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Penile length is preserved after implant surgery

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Objective

To investigate if there is a correlation between penile size measured preoperatively and erect penis after penile implant surgery (PI). A common cause of patient dissatisfaction after PI is caused by patients complaining that surgery has shortened the penis. It has been suggested that stretched penile length preoperatively is almost the same after surgery when the prosthesis is in erect status. However, no comprehensive data supports this theory. This prospective study was done to investigate this theory.

Patients and Methods

Standardised measurements of stretched penile length and girth were performed in theatre before PI implantation then re-measured at the end of the procedure with the penis in the erect position. We recorded type of PI, cylinder lengths and malleable rod diameters. All patients had data recorded on body mass index (BMI), hypertension (HTN), glycated haemoglobin (Hb_{A1c}), and Peyronie's disease (PD).

Results

In all, 133 patients were assessed; 88 (66.2%) had a malleable penile prosthesis (MPP) and 45 (33.8%) an inflatable penile prosthesis (IPP). The median age and BMI were 56 years and 30 kg/m^2, respectively. In all, 40 (30.1%) patients had HTN, 37 (27.8%) had PD, and 89 (66.9%) were diabetic. The mean (SD) pre-implant stretched length was 12.8 (1.8) cm. The mean (SD) flaccid girth was 10.3 (1.2) cm. Postoperatively, the mean (SD) erect length and girth were 13.1 (1.7) cm and 11.3 (1.3) cm, respectively. Overall, there was a significant ($P < 0.05$) increase in both the mean (SD) length at +0.36 (0.63) cm, and girth at +1.04 (1.02) cm. Patients who had an IPP, had a greater increase in both length (mean [SD] 0.62 [0.72] cm) and girth (mean [SD] 1.7 [1.0] cm) compared to those who had a MPP (mean [SD] 0.22 [0.53] cm and 0.7 [0.87] cm, respectively) ($P < 0.05$). We investigated correlations between pre- and postoperative outcomes related to BMI, HTN, diabetes, and PD. None of these variables affected outcome.

Conclusions

PI surgery does not significantly decrease penile size compared to the preoperative assessment. The outcome was not affected by co-morbidities. The preoperative length and girth correlated well with the immediate postoperative erect penis, although girth was not necessarily comparable in this series of patients measured under anaesthesia. Recording penile dimensions in the clinic and agreeing these with patients' preoperatively may be a way of improving satisfaction levels with this surgery.

Keywords

penile implants, penile size, satisfaction, predictors, #Andrology

Introduction

Penile implants (PIs) were first introduced in 1936 by the Russian surgeon Nikolaj Bogoraz [1] and have undergone many technical improvements since then. Modern PIs are now the standard of care, especially for those patients refractory to medical management. In 2016, Welliver et al. [2] analysed data provided by two of the main PI companies (American Medical Systems [AMS] Inc., Minnetonka, MN, USA; and Coloplast Corp., Minneapolis, MN, USA) showing that >62 000 PIs were used world-wide during the period 2005–2010. Device failure is rare, with low infection rates and a high overall patient satisfaction rate, with figures ranging from 76% to 90% [3]. However, subjective loss of penile length or volume remains a significant patient concern. Between 5% and 30% of men may complain of penile shrinkage following PI insertion [3]. Deveci et al. [4] found that there were no statistically significant differences in penile

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size after surgery compared to preoperative measurements, although 72% of the patients reported a decrease in penile length. In contrast, Wang et al. [5] reported a decrease in erect penile length of ~0.75 cm. Levine et al. [6] found that some patients complain of penis shortening after PI implantation but may be comparing their current size with their memory of a fully functional erection. Unrealistic expectations and body changes, such as weight gain and excess pubis fat, may contribute to this impression of shortening. They recommended that physicians discuss these issues with the patient and take a preoperative stretched flaccid penis length measurement for postoperative comparison. Thus, we conducted the present prospective, multicentre observational study to investigate the correlation between pre- and postoperative penile size. Our hypothesis was that PI surgery should not shorten the penis.

Patients and Methods

Study Population

The study population included patients undergoing primary inflatable or malleable PI surgery in two high-volume centres. Exclusion criteria included: re-implant surgery and patients who had complex procedures, such as grafting for Peyronie's disease (PD).

