Satisfaction and surgical outcomes in patients undergoing penile prosthesis implantation for drug-refractory erectile dysfunction: mid-term results in a single center French cohort

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Introduction: *To investigate the mid-term results of penile prosthesis (PP) implantation in patients with erectile dysfunction (ED) from a "real-life" historic cohort in a French academic center.*

Materials and methods: *All patients receiving an inflatable PP between 2004 and 2014 in our institution were included in this study. ED was assessed preoperatively using the IEEF-5 questionnaire. Postoperative satisfaction with the PP was assessed using the EDITS questionnaire at each follow up visit. Postoperative complications were classed according to the Clavien classification. Surgical and functional outcomes were recorded prospectively.*

Results: *Seventy-six men received a PP during the 10 year study period. Median (IQR) age was 62 (58-69) years. The main causes of ED were radical prostatectomy (n = 40; 53%) and diabetes mellitus (n = 28; 36.8%). Five patients (6.6%) had a non-functioning PP in place requiring complete substitution or a previous penile implant which had already been removed at the time of surgery. Sixty-nine (90.8%) patients received an AMS 700 CX device and seven (9.2%) a Coloplast Titan. The surgical approach was penoscrotal in 45 (59.2%) and infrapubic in 31 (40.8%). Intraoperative complications occurred in four (5%) patients, without compromising the intervention. Postoperative complications occurred in 27 (35.5%) patients: 17 (22%) were Clavien I-II and 10 (15%) Clavien III. All major complications resulted in prosthesis removal (n = 9; 11.8%) or revision (n = 1; 1.3%). Median (IQR) follow up was 43 (34-55) months. At the end of follow up, 70 (92.1%) patients had a functional implant. Fifty-four (71.1%) patients were satisfied with the device at the 6 month follow up visit and beyond. Early satisfaction (at 3 months) was reported by 44 (57.9%) patients. A previous PP was the only significant risk factor for prosthesis removal (p = 0.001).*

Conclusion: *PP implantation is a safe and satisfactory treatment for ED. However, patient selection remains crucial in determining the post-surgical success of this procedure.*

Key Words: erectile dysfunction, impotence, outcomes, survival, penile prosthesis

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Introduction

Erectile dysfunction (ED) is a common condition with a prevalence of > 50% in men aged 40-70 years in developed countries. It is estimated that 152 million

men are currently affected by ED worldwide and that this number is likely to reach 322 million by 2025.[1] The most important risk factors for ED include obesity, diabetes mellitus, dyslipidaemia, metabolic syndrome, smoking and lack of physical exercise.[2] In addition, pelvic surgery, notably radical prostatectomy and radical cystectomy, represents the major iatrogenic cause of ED.

The treatment of ED has changed considerably over the past 2 decades. Surgery, which was the only valuable option before the development and commercialization of phosphodiesterase-5 inhibitors (PDE5-I) and injectable prostaglandins (PGE-I), has now been replaced by these drugs as first-line therapy. Implantation of a penile prosthesis (PP) is considered to be the gold standard treatment for drug refractory ED or in patients requesting a definitive solution and who understand the potential infectious and mechanical complications linked to this type of treatment. Due to these risks, the widespread use of penile implants is still a long way off.

Most countries provide only partial or no refund for patients undergoing PP implantation, limiting the number of patients who have access to this procedure. Conversely, in countries like France, where the intervention fee is completely covered by the social health system, only 4% of patients with ED are treated this way, making it an underused procedure outside reference centers.[3]

Although several series of penile implants have been published to date,[4-7] few data are available on the mid-term functional results and patient satisfaction with PP implants, especially in patients with a higher risk of prosthesis infection or removal.[8]

The aim of the current study was to analyze the mid-term results of PP implantation in high risk patients from a "real-life" historic cohort in a French academic center.

Materials and methods

Study population

The database of all patients undergoing PP implantation in a single French tertiary referral center between 2004 and 2014 was reviewed retrospectively. Only patients receiving an inflatable PP were included in the analysis. No other exclusion criteria were set. All patients gave their written informed consent to be included in the database prior to surgery. Approval for the study was granted by the hospital ethics committee and the study conformed to the provisions of the Declaration of Helsinki.

