal

Table 1 Summary of search strategies

Items	Specification
Date of search	1 December 2022
Databases and other sources searched	PubMed and Embase databases
Search terms	The search strategy incorporated the following keywords namely “artificial urinary sphincter”, “urinary incontinence”, “inflatable penile prosthesis”, “erectile dysfunction”, and “prosthetic surgery”
Timeframe	1 January 2000 to 1 December 2022
Inclusion criteria	English language only
Selection process	All studies were screened and approved by the author. Quality assessment was performed using the Risk of Bias tool for RCTs and non-randomized interventions

RCT, randomized controlled trial.

Table 2 Advantages and disadvantages of concurrent synchronous dual *vs.* delayed sequential two-stage implants

Variables	Concurrent synchronous dual implants	Delayed sequential two-stage implants
Advantages	<ol style="list-style-type: none"> 1. A single operation only 2. Greater cost savings 3. Shorter time to return of full urinary continence and sexual function 4. Higher patient satisfaction rates 	<ol style="list-style-type: none"> 1. Less postoperative pain 2. Faster recovery for each operation 3. Fewer complication rates with individual prosthetic surgery
Disadvantages	<ol style="list-style-type: none"> 1. Higher complication rates 2. Greater difficulty in manipulating the two scrotal pumps 3. If prosthetic infection occurs, both devices are at risk and will require full explant 	<ol style="list-style-type: none"> 1. More difficult subsequent surgery (risk of damaging existing prosthesis) 2. Higher risk of infection 3. Additional surgical cost

incision to accommodate the insertion of the pressure-regulating balloon in the retropubic space and control pump in the scrotum (5,6). In contrast, IPP surgery is largely undertaken either as a penoscrotal (trans-scrotal) or infrapubic approach, with each surgical approach having its own advantages and disadvantages (9,12).

A trans-scrotal (penoscrotal) approach allows for synchronous dual implantation of urinary and penile prostheses through a single incision (13,14). This surgical approach has been shown to be feasible and safe with excellent clinical outcomes and minimal complication rates in expert hands (14,15). Furthermore, synchronous AUS and IPP surgery is deemed more advantageous with a greater acceptance rate by patients who required both prosthetics than a two-stage procedure (15).

Concurrent synchronous dual prostheses implantation

Following a single transverse or vertical scrotal incision, dissection is undertaken to expose both the bulbar urethra segment and corporal bodies. Once adequate tissue exposure is achieved, a decision is made to place either the AUS cuff or penile prosthesis cylinder first. It is generally recommended that the proximal bulbar urethra be mobilized first since any inadvertent urethral injury will result in termination (abandonment) of the surgery and avoid discarding unused prostheses. Once a circumferential dissection of the proximal urethra segment is achieved, a measurement tape is inserted to confirm the size of the AUS cuff. Bilateral vertical corporotomies can be made and corporal bodies are dilated and sized for the appropriate

cylinders. The AUS cuff should not be placed at the bulbar urethra at this stage so that corporal dilatation can be performed safely. Once the appropriate penile prosthesis cylinders are placed and the corporotomies are closed, the AUS cuff can be inserted in the proximal urethra segment.

It is generally recommended that both the pressure regulating balloon (PRB) of the AMS 800 device and the reservoir of the IPP device be placed on opposite sites (for example, the PRB on the right side while the IPP reservoir on the left side). The bladder should be emptied before placing the PRB and reservoir on either side in the retropubic or prevesical space by puncturing the transversalis fascia lateral to the external inguinal ring. Care is taken to avoid the spermatic cord laterally and the bladder medially. The pump for each device is usually placed on the ipsilateral side corresponding to the PRB and reservoir, although the IPP pump can often be inserted in the midline scrotum. It is important to ensure that each prosthetic tubing remains within its surgical compartment and does not entangle with another prosthetic tubing. Once all the tubing is connected, it is recommended that the two prosthetic devices are closed with an interposition dartos tissue layer to create and quarantine two separate compartments, one for each device with the tubing, to contain potential hematoma or infection. Meticulous care is undertaken to avoid inadvertently damaging the underlying prosthetic material.

One of the earliest reports on the dual implant of AUS and IPP (16) showed that 90% of patients reported good social continence following AUS implant while 98% of patients had functional penile prosthesis without significantly increased risk of surgical or mechanical problems between the synchronous implant and sequential implants groups. Another study published around the same time (16) reported excellent urinary continence and IPP function in those who had concurrent implants, but the overall erosion/infection rate was reported at 11%.

Patients who underwent concurrent synchronous dual prostheses implantation have been shown to benefit from the shorter overall operative time and greater cost savings (several thousand dollars) than the two-stage surgery (17). Unfortunately, it is difficult to provide an actual cost difference (or cost saving) between staged *vs.* sequential surgery since this number is affected by various factors such as the actual cost of the device, third-party or insurance coverage, and hospital payment systems in various institutions or countries. Furthermore, it appears that most patients reported high satisfaction rates and ease

of operating both implants, similar to those with a single prosthesis, and most patients (94%) are willing to undergo the same procedure again and would recommend dual implantation procedures to interested patients (18).