The type of PI, brand, cylinder length and the rod diameter were recorded, as well as comorbidities such as body mass index (BMI), vascular risk factor profile, and glycated haemoglobin (Hb_{A1c}) level.

Preoperative Counselling

The preoperative discussion was focused on the goal of surgery of obtaining a 'functional erection', an erection permitting sexual intercourse. Choosing a malleable penile prosthesis (MPP) vs an inflatable penile prosthesis (IPP) was based on patient's preference including factors such as concerns about concealment and ease of use, but often relied heavily on cost, as PI surgery is not covered by insurance in our geographic location. The consent form signed by all patients included all the potential complications and stated that PI surgery is for restoration of functional erection for penetrative sexual activity and not for other purposes like penile size enhancement. The study was approved by our Institutional Ethics Committee, and consent to measurement under anaesthesia was obtained from patients.

Penile size Measurement

Penile girth and stretched flaccid length were assessed by the operating surgeon using a standardised method. The first measurement was performed under spinal or general anaesthesia before surgery. Using a rigid plastic ruler, bone-to-tip measurement was conducted as follows: with the penis fully stretched, the base of the ruler was placed on the pubic bone and the tip of the ruler was placed at the level of the tip of the glans. Penile circumference was measured with a tape at the base of the penile shaft. After wound closure, we repeated the same procedure. In those who had an IPP, the measurement was performed after full inflation of the device.

Surgical Technique

All operations were carried out in standard fashion. The MPPs were inserted via ventral midline incisions, whereas the IPPs were placed via peno-scrotal incisions.

Statistics

Assuming an average penis length of 13.2 cm (from a recent 15 521 patient systematic review [7]), we felt a penile length loss of 1.5 cm (Δ11%) would be significant and relevant to most patients. Aiming for 80% power and 95% CI, by using the following formula: $n = (Z_{\alpha/2} + Z_{\beta})^2 * 2 * \sigma^2 / d$, we calculated that the sample size needed was 130 patients.

Pre- and postoperative penile length and girth were compared using paired *t*-tests. The differential penis sizes of the different PIs (IPP vs MPP) were compared using one-way ANOVA. All data are presented as mean ± standard deviation (SD), with $P \leq 0.05$ considered as statistically significant.

Results

Patient Population

In all, 133 patients were measured; 88 (66.2%) had a MPP and 45 (33.8%) had an IPP. Amongst the IPPs, 11 (8.2%) were AMS and 34 (25.6%) Coloplast. Of the MPPs, 83 (62.4%) were Coloplast Genesis, the remaining five (3.8%) Silimed (Silimed, Rio de Janeiro, RJ, Brazil) (Fig. 1). The median age and BMI were 56 years and 30 kg/m^2, respectively. In all, 40 (30.1%) patients had hypertension (HTN), and 37 (27.8%) had PD. The majority of the patients, 89 (66.9%) were diabetic.

Penile Length Measurements

The mean (SD) pre-PI stretched length was 12.8 (1.85) cm and after PI surgery it was 13.1 (1.76) cm. The mean (SD) preoperative girth was 10.3 (1.21) cm and postoperatively was 11.3 (1.28) cm, as shown in Table 1.

After PI surgery, 98 (73.7%) patients had some objective increase in either length or girth. In all, 56 (42.1%) patients had an increase in length, whilst in 48 (36.1%) both length and girth increased. Only four men (3.0%) had an objective decrease in both length and girth. Looking at length change by stratifying for type of PI implanted, 26 (57.8%) patients and 30 (34.1%) had an increase in the IPP and MPP groups,

Fig. 1 The proportion, type and brand of the PIs implanted in our patients.