Clinical procedure and patient monitoring

All patients attended a pre-implantation consultation comprising a clinical interview, examination and an assessment of the degree of ED using the International Index of Erectile Function 5 questions questionnaire (IIEF-5).[9] All patients were proposed a PP after at least 6 months of unsuccessful medical treatment or to replace a previous, non-functioning prosthetic device.

All patients were implanted with a three-piece inflatable PP. The implanted models were AMS 700 CX (American Medical Systems, Minnetonka, MN, USA) or Coloplast Titan (Coloplast Corp, Minneapolis, MN, USA) depending on the surgeon's choice.

The procedures were carried out by two experienced surgeons using either the penoscrotal (PS)[10] or infrapubic (IP) approach,[11] according to the surgeon's choice. Perioperative and late surgical complications were recorded. Postoperative complications (within 90 days of the intervention) were classed according to the Clavien-Dindo classification.[12] At the end of the procedure, the device was left inflated at approximately 70%-80% of its maximal capacity and deflated on postoperative day 3. Patients were subsequently instructed to activate/deactivate the device 6 weeks after surgery.

An intraoperative alcohol-based scrub was performed and antibiotic prophylaxis was administered according to guidelines (2nd generation cephalosporin or aminoglycoside) in order to prevent perioperative infection.[8,13]

The patients were screened preoperatively, at prosthesis activation (6 weeks after surgery), at medical consultations 3, 6, 12, 18 and 24 months after the procedure and then annually according to the hospital protocol.

Satisfaction with the device was assessed at every follow up visit using questions 1, 2, 7 and 11 of the EDITS questionnaire, patient version.[14] Patients were considered satisfied if they answered a or b to all four questions.

Removal and/or revision of the device were analyzed separately. Removal was defined as complete removal of the PP, with or without reimplantation, due to infection or mechanical failure. Revision was defined as any surgery on the PP due to malfunction with substitution of the non-functioning part but without complete removal of the device.

Study endpoints

The study endpoints were surgical complications, PP removal and patient satisfaction.

TABLE 1. **Baseline characteristics of the study cohort**

	Study cohort (n = 76)
Age (years), median (IQR)	62 (58-69)
IIEF-5 score, median (IQR)	5.5 (5-7)
Time between ED diagnosis and PP implant (months), median (IQR)	48 (30-87)
Primary cause of ED, n (%)	
Diabetes related vascular disease	28 (36.8)
Radical prostatectomy	40 (52.6)
Priapism/penile trauma	6 (7.9)
Spinal cord injury	2 (2.6)
Previous ED treatment, n (%)	
PDE5-I	40 (52.6)
Intracavernous injection	75 (98.7)
Penile prosthesis	5 (6.6)
Vacuum device	4 (5.2)

IIEF = International Index of Erectile Function; ED = erectile dysfunction; PDE5-I = phosphodiesterase 5 inhibitor

Statistical analysis

For statistical purposes, independent variables included all patient- and surgery-related data collected prospectively in the PP database. Continuous variables are described as median (and range) or mean (± standard deviation, SD) and categorical variables are given as frequencies and percentage.

Pearson's Chi-squared and Mann-Whitney U tests were used to compare the distribution of key outcome variables among patients with or without PP removal.

Statistical analyses were performed using SPSS v. 24 (IBM SPSS Statistics for Mac, Armonk, NY, IBM Corp). All tests were two-sided with a significance set at $p < 0.05$.

Results

Study population and surgical approach

The demographic and clinical characteristics of the 76 men included in this study are shown in Table 1. Median (IQR) age of the patients at the time of surgery was 62 (58-69) years. Among the 76 patients, the two main causes of ED were previous radical prostatectomy in 40 (53%) cases and diabetes mellitus in 28 (36.8%).

In addition, five patients (6.6%) had a non-functioning PP implant in situ that required complete replacement or a previous PP implant that had already been removed at the time of surgery. Seven (9.2%) patients had received an artificial urinary sphincter (AUS); in these patients the PP was inserted via the PS approach in six (7.9%) and infrapubic approach in one (1.3%). All patients had previously received PDE5-I and at least 1 year of PGE injections.