A more recent study comparing dual *vs.* single prosthetic implants (19) reported longer surgical time in the combined prosthetic implantation compared to individual IPP or the AUS surgery (mean 218.1 *vs.* 145.9 and 114.7 minutes, respectively, $P < 0.001$), although there was no difference combined or staged procedures in terms of mechanical malfunction and prosthetic infection rates ($P > 0.05$). A population data using a local health department database (20) found that combined prosthetics implantation was associated with a higher likelihood of IPP reoperation [at 3 years; odds ratio (OR) 2.60, 95% confidence interval (CI): 1.69–3.99, $P < 0.01$], while the AUS revision rate was comparable and not significantly higher.

While the advantages of concurrent synchronous dual implants are numerous such as a single operation only, greater cost savings, a shorter time to return of full urinary continence and sexual function as well as potentially higher patient satisfaction rates, these benefits will need to be balanced against the potential higher complication rate with a longer operation and recovery time. The systematic review and meta-analysis of synchronous surgical management of ED and SUI found that a combined surgery had high satisfaction rates and significant improvement in both conditions but was associated with higher reoperation rates (OR 2.02, 95% CI: 1.29–3.16, $I^2 = 36\%$ and OR 1.7, 95% CI: 1.25–2.32, $I^2 = 0\%$, respectively) compared to implantation of only a penile prosthesis or an AUS (21).

Delayed sequential two-stage prosthetics surgery

If the implants are not placed synchronously, the AUS is usually placed first followed by penile prosthesis since most patients are more likely to be bothered by the SUI, and the presence of urine leak during sexual intimacy is associated with significant psychosexual distress (4). A two-stage procedure will require more attention at the sequential prosthetic surgery to avoid damaging various components of the existing implant and the potential complexity of operating in less well-defined tissue planes. Additional attention should be given at the time of penile cylinder placement with corporal dilation to avoid injuring the urethra and damaging the in-situ AUS cuff. A single-step dilatation of the corporal bodies can be achieved special instrument such as a Dilametz dilator can be useful instead

of sequential serial corporal dilatation to minimise the risk of inadvertent urethral injury.

For some patients, a malleable penile prosthesis could be considered since it has fewer components to be inserted with a more distal corporal incision and less likelihood of AUS cuff damage (10,11). While it is expected that the existing prosthetic components should be located within the ipsilateral compartment, surgeons should exercise additional precautions by reviewing previous surgical records or organizing pre-operative imaging to delineate the anatomy and plan for surgery (10,12). In patients with a pre-existing AUS, the placement of the pump and reservoir IPP should be on the contralateral side of the AUS. A surgical incision with cautery (cutting current is safer than coagulating diathermy) than sharp dissection to minimize the risk of damage to the existing device.

The proposed benefits for delayed sequential implants are potentially less pain, faster recovery, and fewer complication rates with individual prosthetic surgery. Furthermore, there is likely less postoperative scrotal swelling, and having one pump in the scrotum initially makes it easier for some patients to get familiar with a particular device. Studies have shown that patients who receive radiation therapy are at high risk of complications such as cuff erosion and prosthetic infections (14). Patients with prior radiation exposure are associated with higher AUS complications due to unhealthy urethral tissue, indistinct surgical plane, higher rate of improper cuff sizing, and earlier risk of cuff atrophy (22,23). For patients who developed a prosthetic infection after the first stage of surgery, some patients may not wish to proceed with further prosthetic surgery.

A two-stage procedure can pose a surgical challenge for novice surgeons and meticulous surgical attention is often required given the absence of distinct surgical planes and the risk of potentially damaging the existing components of the first prosthetic device. There is also the theoretical risk of higher prosthetic infection in “revision” surgery with exposure to quiescent organisms (within the existing biofilm) and increased tissue damage (9,10,24).

For those with suspected or proven prosthetic infection, there is a concern that it will spread to all underlying prosthetic components and a full explant of both devices may be necessary. To salvage an infected prosthetic device, it is paramount that the surgeon acts promptly and can confidently determine which prosthetic device is infected and whether it is possible to leave the components of the unaffected device intact (25). There is very limited published literature on the role of prosthesis salvage in the

setting of dual prostheses (16,26). Given it is often difficult to ascertain if the other “non-infected” device is affected too, it is probably safer to explant both devices at the time of surgical exploration.

Conclusions

For carefully selected patients with SUI and ED, dual implantation of AUS and IPP provides a definitive treatment to address both conditions at the same time. The decision to proceed with concurrent synchronous dual *vs.* delayed sequential two-stage implants is likely determined by the patient’s preference, the surgeon’s expertise, and the availability of prostheses. In either situation, patients should be counselled regarding the advantages and disadvantages of synchronous concurrent *vs.* sequentially delayed implants as well as technical considerations regarding the sequence of prosthetic device surgery is dependent on the patient’s anatomy and the surgeon’s preference.

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Footnote

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Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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