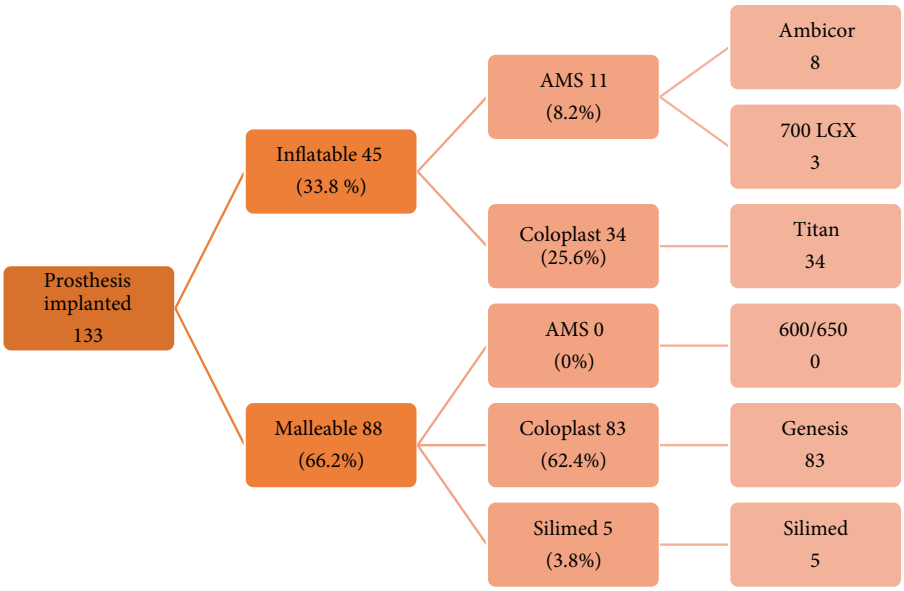

Table 1 The average penile length and girth before and after PI surgery.

Variable	Before surgery	SD	After surgery	SD	Mean difference	SD
Length, cm, mean	12.8	1.85	13.1	1.76	+0.36	0.63
Girth, cm, mean	10.3	1.21	11.3	1.28	+1.04	1.02

respectively, compared to stretched length. In all, 42.2% of the IPPs and 55.7% of the MPPs resulted in no change. Only nine patients (7%) had a decrease in length, all amongst the MPP group (Table 2).

Turning to girth change, >80% of the patients who received an IPP witnessed an increase and >55% of the MPP patients saw an increase in girth (Table 2).

Statistical Analysis

Using a paired *t*-test, we compared post- to pre-surgical stretched penile length and girth. The test performed showed a statistically significant increment in both length (mean [SD] +0.36 [0.63] cm) and girth (+1.04 [1.02] cm) ($P < 0.05$; Table 3).

We also stratified patients by type of PI implanted (IPP vs MPP) by using an ANOVA test. The differential lengths and girths (length/girth post-surgery vs length/girth pre-surgery) of the two groups were compared (Table 4).

Patients who had IPPs had a statistically significantly greater increase in length (mean [SD] +0.62 [0.72] cm) and in girth (+1.67 [1.0] cm) compared to those who had MPPs (+0.22 [0.53] cm) and (+0.72 [0.87] cm, respectively) ($P < 0.05$).

Comorbidities and Size

Univariate analysis was carried out for comorbidities such as obesity, HTN, diabetes and PD: none were of any significance.

Table 2 The postoperative dimensional changes, stratified by PI type (IPP and MPP) and subdivided per cluster of change (increased, unchanged, reduced).

Variable	*N*	Increased, *n* (%)	Unchanged, *n* (%)	Reduced, *n* (%)
ΔLength				
Total PIs	133	56 (42.1)	68 (51.1)	9 (6.8)
IPPs	45	26 (57.8)	19 (42.2)	0 (0.0)
MPPs	88	30 (34.1)	49 (55.7)	9 (10.2)
ΔGirth				
Total PIs	133	90 (67.7)	37 (27.8)	6 (4.5)
IPPs	45	40 (88.9)	5 (11.1)	0 (0.0)
MPPs	88	50 (56.8)	32 (36.4)	6 (6.8)

Table 3 Results of the *t*-test performed to identify differences in penile length and girth after PI surgery.

Paired *t*-test	Paired differences			*P* (two-tailed)
	Mean (SD)	95% CI of the difference		
		Lower	Upper	
Length, cm				
Post vs pre-surgery	0.357 (0.629)	0.249	0.465	<0.05
Girth, cm				
Post vs pre-surgery	1.041 (1.019)	0.867	1.216	<0.05

Table 4 The results of the ANOVA test performed to show the difference in length and girth stratified by type of PI implanted.