Sixty-nine (90.8%) patients received an AMS 700 CX device while seven (9.2%) were implanted with a Coloplast Titan. The intervention was carried out via the PS approach in 45 (59.21%) patients and by the infrapubic approach in 31 (40.79%).

Complications and post-surgical monitoring

Intraoperative complications occurred in four (5%) patients. These included one urethral perforation, two cavernosal cylinder cross-overs and one crural perforation. All complications were resolved during surgery, the prostheses were successfully implanted and no other morbidity occurred in these patients.

Postoperative complications occurred in 27 (35.5%) patients, the majority (n = 17, 22%) being classed as Clavien I and II. Major complications (Clavien III) occurred in 10 (15%) patients. All major complications resulted in prosthesis removal (n = 9, 11.8%) or revision (n = 1, 1.3%).

TABLE 2. **Surgical outcomes for the study population**

	Study cohort (n = 76)
Operative time, median (IQR)	62 (58-69)
Implanted PP, n (%)	
AMS 700	69 (90.8)
Coloplast Titan	7 (9.2)
Surgical approach, n (%)	
Penoscrotal	45 (59.2)
Infrapubic	31 (40.8)
First PP placement*, n (%)	71 (85.5)
Second PP placement*, n (%)	5 (6.6)
Re-implanted during series	6 (7.8)
Intraoperative complications, n (%)	
Urethral injury/lesion	1 (1.3)
Crural perforation	1 (1.3)
Cylinder crossover	2 (2.6)
Postoperative complications, n (%)	
Clavien I	16 (21.0)
Clavien II	1 (1.3)
Clavien III	10 (13.1)
36 month survival rate (%)	86

*at the time of inclusion
PP = penile prosthesis

Device removal due to penile abscess/infection occurred in six (7.9%) patients, four of whom developed an infection within 6 months of surgery. No patient with infection received a replacement implant in our institution. An erosion was reported in two patients, one on the gland and one on the scrotum. The implant was removed in these patients and a replacement implant was inserted after 6 months. One patient had a peri-prosthetic hematoma after cardiac stent surgery which led to device removal 4 years after surgery. This patient underwent immediate reimplantation. Patients who had had a previous PP implant had a similar complication rate to those undergoing a first implant.

Further details on the surgical outcomes and complications are shown in Table 2.

Median (IQR) follow up was 43 (34-55) months. At the end of follow up, 70 (92.11%) patients had a functional implant. Among the entire cohort, one patient underwent revision, three underwent reimplantation (two erosions, one hematoma) and six (7.89%) were completely explanted. The 36 month survival rate (without revision) was 86%. The 36 month removal-free rate was 88%.

The only risk factor for PP removal by univariate analysis was a previous PP (p = 0.001). Surgical approach, concomitant diabetes, hypertension, smoking status, previous prostatectomy or previous implantation of an AUS were not linked to PP removal, Table 3.

Overall, 54 (71.1%) patients stated that they were satisfied with the device at the 6 month follow up visit and later. Early satisfaction (at the 3 month follow up visit) was reported by 44 (57.9%) patients. None of the patients who declared that they were satisfied at 3 months were dissatisfied during subsequent follow up, while 10 more patients became satisfied during follow up. No predictive factor for postoperative satisfaction was found in our series.

Discussion

PP implantation is a valuable option in men with drug-refractory ED, providing an overall satisfaction rate of 81%, which is higher than that with oral and intracavernosal therapies. The cost of a PP implant may be an issue in many countries since few patients can afford the price of the device and few healthcare systems cover the costs of the intervention. Nevertheless, the healthcare system in France refunds patients who require a PP, if affected by ED secondary to diabetes, previous pelvic surgery and a few other conditions. Despite this, PPs are only implanted in France in a limited number of tertiary reference centers, rarely exceeding 15 implants per year per surgeon. In the light of current data, PP implants may be underused in France because medical personnel and the general public have little information on this therapy.[15] Because the procedure is reimbursed in France, it is possible for patients to undergo PP replacement if the first implant fails mechanically or needs to be explanted due to erosion or infection. In our series, five patients underwent insertion of a second PP as first-line treatment and six more were replanted during follow up. The complication rate and satisfaction in these patients was in line with previously published results.[16]