ANOVA test Post vs pre-surgery	*N*	Mean (SD)	95% CI of the difference		*P*
			Lower	Upper	
ΔLength, cm					
IPPs	45	+0.622 (0.724)	0.405	0.840	<0.05
MPPs	88	+0.222 (0.530)	0.109	0.334	
Total PIs	133	+0.357 (0.629)	0.249	0.465	
ΔGirth, cm					
IPPs	45	+1.667 (1.000)	1.366	1.967	<0.05
MPPs	88	+0.722 (0.874)	0.536	0.907	
Total PIs	133	+1.041 (1.019)	0.867	1.216	

Discussion

PIs have improved over the past 40 years, resulting in a more effective and reliable treatment for advanced erectile dysfunction (ED) [6]. Early PIs had failure rates ranging from 21% to 45% in the first few years after surgery [8–10], whereas modern devices show mechanical survival ranging from 75% to 94% depending on the year of implantation and model [10]. Overall satisfaction rates have also seen a steady increase over the years, from 76% in 1994 [3] to well over 90% in more recent studies [11,12].

Scant literature exists on penile length loss after PI surgery, despite its relevant role in patient's quality of life. Most authors do not focus on this issue and when they do, the problem is described together with other causes of dissatisfaction. Montorsi et al. [11] reported their results in 200 patients who had AMS three-piece IPPs implanted in five centres, with a mean (range) follow-up of 59 (6–130) months, and they were extensively questioned about the function of the device and its impact on their sexual life. A high percentage of patients were satisfied. Reasons for patients' complaints included postoperative penile shortening in 60 (30%) cases and poor glandular engorgement in 40 (20%) cases. They concluded that IPPs provide an overall patient and partner satisfaction rate of 92% and 96%, respectively. However, postoperative penile shortening and poor glandular engorgement were the causes of some complaints amongst the patient population, as well as the unnaturalness of prosthetic erection amongst female partners. On the other hand, Bettocchi et al. [13] reported their results with the AMS 700CX PI in a single centre, by the same surgeon, over a period of 5 years. All the patients included in that study were contacted by telephone by a single operator who asked for their consent to collect information about their operation, the use of the PI, and the couple satisfaction. They used a 9-point questionnaire. They mentioned that 8% of the patients were dissatisfied; amongst the reasons included insufficient rigidity and penile length for normal intercourse. In a recent retrospective multicentric study, Gentile et al. [14] reported their results in an analysis of a group of 42 patients who underwent a two-piece IPP implantation from November 2005 to November 2013, in four centres with established experience. Every patient was asked to complete the Erectile Dysfunction Inventory of Treatment Satisfaction (EDITS) specifically modified, in order to assess their own satisfaction after surgery and, its impact on their quality of sexual life. In all, 42 patients were evaluated (AMS Ambicor: 28; Coloplast Excell: 14). The mean age at the time of operation was 60.7 years and the mean follow-up was 27.6 months. In all, 5% of patients reported being dissatisfied with penile length or girth postoperatively

Despite being a recognised problem, there are only two papers concentrating on penile length after PI surgery. Deveci et al. [4] published a paper in 2006 in which they analysed length alterations after surgery. In all, 56 patients received either a three-piece (Coloplast Alpha-1) or two-piece IPP (AMS Ambicor). Stretched flaccid penile measurements were taken immediately before PI surgery under anaesthesia, and then at 1 and 6 months after the PI operation. Their results showed no difference in length before and after surgery.

Despite the absence of statistically significant length changes, 71% of patients had subjective penile length shortening, although only 43% had an objective reduction.

In the second study, Wang et al. [5] assessed only 11 patients, who had IPP surgery (AMS 700CX, Coloplast Titan). Before surgery, erect penile length was measured after the induction of a full erection using intracavernosal injections. At 6 weeks, 6 months and 1-year postoperatively, erect penis lengths were measured from the pubic bone to the tip of the penis glans after full inflation of the IPP in the outpatient clinic. A mean (SD) decrease in erect penile length of 0.83 (0.25), 0.75 (0.20), and 0.74 (0.15) cm, respectively, was reported at the three time points.

The main drawbacks of the above-mentioned study rely on the fact that preoperative measurements were performed only in patients who had full erections after intracavernosal injection with Trimix, and then compared to the postoperative size after PI implantation. Our present data and that of Deveci et al. [4] used stretched flaccid length. That may explain why Wang et al. [5] found a reduction in size whilst we did not. However, most of our present patients were unable to get a full erection even using high doses of Quadrimix, so we could not have carried out the test in such a way.

In our present study, the aim was to establish a valid (reference) penile size before surgery to compare postoperatively when counselling the patient about the expected outcome. We used the immediate preoperative stretched flaccid penile size, as the patient with ED (non-functioning) as a valid reference to compare with the immediate postoperative functional penis, which is more logical and practical.

We think that counselling patients before PI surgery should focus on the patient status (including stretched penile size) before surgery, as they usually have severe ED, making this a suitable reference when comparing outcome postoperatively. Patients should also be informed that it is unlikely, after having a PI, to retain their original glans engorgement, which usually adds a few millimetres and more pleasure during intercourse. Good counselling before surgery is critical for improved patient satisfaction, and the best candidates for PI surgery are patients who have failed non-surgical treatments but who are still motivated to have surgery to improve their sexual performance [15].

In our present study, patients with an IPP had a statistically significantly longer (mean [SD] length +0.62 [0.72] cm) and thicker penis (mean [SD] girth +1.67 [1.0] cm) compared to those who had MPPs (mean [SD] length +0.22 [0.53] cm and mean [SD] girth +0.72 [0.87] cm). However, the groups compared are unbalanced (33.8% vs 66.2%) and not randomised, therefore we do not know how the numerosity and heterogeneity of the sample might have impacted on our present results. It is also impossible to compare girth in men with severe ED to what the 'normal' would have been for the man before his ED. Whilst we measured girth, this may have limited reproducibility and relevance to the postoperative state after healing.

Measuring immediately after surgery should have meant minimal or no oedema, but there might be minor swelling due to tissue trauma occurring during surgery, as well as due to instillation of irrigation fluid that might cause extra-tunical engorgement of the penis, which might be a potential limitation of our present study. On the other hand, it is hard to imagine a process by which a MPP could be smaller weeks after the operation, although poor inflation of IPPs could cause this. The data that do exist on IPPs suggest the reverse and that an IPP often has tissue expander properties in the longer term.

Of course, if a surgeon is happy with penis size but the patient is not the operation is hardly an unqualified success. While our present data confirm that PI insertion does not cause penile shrinking, it may be that men's perception of 'normal' is skewed either to begin with or after years of ED. We know that a perception of the surgery as an agent of penile shrinking occurs in PD, and that many men perceive their penis to be shorter than reality. A much more complex study would be needed to address these points. Clearly the perfect study would involve measuring men in full erection before they had ED, but this would be virtually impossible as it would mean predicting men who would need PIs years in the future.

An assessment of how men perceive penile size and function before and after surgery would be very useful and would address many of the simplistic issues raised by our study and others to date. However, the nomogram developed by the King's College group has not been validated in men with severe ED, so the correct instrument to assess these men may not exist.

Finally, the stretch may falsely elongate the penis as compared to the erect penis, and we also did not perform an intra-observer error measurement, which could be considered as a potential flaw.

Conclusion

PI surgery does not decrease penile size compared to the preoperative stretched measure but preserves or increases it for the great majority of patients. Men having an IPP are likely to witness a more substantial length increase than those with a MPP. The outcome of PI surgery was not affected by co-morbidities such as diabetes, HTN or PD.

Preoperative penile length and girth correlate well with the immediate postoperative erect penis. Recording penile dimensions in the clinic and agreeing these with patients'

preoperatively may be a way of improving satisfaction levels with penile size postoperatively.

It is interesting to speculate whether some men who are concerned about penile size preoperatively would be better managed by either psychosexual counselling or if the IPP may give greater satisfaction.

In any event, patients can be reassured that no immediate direct size loss is expected in the great majority of cases.

Conflict of Interest

None declared.

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Abbreviations: (I)(M)PP, (inflatable) (malleable) penile prosthesis; AMS, American Medical Systems; BMI, body mass index; ED, erectile dysfunction; HTN, hypertension; PD, Peyronie's disease; PI, penile implant.