Until now, PP outcomes have only been reported for a single surgeon and/or center series.[4,5,17] Data from the Prospective Registry of Outcomes with Penile Prosthesis for Erectile Restoration (PROPPER) study,

TABLE 3. **Possible factors related to prosthesis removal**

	Study cohort (n = 76)	**Removed (n = 9)**	**p value**
Surgical approach, n (%)			0.227
Penoscrotal	45 (59.2)	7 (77.8)	
Infrapubic	31 (40.8)	2 (22.2)	
Recognized risk factors, n (%)			
Previous AUS	7 (9.3)	1 (11.1)	0.845
Previous PP	5 (6.6)	3 (33.3)	0.01
Diabetes	28 (36.8)	2 (22.2)	0.333
Prostatectomy	40 (52.6)	5 (55.6)	0.852
Hypertension	37 (48.7)	4 (44.4)	0.786
Smoking	18 (23.7)	2 (22.2)	0.913

AUS = artificial urinary sphincter; PP = penile prosthesis

an ongoing prospective, multicenter trial, have not yet been published. It is therefore of interest to report the results of a decade of PP implantation in a single French academic center, in a country where its use remains limited despite most patients potentially having access to PP implantation. Few surgeons implant more than 10 PPs per year and it has been found that only 10% of French urologists perform penile implants at all.[15]

In our series, most of the patients could be considered to be at higher risk of infection or erosion, due to their baseline clinico-pathological conditions, previous surgery or lifestyle habits.[18] Five of our patients already had an AUS implant, five were at second PP implantation and half of the patients suffered from diabetes or had previous prostate cancer[18] the surgeons' caseload was also lower than in usual referral centers (< 15/year).[19]

A higher removal-rate was associated with the PS approach, but this is not consistent with the current literature, where no single approach appears to be superior to another.[8,20,21] This finding should be considered in light of the fact that all replants were performed via PS access, including patients who already had a PP at the time they were entered into the PP implant database for the first time. Therefore, we cannot draw any conclusions on the link between risk of removal and surgical access. Despite the small sample size, a previous PP implant was the only predictive factor for PP removal ($p = 0.001$). Other common risk factors such as diabetes and previous pelvic surgery had no impact on device survival rate.

Mechanical failure rates of < 5% after 5 years of follow up have been reported in literature.[17,22,23] Additionally, Wilson et al reported a 5, 10 and 15 year mechanical survival rate of 3-piece inflatable PPs of 85%, 68% and 57%, respectively.[17] In our series, the 36 month survival rate (without revision) was 86%; and result may be due to the small sample size.

Concerning patient satisfaction, our results are in line with previously published data,[24-26] although they are not in the highest part of the range, reaching complete satisfaction in only 71% of patients during the entire follow up period. Satisfaction is a complex issue not only related to the technical success of the intervention but also to the patients' expectations of it, which may be overestimated. Additionally, pump manipulation remains difficult to manipulate for the patient at the beginning, both for AMS than for Coloplast devices. A "learning curve" period for the patients has to be taken into account when considering satisfaction rates. A period of continuous patient education once the implant is placed may boost early satisfaction rates. The diverse nature of the cohort in terms of previous ED treatment, marital status, age and replant experience may also have affected the satisfaction rate, as although some patients may have had a functional implant they were no longer engaging in sexual intercourse.

The current study has several limitations including its retrospective, monocentric study design and the relatively small sample size. Nevertheless, the unselected nature of the patients included in the study represents a "real life" scenario probably missing in the current literature. Our study provides important insights for urological surgeons developing PP implantation.

In conclusion, PP implantation remains an effective and satisfactory procedure even in high risk patients. However, prosthesis reimplantation represents a serious challenge even in experienced reference centers. □

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